THE SELECTION OF APPROPRIATE COMMUNICATION MEDIA FOR INSTRUCTION: A GUIDE FOR DESIGNERS OF AIR FORCE TECHNICAL TRAINING PROGRAMS

Rudy Bretz

A Report prepared for

UNITED STATES AIR FORCE PROJECT RAND
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The Communication Media

(See Appendix for notes on this taxonomy)
R-601-PR
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UNITED STATES AIR FORCE PROJECT RAND

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PREFACE

The study presented in this Report is a part of a larger Rand investigation of systems for Air Force education and training. The use of communication media figures very prominently in many innovative and highly effective instructional techniques. The purpose of this Report is to identify the appropriate communication media for various training applications. It will provide valuable guidance to the designer of a technical training program.

The terminology used in this Report is intended to convey specific meanings in the context of the discussion. A glossary is included, which defines many of the terms as they are used herein. Attention is particularly directed to the definition of the terms communication medium and instructional medium, as opposed to instructional aids. This study is concerned only with self-contained communication systems which have reproducible software; supplementary media such as audio and visual aids, which only assist a teacher in presenting a lesson, are not considered.

This Report is the second in a series that is planned to provide a comprehensive treatment of the subject of communication media. The first, RM-6070-NLM/PR, Communication Media: Properties and Uses, was published in September 1969.

The author is a consultant to The Rand Corporation.
SUMMARY

This Report presents a description and discussion of the uses of communication media of all classes in instruction. Communication media are systems that transmit messages for larger user systems which serve such purposes as instruction, information, entertainment, or propaganda dissemination. The function of a communication medium is simply to communicate, and this function is the focus of this Report. No attempt is made to consider the values of communication, its results, or its effectiveness, as any such evaluation must be done in the specific context of the system being served by the communication medium.

Eleven uses for communication in instruction are described, each of which has distinct requirements in terms of communication media, equipment configurations, and program content:

1. Providing the learner with knowledge of his learning objectives
2. Motivating the learner
3. Presenting information
4. Stimulating discussion
5. Directing learner activities
6. Conducting drill and practice
7. Reinforcing learning
8. Providing a learner/simulator interface
9. Evaluating learner progress and program effectiveness
10. Assisting in the administration of instructional systems
11. Assisting in research and development

The selection of the appropriate media for each of these uses is discussed, and criteria are given for determining the need for various system capabilities in illustrative instructional situations.
ACKNOWLEDGMENTS

The author is grateful for the help of several of his Rand colleagues in the preparation of this Report. Polly Carpenter, as always, was the most helpful, contributing substantially to the basic thinking and providing detailed critical comment on the writing. Herbert Kiesling, Robert Specht, and John White were generous enough to review the manuscript and point out passages which needed clarification or improvement.
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I. INTRODUCTION

A communication medium is a complete system for the communication of messages, generally encompassing a process for the production of programs (to carry messages), a process for the delivery of these programs, and a means for program display. The primary inputs to such a system are the messages it processes. Secondary inputs consist of resources such as capital equipment, labor, and expendable materials used in program planning and production, engineering, administration, and the like. Outputs of communication systems are essentially the messages that were put in: displayed programs or displayed data.*

Communication generally has a purpose larger than itself, because it generally serves some larger system (see Fig. 1). A communication system may serve an instructional system, for example, which will include many additional elements such as instructors, learners, school plant, and processes (for example, instructional design, learner activities, and evaluation). The purpose of the instructional system is to bring about student learning. The purpose of the communication system is to help the instructional system to function.

One of the ways in which the communication system can do this is by conveying instructional programs or lessons. The effects or results of such programs, like the messages that go into them, are not part of the communication system, but are part of the instructional system which, as we have stated, it only serves. Let us restate this point, because it is crucial to the understanding of communication media. Despite what Marshall McLuhan may choose to mean by “message,” in this discussion message is used to mean the content of a communication—the meanings, ideas, concepts, and data which are communicated. This message exists before a communication medium (system) is involved; in fact, the message may be communicated face-to-face without the use of a medium at all. And it may have the same effects and results (more effects and better results, in the opinion of educational conservatives who have not yet fully accepted communication media).

The functions of a communication medium are to express the message as a program, to record and/or transmit it, and to display it before its intended audience.

When a communication medium serves an instructional system, it is fed

*The term display is used in a broad sense to include messages for perception by other senses as well as the visual.
instructional messages from which instructional effects and results are expected. When it is used as part of an information system, or a propaganda system, or an entertainment system, its messages and its effects and results will be quite different, while the medium itself may remain largely unchanged.

The same film medium employed in making instructional films, for example—the identical cameras, laboratory equipment, film emulsions, and projection equipment, the same trained operators, the same writers and projectionists—may be integrated into a somewhat different process and used in making other kinds of films, e.g., commercials, feature films, and so forth, each of which has a different set of purposes.

Sometimes a communication medium will serve only one system, functioning thus as a permanent subsystem of a larger whole. An example of this is the closed-circuit television system (or broadcast station) which is operated by a school system. In other cases (e.g., general broadcasting), the medium may serve many masters, often in rapid succession, such as advertising, public information, political propa-

![Diagram](image)

Fig. 1—The relation of a communication system to transmission or recording subsystems and to an instructional system. The purpose of a message is shown, from its origination by the sender ③ at far left to its perception and comprehension by the receiver ⑧ at far right.
ganda, or organized religion. In these cases the broadcasters quite understandably do not consider themselves a subsystem of any of these larger systems, but assume autonomy. This does not change the essential nature of the relationship, however; although the broadcasting station may not be a permanent part of any one system, it can function temporarily as a subsystem of many.

In each case the output of the communication system, i.e., the results or effects of communication, are to be evaluated only by looking beyond the communication medium itself, into the larger, user system, and asking how well it is being served. The larger system, of course, is composed of many parts, all of which contribute to its functioning. No one part could be expected to do the larger job alone.

This explains why advocates of the use of communication media, such as films or television, in education foresee and claim benefits to be achieved with the aid of film or television, being very careful to state that film or television is not expected to achieve these benefits by itself. There is a widespread misunderstanding on this point by the general public.

The only contact many laymen have with instructional television occurs when they tune their home receivers to adult courses. Observing no integration with student activities or other instructional methods, the casual viewer may receive an impression of learners doing nothing but watching television sets. This then colors his view of in-school uses of the media as well. Of course, participation in a broadcast course will usually involve the learner in other activities as well (such as correspondence and supplementary reading).

Communication media can play many different roles in instructional and other systems; each such role will be considered a different use in the discussion that follows. "Use" is a general and abstract concept; when concrete and specific instances are discussed, the term "application" will be used. When we speak of an application of a given medium, we will mean a particular system of equipment and software specific to place, organization, or project. A use of a medium, on the other hand, will imply a general way of applying the medium.

Fitting the medium to the use requires the consideration of many factors. This problem may be approached from the viewpoint of the medium, by asking, Given this particular medium, to what various uses is it suited?; or it may be approached from the viewpoint of the use, by asking, Given this particular requirement, what various media, submedia,* equipment configurations or combinations of media are usable?

In practice, the first approach has been the most common, particularly in the case of new media whose capabilities are not always well known to their users. In a typical example, a television studio and distribution system is installed by an institution, and someone is put in charge and directed to explore and develop its uses.

The second approach requires prior analysis and planning. The overall system that the communication system will serve is identified and described, the roles of communication at various points in the process are identified, the requirements

*The 8mm sound cartridge, for example, is a submedium of sound film.
for media of communication are defined, and from this information the various suitable media alternatives are deduced.

It is not uncommon that both approaches may be used, alternately, in arriving at a single decision. That is, a medium is identified which will fulfill the major requirements, and the application of that medium is further justified, either before or after implementation, by finding other roles for it to play.

In the present Report the planning-and-analysis approach will be taken. After a general discussion of the various uses of communication media in instructional systems, a procedure will be described for choosing the most appropriate communication-media class for a given instructional need. This choice will be based on the previously determined learning objectives, the nature of the subject matter to be taught, certain characteristics of the learner population, and the instructional method that has been chosen.

This approach is akin to that taken in *Instructional Media: A Procedure for the Design of Multi-Media Instruction, A Critical Review of Research, and Suggestions for Future Research*, by Briggs, et al. [1]. Briggs is concerned with all instructional media, however, including not only communication-media materials and devices, but also such "media" as teachers and actual objects (rocks, leaves, manufactured products, etc.). The present Report is limited to communication media (as defined on p. 1). Both this Report and the Briggs book approach the question of media selection by first identifying and specifying the instructional requirement.

This Report is directed toward the instructional designer. The process of designing instruction, as a separate function from instructional implementation, has only recently emerged. Previously, nearly all instructional design was done by individual classroom instructors for their own use. With the development of large instructional systems, such as Air Force technical training, in which many class groups or individuals follow a standardized curriculum, both curriculum development and instructional design have been separated from the functions of the classroom teacher or instructor. This has been a necessary prerequisite to the efficient application of instructional media systems. In addition, when media software is produced commercially for wide-scale use by many instructors, it is of course planned and designed by others than those who use it. This also has encouraged the development of instructional design as a separate function from teaching.
II. RESPONSE AND FEEDBACK

It has often been said that true communication is a two-way street. Dialogue, it is thus implied, is better than monologue, both for the sender of a message and for its receiver. To the instructor the statement implies that he should monitor student responses in order to know whether his messages are being successfully conveyed, received, and understood, and so that he may improve them if they are not. To the learner it recommends that he reply in some fashion, not only so that this monitoring can be done, but so that he will begin using the information contained in the message, and thus increase the probability of learning and retaining it.

In face-to-face communication, where media are not used, constant feedback is available to the sender if he wants it; he needs only to send some stimulus, such as a question, to elicit a response which will give him a clue as to the success of his previous one-way communication. Of course, the value of a single response is somewhat less if he is speaking to a small group of people rather than an individual, and becomes progressively less and less likely to be representative as the group becomes larger. In the large lecture hall it has generally been considered impractical to ask for response unless it is merely selected response provided on a group basis, by a show of hands, for example, or by having each student hold up one of several colored cards to indicate his selection from a set of possible answers.

Response is also considered to be of great value to the message receiver. When stimuli that elicit overt (or covert) response (e.g., questions or directions) are integrated into a presentation, the learner is kept active and therefore, theoretically, more alert and receptive, even if there is no evaluation of the response and the learner receives no knowledge of the correctness of his responses. However, such knowledge is easy to provide, at least in the case of cognitive objectives, simply by giving the correct answer and allowing the learner to decide how close he came to being right. Thus the learner, through evaluating his responses, is constantly monitoring his own success in understanding the message, and constantly practicing the kinds of responses he will need to know in order to retain and use the knowledge or skills he is learning.

The possible combinations of presentation, response, and feedback can be listed as follows:
1. **Presentation alone.** The learner is passive, responding only covertly if at all.

2. **Presentation with integrated response stimuli.** The learner is stimulated to respond covertly or overtly. He may be asked to select his response or to construct it. No communication media are required.

3. **Presentation, integrated response, and knowledge of correct responses.** The learner is stimulated to respond, then given the correct answer, enabling him to generate immediate knowledge of his own results. No communication media are required for response, although learners may make notes for their own use.

4. **Presentation, integrated response, knowledge of correct responses, recording of learner responses, and eventual feedback of this information to the learner and to the instructor.** The learner is stimulated to respond, is given the correct answer, and subsequently receives information as to his general progress; the instructor also uses the information to evaluate the effectiveness of the teaching program. A "response medium" is required.

5. **Presentation, integrated response, knowledge of correct responses, and immediate feedback of learner responses to the instructor or an instructional program.** The learner responds to a stimulus from the instructor; the instructor or the program is then provided with immediate knowledge of the learner's responses so the instruction may be altered and adapted to the learner's needs immediately, while it is in progress. A "feedback medium" is required.

Let us define the terms "response medium" and "feedback medium": In brief, "response medium" refers to recording media systems, while "feedback medium" applies to systems that use telemedia. There may of course be learner response that is not conveyed to anyone but is merely used by the learner himself to compare with the correct answers and determine his degree of success. In this case, communication media are not involved.

The "response medium" records or registers responses for later use by learner or instructor. This may be done directly, as with paper and pencil, or remotely, after transmission by electronic means.

The "feedback medium" feeds the response back to the instructor or the instructional program in real time so the course of the instruction may be immediately adapted to the learner's needs.

**RESPONSE AND TELECOMMUNICATION MEDIA**

The fifth combination above involves feedback communication in real time, during the presentation itself, and immediate adaptation of the presentation to the knowledge which this feedback provides. If this is to be accomplished by an instructor, rather than an instructional program, it is clear that both presentation and response must be transmitted in real time, i.e., by telecommunication media.

Audio feedback by wire from classrooms or by telephone or radio from selected groups that are viewing instructional television broadcasts are examples of
immediate monitoring of message reception. The best example, of course, is the telephone, which is almost universally used for dialogue. Feedback is generally accomplished by means of a separate communication system rather than the one that conveys the original message. A telephone conversation generally requires a pair of wires, one for each direction of talk; two sets of encoding, decoding, and associated equipment—in short, two complete communication systems. This point is even more obvious when an audio system serves as feedback to a live television program, or to a telewriting lecture. Two communication systems are in use even when a single transmission channel is used alternately for communication in one direction and then the other. Both program-origination and display systems are needed at either end, even though the two systems may share a common transmission channel.

With recording communication systems, immediate feedback to the message sender is inherently not possible. Since the message has been recorded in advance of its playback and display, the sender cannot make any immediate changes in the prerecorded message. He may, however, be on hand at the time of playback and may conduct a subsequent question-and-answer session via some telemedium or media.

RESPONSE AND RECORDED MEDIA

Until relatively recently it was not considered possible, or particularly desirable, for recorded media to elicit response at all, let alone feedback. Books, films, filmstrips, audio tapes, and all the rest were merely presentation media to which the receiver was expected to remain essentially passive, or to respond covertly in some way that was never clearly expressed and never specified. During the last ten years, however, several methods of integrating response into information presentation have been developed. These methods, generally termed "programmed instruction," attempted to allow the learner's response to control the information presentation in some manner. Combination presentation-response devices called "teaching machines" appeared on the market in great variety. Some did no more than stop the presentation after a multiple-choice question and start it again only when the correct selection was made, with all learners receiving the same material. Some kept a record of responses. Others allowed the learner to construct his answer, usually by writing in a word or a phrase, then presented the correct answer for his comparison and self-evaluation. Some sophisticated types, including the "scrambled book," adapted the program of information presentation to the learner's responses, and learners with different learning characteristics could receive different presentations. Computer-assisted systems were also devised that could do all these things and more.

Naturally, these systems were designed for individual use, as self-pacing was considered one of the most valuable new possibilities opened up by this kind of technology. However, conversion of existing instructional systems to individualized program learning seemed unlikely. Education had shown a reluctance to incorpo-
rate even such an obvious use of instructional technology as the presentation by television of lesson information to classroom groups, except as a kind of supplement or enrichment to teacher presentation. If group presentation could be retained, programmed learning might be more acceptable.

Possibly with this thought in mind, during the early sixties, investigators looked at the possibility of integrating response and knowledge of results into group presentation. They asked what loss, if any, might occur if each learner were provided with all the characteristics of programmed instruction but because of the group mode, did not have the opportunity to progress at his own pace. One study showed that most students had a wide tolerance for variation in pace, and that if the group pace was set reasonably high, most students progressed faster than they would have in the individual mode [2]. Other similar studies indicated significantly increased learning within the same instructional time, just as with programmed individual instruction. Today it is fairly widely recognized in educational circles that programmed instruction can be applied in the group mode as well as the individual.

If programmed instruction could succeed without self-pacing or without adapting the sequence of presentation to the needs of the individual learner, neither of which is possible in the group mode, the integration of learner response may (as was assumed by some) have caused the improvement. It could also have been the immediate feedback of knowledge of results or the division of the information presentation into short increments, both of which are further characteristics of programmed instruction. It seems most likely, however, that it was the improved organization and planning of a presentation, the elimination of unnecessary material, and the careful sequencing of objectives, all part of the discipline imposed on the writer of programmed instruction, which caused the effect.

It is clearly perceived by most educators today that practically anything that can be experienced in the group mode can also be experienced individually (provided a practicable medium is chosen), although the reverse is not true. More important than that, however, is the realization that any communication medium may be programmed, not just the teaching machine and the book. Whereas programmed instruction was at one time classed along with films and television as one of the "new media," it is now widely understood that programming is simply a technique or method of instruction and may be applied in some degree to any medium.

ADAPTATION OF THE PROGRAM

Having to respond keeps the learner active rather than passive, and when the program then immediately presents him with the correct answer, the opportunity to evaluate his results reinforces the wanted responses and tends to inhibit unwanted ones. With recorded media this sequence is not true feedback, however; no message sent by the learner is received by the instructor. Consequently, the instructor cannot respond to individual or group-average behavior by changing the intended course of the program. The program is already "in the can." An individual
learner, even a group, can stop, pause, and restart a program, but the course of the recorded program cannot be changed.

What can be done, of course, is to change programs. Even for group instruction, two or more alternative programs may be recorded and a set of rules established for changing from one to another. Sometimes these programs take the form of slow and fast “tracks," the slower tracks containing more or different steps of presentation. Usually there will thus be more enabling objectives* in a slow track to assist the learner in achieving each criterion objective. Branching programs (as exemplified by the “scrambled book”) achieve the same addition of more and different enabling objectives for the slower learner, plus review of previous content where needed. Branching, called “intrinsic programming” by Norman Crowder, its chief proponent [3], differs from a set of fast and slow tracks in that all learners follow one program but may separate at certain points to take different routes, either to leap-frog information presentation which they do not need, to review, to follow a sequence of remedial instruction, or to proceed directly to the next objective.

Thus, an adaptive system in which the basic information presentation is recorded must consist of the following components: (1) an information-presentation system (which is a full communication medium); (2) a response system (which is also a full communication medium) that accepts messages from the learners and transmits these either in real time or in delay time; and (3) a managerial system. This third component receives the response messages from the learner (or learners), evaluates them by comparing with a set of models of correct responses, and, according to a set of rules of instructional strategy, decides when and how to change programs. In conventional instruction this function is performed by the classroom instructor, as best he can, subject as he is to the constraints of group instruction. In individual-mode presentation (tutoring) high adaptivity is possible, and of course the machine with maximal capability in the managerial function is the computer. Note that computer-assisted instruction integrates two communication systems, one for information presentation and one for response. The first usually conveys a recorded program; the second must be a telecommunication system if the managerial system is to be adaptive to feedback.

*See Glossary for definition.
III. INSTRUCTIONAL USES OF COMMUNICATION MEDIA

For the purposes of this discussion, we shall describe eleven different uses for communication media within instructional systems. (There are undoubtedly other minor functions that communication can perform, especially in unusual instructional systems.) Figure 2 indicates these eleven primary uses within a graphic model of a typical instructional system. It is rare to find all of these functions fulfilled by communication media in any one instructional system, and they are probably never as clearly separated and defined as the model shows. Also, a single program will often fulfill several of these functions simultaneously. They do not always occur in the order shown, but may occur in many orders and many iterations within the time span of the instructional process. In most of these functions the sender of the communication is a teacher or instructor of some sort and the receiver is the learner. The "teacher," in the case of instructional media, may be a teaching team consisting of instructional designers, production personnel, and an audible and/or visible "media teacher" to whom the learner may relate directly. Function 10, Assisting in the Administration of Instructional Systems, is administrative rather than directly concerned with instructional implementation, and in this case communication is between administrators and other staff personnel of the instructional system but not with learners.

In the discussion of the various roles of communication in the instructional system, it will not be possible to do justice to the instructional system itself. No attempt will be made to properly describe instruction or to uphold any particular concept of what a typical instructional system is or should be. The uses of communication in instruction that are described, however, are accepted uses that are frequently found in regular and practical operation.

1. PROVIDING THE LEARNER WITH KNOWLEDGE OF HIS LEARNING OBJECTIVES

At the outset of instruction in a unit of subject matter, the learner is generally informed in some fashion as to the knowledge he will acquire, or the skills he
Fig. 2—A conceptual model of a typical instructional system.
will learn. He is told or shown what will be expected of him, what he should be able to do to show that he has mastered the material, and the level of proficiency that is expected. With his goal thus clearly in mind, the learner may judge, throughout the process, the rate at which he is progressing toward it. While it is not always true that learning objectives are clearly seen by the learner (or the instructor either), any instructional system worthy of the name will possess some kind of established objectives. The best practice, at least in cognitive learning and skills learning, is to specify these objectives, whenever possible, in terms of terminal behavior. Performance can usually be readily described by communication media, either in the form of verbal description or audio or audiovisual demonstration. The entering learner may even be asked to attempt the terminal performance himself. This pretest approach has the added advantage of demonstrating to the learner the level of his entering capability, and by making him dissatisfied with his existing abilities, of helping to motivate him to want what he is being offered. It may also provide the instructional manager(s) with diagnostic information on the state and needs of the learner. This is an instance in which a single use of a communication medium may serve more than one instructional function, i.e., knowledge of objectives, motivation, and, in addition, the presentation of stimuli, the responses to which may be used to diagnose the learner’s state of knowledge.

For instruction in motor and psychomotor behavior or cognitive skills, the visual media, especially those with motion, may present the learner with a demonstration of the performance he will learn, thus providing a model of the behavior he is expected to exhibit at the termination of the particular unit of instruction. This performance model can be referred to frequently by the learner during the instructional process in order to check his progress. Films and tapes are often used for this purpose in teaching athletic skills, such as tumbling and diving, or vocational skills, such as the operation of motorized equipment.

The learner’s performance is often recorded on magnetic tape so that he can compare his achievement with the model. (Being erasable and reusable, the same tape may be used to record hundreds of such performances.) By reviewing his performance and the model performance in rapid succession, or simultaneously on adjacent screens, the learner can note his deficiencies. When earlier recordings are retained, he may review these and assess his achievements. In physical education, learning objectives are conventionally conveyed by the instructor through verbal description. The effectiveness of this kind of communication depends on both the instructor’s ability to describe and the learner’s ability to visualize. There is no certainty that the final visual image in the learner’s mind bears a resemblance to the original visual image which the instructor sought to convey.

*In many instances, such as fine arts, writing, science research projects, and many kinds of problem-solving, terminal behavior cannot be specified by any of our presently known means.
2. MOTIVATING THE LEARNER

One of the most common roles for communication media in instruction is that of motivating the learner. Without some motivation, it is very unlikely that teaching could result in any learning at all (even if the motivation is negative, where the learner wishes only to avoid the punishments that will result from not learning, i.e., getting low grades, etc.). On the other hand, hardly anything can prevent a person with sufficient motivation from learning.

The attempt to motivate the learner frequently consists of describing as vividly as possible a typical future situation in which he will need to use the knowledge he is about to acquire. The military instructor may dramatically recount a personal incident. Meanwhile, the attentive student mentally places himself in the situation that is being described. If he becomes convinced of the relevance of the instruction to his future need, he will be motivated to take full advantage of it.

The media are particularly well adapted to describing a future situation, especially those media that can show something as well as tell about it. When the technique of enactment is used (e.g., skits and dramatizations) the learner's vicarious experience can be even more intense.* In this regard the communication media can provide resources that are not normally available in the classroom.

Instructional films are often produced and used for motivational purposes of a more general nature. A film that emphasizes the immensity and the glamour of the space program, its national importance, and so forth, may be used to help motivate industrial trainees learning assembly skills on a minor part of a missile sub-sub-system. The objectives of such communication are not the learning of facts and concepts or psychomotor skills, but the acquiring of motivating attitudes. The learner is intended to acquire an appreciation of the importance of the work he is doing or the skill he is about to learn.

The above are examples of what might be called "intrinsic motivation," i.e., motivation that arises directly from the knowledge and skills that are to be taught. There are other forms of motivation that could be called "extrinsic," since they consist of rewards and advantages that will accrue to the learner indirectly, simply because he has acquired a particular kind of knowledge. Grades and credits are examples of extrinsic reward. A program that attempts to interest the learner in a subject by promising increased earning capacity after he has achieved a certificate is an example of the use of media for extrinsic motivation. Media may also be used to describe, show, or dramatically enact the rewarding situation awaiting the successful learner.

3. PRESENTING INFORMATION

Probably the most common use of communication media in instruction is for

*A future publication by the author will be devoted to the methods and techniques of expression.
lesson presentation. In large instructional systems containing many groups studying the same curricula, media such as film and television are being increasingly used for information presentation. Because of this wide use, considerably more effort and expertise can go into production than is normally expended on classroom presentation; thus the average quality of lesson presentation can be raised throughout the system. At the same time the classroom instructor is freed from the task of lesson preparation and presentation and can devote his energies to other functions such as planning student activities, diagnosing learner problems, and counseling individual learners. These are functions which require human judgment, insight, intuition, compassion, and interaction with learners, and are much more important for classroom teachers to perform if they can. The use of media for information presentation—a function in which media are generally superior to classroom teachers—can thus enhance the value of the good instructor.

There is a continuum of essentiality on which media programs that present information may be classified. At one end is "basic" presentation, which brings to the learner the first introduction of a subject, or unit of instruction. The basic presentation may later be supplemented by other means such as discussion, learner activities, or review by the classroom teacher. When used in this fashion, the medium is an integral part of the regular instructional program. Midway in the continuum is "supplementary" presentation; after the basic lesson presentation has been made by the classroom teacher, media are used to bring additional resources to the classroom, to do things which could not be done in the classroom by any other means. At the extreme opposite end of the continuum is "enrichment" presentation, which consists of information that is not part of the specified learning objectives of the lesson. Enrichment programs are often used because they are considered to have motivational value and may achieve affective changes in learners. Since such materials are not part of the curriculum, they are not generally included in instructional design.

While the classroom teacher in public education is most often given the option to use available television programs that are broadcast during school hours, or to pass them by, the military instructor is generally expected to utilize all instructional media that are provided. The result, of course, is that in military instruction, basic presentation can be incorporated into media programs. The 205 half-hour television lessons produced by the television center at Lowry AFB, for example, constituted the core instruction of the standardized Fundamentals of Electronics course and with regular updating have been used as the basis of the instruction of this course at all five technical training centers.

Most of the information presentation that is done via the telecommunication media is designed for group reception. Normally, little overt response is required from the learners. There are exceptions, of course, such as language teaching, where classes are encouraged to respond verbally, and technical training programs where students follow a television lecture with a workbook in which they take notes and make constructed responses.

Information presentation delivered in the individual mode will more often include the necessity and the facility for learner response. Once a question has been
posed it is a simple matter in any media system, whether presentation is in the individual or group mode, to reinforce a correct response by simply providing the correct answer so the learner may compare it with his own. This is even possible when the response is purely covert and no action is required. The program must pause, of course, to allow an opportunity for thought, and this is anathema to the traditional film producer or broadcaster, who cannot abide "dead air." Some of the individual-presentation devices require an overt response, such as an answer selected from several alternatives by pushing the appropriate button, and will not proceed to the next increment of exposition until the correct answer has been given. If such response and presentation aspects are built into the same device, it may be considered a simple type of teaching machine.

One of the few definite findings from the large amount of experimental evidence accumulated in educational research is that additional instructional time devoted to the same subject material—up to a certain point—generally results in more retention. It is no surprise to educators that review is helpful to learners; reviewing constitutes a kind of practice during which the learner may exercise the new associations and responses he has developed. Recording media are very useful for this purpose. If programs can be made readily available, individuals or groups may review existing presentations at little cost or effort beyond their own time. The U.S. Army discovered early in their experimentation with television in basic training that special productions, viewed by the men in the evening in their barracks, which both reviewed what had been taught during the day and previewed what was scheduled for the following day, significantly increased the soldiers' learning [5]. This use of television has subsequently been adopted as a regular part of Army basic training.

4. STIMULATING DISCUSSION

The use of media to stimulate discussion, sometimes called "springboard," generally takes the form of a relatively short presentation, displayed in the group mode and followed by group discussion. A typical format presents an issue or a question, often through the dramatization of a single instance of specific human experience. The presentation is then left open-ended, with no conclusions drawn and no solution suggested. Conclusions or answers are provided by the learners themselves in interaction with their leader and with each other. The media presentation serves to stimulate thought, to open the subject, to present background information, and in general to give the class discussion a focus.

In instructor-training courses, film or video tape is frequently used for this purpose. A short dramatization of an instance of classroom teaching, the handling of a classroom situation, or a similar subject is shown to the class, who then critique the techniques that were displayed. In military instructor training, students take

*The various classes of response equipment and the kinds of interaction and adaptivity they provide will be discussed in detail in a later report on response, feedback, and control.
turns practice teaching; the practice-teaching sessions are recorded so that the instructor-trainee can look at his performance objectively and hear it discussed by the entire student group. Before the availability of inexpensive audiovisual recording media, for such discussions to be possible, the entire class had to sit in the back of the training classroom, or themselves simulate the class being taught. The use of media in instructor training provides so many advantages that little military instructor training is presently done without live television or video-tape facilities.

5. DIRECTING LEARNER ACTIVITIES

The direction of activities applies to those instructional methods that are generally termed "performance" or "application" methods. The emphasis in these methods is on doing; the media may be used briefly or intermittently to start the learner off on a project, or they may be used throughout a segment of performance instruction to guide the student one step at a time. The presentation can range from the simplest instructions for learner activities, such as the assignment of homework problems, to step-by-step directions for the performance of complicated laboratory experiments.

In several fields (such as physics and physiology) where laboratory work constitutes a large part of the university curriculum, some institutions have revised their laboratory course objectives. The new courses deemphasize the performance of manual laboratory skills (such as setting up equipment and taking measurements) in favor of the thinking processes of manipulating the experimental data that have been obtained. Where a large amount of student time in conventional laboratory courses was devoted to practicing manual skills, the new courses provide a brief media presentation of an experiment, after which the student is given a set of data that could have come from such an experiment and then spends the major part of his time in data manipulation.

Applied in the individual mode, media have been used to provide nearly continuous step-by-step demonstrations. For example, in a successful U.S. Navy on-the-job training program in use of the oscilloscope, the learner has an oscilloscope and an 8mm cartridge viewer side-by-side. The instruction consists mainly of a series of directions, after each of which the learner turns to the oscilloscope, making the adjustments or performing the actions which have been directed, then restarting the presentation. This is sometimes called "follow-me" instruction or "controlled performance exercise." Because the laboratory activity is an adjunct to the instructional program, it can also be called "adjunct programming."

Military-application problems, which can include such factors as the conduct of naval gunfire, close air support, and integration between various forces, can make good use of the direction provided by a well-prepared media presentation. A preliminary presentation showing representative battle action can set the scene, and the media may also carry short discussions on the problems presented as the situation changes.
Gaming has become a valuable instructional method, particularly at the secondary-school level; it has very great motivational value, involving more students more intensely than most other instructional methods. One disadvantage to gaming, generally, is that considerable time has to be devoted simply to teaching the students how to play the game. While much of this can be done verbally by the classroom teacher, demonstration is vital, and the game is not generally mastered until the students have actually been playing it for a while. Media can be used to shorten this period. The explanation of the game may be prepared by an expert who is able to explain it more briefly and clearly than the classroom teacher, and in addition the game may be demonstrated. Thus the learner is given a vicarious experience which can make it possible for him to come very much closer to maximum proficiency the first time he plays the game. Gaming is listed in this category because even though the game itself is generally a type of simulation, communication media are actually used to direct learner activities.

6. CONDUCTING DRILL AND PRACTICE

In the learning of skills, whether cognitive, motor, or psychomotor, the repetition of responses is generally considered to be essential to the improvement of both speed and level of proficiency. The term "drill" generally applies to the simpler kinds of responses: paired associate responses like learning the translation of foreign words, or simple psychomotor responses such as the pronunciation of foreign words. "Practice" generally refers to more complex activities which require the coordination of several skills and often the application of knowledge as well. Learners must practice individual or team sports, and the solving of problems of any sort; only drill is required for objectives such as visual identification of aircraft or the memorization of the multiplication tables. The presentation of drill stimuli is a purely mechanical process and can be performed patiently and unthinkingly by a communication medium, particularly when under the management of a computer. The individual may be given, via media, a model of the desired behavior, such as the correct word, or the proper pronunciation, with which he can then compare his own response. In many cases practice, too, can be media-directed and self-evaluated, thus obviating the need for a tutor or coach.

A widespread example of media use in drill and practice is the language laboratory. In a conventional classroom of 30 students, the language learner has little opportunity to practice and improve his pronunciation of foreign words and phrases, except in group response chorus, when he has very little idea of how well he is succeeding. The great advantage of the language laboratory is that a group of 30 or so students may work individually and benefit from the full time of the instructional period.

Language laboratories are of three kinds, or levels. The simplest kind provides the learner with a model to emulate—a recording which he listens to on earphones. He responds aloud but does not hear himself as others hear him, except
through the normal bone-conduction hearing which enables one to hear himself when his ears are plugged. The second level provides the learner with a microphone as well as a headset, so his response is fed back to his ears. This also makes it possible for his response to be fed to a group teacher who may monitor each student at will, evaluate his progress, and address him directly if need be through the earphones. The third level involves the recording of the student response, either on a tape or disc recorder, located in his carrel or in some remote central location. The student may thus listen to his performance after it has been completed and can evaluate his proficiency very much better. A typical format provides drill materials consisting of phrases or words separated by pauses during which the learner may respond. The whole is then recorded together—stimuli and responses—and is played back to the learner. Some systems allow the learner to erase and rerecord another response in place of one with which he was dissatisfied, thus providing a quick method of additional practice where it is particularly needed.

The core of the language-laboratory system, the part which is indispensable no matter what level of operation is involved, is the practice tape. This is the main role played by the audio medium in the language laboratory. The practice tape is also used in the system for handling learner response and feeding back knowledge of results.

An example of a visual medium used for drill and practice is the Navy Training Aids Facility on-the-job training package entitled "The Identification of Sonar Targets." This course is about 15 hours in length, about half of which is drill. The student is drilled in the identification of sonar echo sounds and the shapes of the blips on the sonar-scope display. The package is designed for use by the learner at sea, under the supervision of a proctor, and consists of 8mm sound cartridges plus learners’ and proctors’ guides. Proctors need have no familiarity with the subject matter of the course.

Probably the student workbook is the most familiar and the most useful example of a medium used for drill and practice. Since the workbook is a print-page medium, it is portable, highly accessible, individualized, and can be applied in either the cognitive, cognitive-skills, or motor and psychomotor-skills learning-objective categories.

7. REINFORCING LEARNING

Reinforcement is sometimes equated with motivation, or subsumed under motivation as a special case. Reinforcements are short-range satisfactions resulting from learning which tend to increase the probability of the learner responding with the desired behavior after a given stimulus.

As with motivation, there are two kinds of reinforcements, those which are intrinsic to the instruction and those which are extrinsic to it. Intrinsic reinforcement includes such relatively immediate rewards for good performance as team-member approval, the satisfaction of using increased faculties (new skills), satisfac-
tion in seeing oneself make progress toward a goal, and creative satisfaction in the completion of a project. Extrinsic reinforcements are rewards which do not bear any direct relationship to the behaviors themselves but might equally well reinforce a wide range of behaviors. Examples are grades, time off, or special citations.

The opposite of reinforcement, negative reinforcement, can also tend to increase the probability of the learner responding in the desired manner to a given stimulus. This has in the past been far more common than reinforcement in human education. Even today, learners are probably more often encouraged to avoid the unpleasant effects of not giving the desired response (black marks, instructor disapproval, class ridicule, and other punishments) than they are encouraged to respond with the desired behaviors in order to be rewarded.

Reinforcement has been shown experimentally to be most effective when it occurs within a few seconds after a response has been made. Therefore, it must be closely integrated with the functions that activate the student to respond. In Fig. 2, these are functions 3, 4, 5, 6, and 8. In function 4, Stimulating Discussion, reinforcement arises out of the response situation—the participant in group discussion is reinforced by the live reaction of the group. In the other cases, however, when the response is short and is integrated into an instructional period, reinforcement may be appropriately performed by the same media programs that do the presentation.

The most common type of reinforcement is knowledge of results. A program asks the learner a question; he then either composes an answer or chooses from among several possibilities which are displayed before him. After he has committed himself, he is more highly motivated to know the truth of the matter than he was when his posture was purely passive. When he answers correctly and can be informed of this fact, he is reinforced. Even when his answer is wrong, evaluation of his response, showing him how close he came to the truth, can sometimes be reinforcing. Immediate feedback to the learner giving him knowledge of correct results is one of the most important principles underlying programmed learning.

It was noted earlier in this Report that any medium capable of information presentation is also capable of question presentation, and thus of stimulating learners to respond. Any medium capable of these functions is also capable of giving the correct answers to cognitive questions after the learners have had time to respond to them, thus enabling comparison and immediate knowledge of results.

The traditional program techniques of the mass media, where the audience is passively interested or entertained, have so influenced instructional uses of the same media that the highly valuable possibilities of integrating learner response and reinforcing desired responses have been almost entirely neglected.

8. PROVIDING A LEARNER/SIMULATOR INTERFACE

The simulator is a device to create an artificial environment that will realistically stimulate a learner and react to his responses (actions or manipulations), thus providing practice in relatively complex behaviors that require special environ-
ments. Familiar examples are automobile simulators, used in driver training, and airplane simulators, used in pilot training. Although it is not always necessary, an instructor is generally part of the system, providing immediate evaluation of student performance technique and inserting malfunctions into the system to provide the student with practice problems. Communication media often play an important role in simulation, since the learner (or manipulator of the system) must communicate information to the machine and the machine must in turn inform the user as to its status as the simulated system changes.

In the case of the Link trainer, an instrument-flying trainer, information is input by movements, pressures, switches, and the like; output of information is displayed on dials and various special instrument faces, as well as through kinaesthetic sensations as the device simulates the airplane’s movement. None of the general-purpose communication media are employed, except that recorded audio instructions may be given to the student pilot via his headset.

In driver simulation, however, silent or sound motion pictures have been found very useful for presenting the visual and aural stimuli to which a student driver must learn the proper responses.

The same is true of the more complex jet-aircraft simulators that are used to train student pilots to land the aircraft. Many Air Force bases are equipped with flight simulators that consist of a complete airplane cabin containing standard instruments and controls, plus a large-screen visual display of an approaching landing strip out the front window. The B-52 simulators at Castle AFB are typical examples. The picture is in many cases a high-quality live television image from a camera (elsewhere in the same building) moving over a large terrain model of an airport. The live transmission is necessary so that the pilot’s input (controlling movements, etc.) can be reflected in the visual information he receives.

The airport terrain model (some 60 feet in length) is usually placed on a wall instead of a floor or table in order to save space (of course, the vertical and horizontal are adjusted in the visual display). The television camera is suspended on its side some distance out from the wall and can move along the runway, to either side of it, and closer to or farther from it. It can even roll to simulate the visual effect of a bank. Forward pressure on the stick moves the camera toward the model, the throttle controls the speed of forward movement, and so forth.

Some simulators utilize film rather than live television; the actions of the pilot cause the film projectors to pan, tilt, optically enlarge the image, and so on, within the range of movement required to simulate the visual effects of landing and takeoff. Equipment is also available by means of which a visual simulation may be continuously calculated by a computer and displayed in color on a CRT screen.

Not only are airport and aircraft-carrier landings simulated visually by computer, the same equipment has also been applied to the needs of architects. A proposed building or group of buildings which are in the early design stage may be visually simulated on the color screen. The designer may then control an imaginary vehicle which allows him to move around and among the various volumes and spaces, examining the visual aspects of his design from every conceivable angle, inside and out. When this technique is applied to the design of freeway interchanges,
a number of moving vehicles may also be displayed. In the future it may become possible for several "players" to control individual vehicles, each seeing the simulated environment from the point of view of his own vehicle, the movements of which are displayed in the view of each of the other players.

Simulators are not limited to systems that are concrete and self-contained, such as airplanes and automobiles, but may be applied to more abstract systems, such as the national economy of an ancient city-state, school-system budgeting, or the functioning of an embassy aie in a small African country. Computer programs can make possible simulations of very complex systems, accepting inputs communicated from the learner, calculating results, and informing the learner via a communication medium of the changes his manipulations make in the system. Another type of simulation is the game: the simulation of a competitive system at which two or more learners or learning teams may interact. Because of the closeness with which simulation can reflect reality, it can help develop responses that are readily transferable to the real world.

Experiments have been made with a classroom simulator that presents a student teacher with the film image of a classroom on the screen, giving him the impression of actually facing a class. A typical classroom event is depicted on the screen, to which the teacher is required to respond. The instructor (who must be a part of this simulation system) then selects the most appropriate of several feedback films which are ready for immediate projection (this system requires several projectors). The teacher then sees the class respond to his action. This appears to be a far less flexible system than most simulators, since the range of possible actions and reactions is necessarily quite limited.

Role-playing is often part of simulation techniques that are applied to the teaching of human-relations skills. The medium—usually film, video tape, or audio tape—is used to record an encounter between the student and someone who simulates the real-life person or persons with whom he is being trained to interact. The simulated role may be that of an enemy prisoner (in the training of interrogation techniques), a foreign national (in the training of U.S. military officers for overseas missions as advisors, consultants, trainers, and the like), or a job applicant, student, or psychiatric patient (for training in interviewing techniques). The simulation may include an entire group of people, as in sensitivity training or in training in managing group discussion. In each case, the performance of the learner is recorded and then played back for self-evaluation, group discussion, or individual instructor criticism.

9. EVALUATING LEARNER PROGRESS AND PROGRAM EFFECTIVENESS

Evaluation in instruction can have two meanings: the evaluation of learner progress or achievement, and the evaluation of the effectiveness of the instruction itself. Communication media may play a direct role in the administration of tests,
exams, quizzes, and the like, but they can affect the second kind of evaluation only indirectly as data obtained from student achievement evaluation are analyzed. Therefore, only the first type of evaluation will be considered here.

A limitation of much academic testing, either essay or objective, is that it is largely verbal and cannot test visual discriminations, recognitions, understanding of spatial relationships, structures, and the like. When the instructional presentations and the consequent understandings are visual in nature, verbal testing is inappropriate. Furthermore, results of printed exams can be misleading in the case of some learners, who, like slow readers, acquire most of their knowledge through audible speech. Such exams also test the learner's reading ability, and his ability to translate from one set of symbols to another, and a low performance in these skills can make it appear that the learner has not mastered the subject matter, when in fact he has. Thus, if a given means of expression has been used for presentation of the subject-matter information, the learner's achievement may best be assessed by testing him with the same means. If he has learned responses to a motion-visual stimulus, for instance, he may not recognize the same stimulus when it is translated into words. Printed exams have long incorporated pictorial and line-graphic stimuli for just these reasons; audiovisual presentation also requires audiovisual testing.

Another argument in favor of audiovisual tests is that they permit lifelike visual and aural stimuli to be presented. The learner is thus tested on his ability to respond appropriately to the stimuli of the real-life situation for which he is being trained instead of on his ability to memorize and later recognize a verbal stimulus and recall a proper verbal response. "Because they present concrete situations, such tests can avoid the ambiguities of meaning sometimes present in verbal tests, and this can result in high reliability [6]."

In some instructional systems the recording of an examination in advance of its administration is considered a risk of security. This is particularly true of exams that merely sample the students' knowledge of the subject area randomly. If a student obtains a copy of these questions before an exam, he may concentrate on reviewing only these selected points and obtain a high score, which is not, of course, representative of his total knowledge of the course material. To prevent such cheating, television has been used rather than printed materials for the administration of final exams. Only one copy of the exam need exist, to be placed before a television camera at the hour of the exam.

The administration of exams by computer appears to offer very great advantages, not only in evaluation of achievement, but also in diagnosing the state of the student's knowledge and capabilities prior to instruction. Media are of course used by the computer for the presentation of information and response stimuli, but the computer itself is much more than a communication medium.

The computer may adapt an examination while it is being administered, instantly evaluating the student's answers and basing the selection of a second question on the student's answer to the first. The most comprehensive question, or problem, may be presented first; if the student handles this satisfactorily he may be considered competent and need no further questions on that area. If not, the com-
puter may probe with further questions to diagnose his state of knowledge. Thus each student may, in effect, be given a different exam.

The purpose of the evaluation is thus broadened; instead of being merely a test sample of the student's capability, the exam becomes a diagnosis of his abilities and his weaknesses, and a valuable aid to future counseling.

10. ASSISTING IN THE ADMINISTRATION OF INSTRUCTIONAL SYSTEMS

Possibly the most common communication medium in instructional administration, beyond written, typewritten, and printed materials, and of course the telephone, is television. Many school systems are spread out over a wide area; one plant may be separated from another by water or considerable land distance, and in such cases assembly of staff groups can be so time-consuming that it is attempted only infrequently. When a live interconnection exists (generally, one that is already being utilized for instructional presentation purposes), school administrators can call meetings with only a few hours' notice, or even a few minutes, and staff members may attend simply by going to the nearest closed-circuit television receiver. Such staff meetings may be one-way (e.g., those in which policy, news, announcements, and administrative plans are communicated to the staff), or two-way, with viewing groups responding via regular telephone facilities or special feedback audio lines.

Communication media have proved particularly useful in classification and processing, which includes registration and the administration of entrance tests of various kinds. Television is used regularly in several California state colleges to communicate the instructions that are necessary before the students can properly fill out the test forms. Where large numbers of students are involved, many rooms are used for entrance testing. Before television became available, each such room required its own trained test administrator. With the use of a closed-circuit television system, one administrator can direct the test-taking activities of all rooms, and supervision in the other rooms can be left to monitors who have to be there any way to hand out and collect the materials. With verbal instructions thus standardized, student errors have been virtually eliminated.

Computer systems are also used to great advantage in class scheduling and even as an aid to the counseling process. Whenever computers are used, communication media must provide the interface between man and machine. Recorded information, typed or on punch cards, is the typical input, while information in the form of a cathode-ray tube (CRT) display or computer printout constitutes the typical output.

Another essentially administrative use of communication media could be called "extracurricular instruction." In most educational institutions incoming students require several kinds of orientation; they need to learn the procedures of the school, how to find their way around, and how to make use of the facilities and resources that are available to them. Orientation may take the form of conventional
lectures, demonstrations, field trips, or tours. Considerable faculty and staff time has been saved in many institutions by producing orientation sessions in the program format of a medium. A typical example is the introduction to the school library, required in secondary schools. First-year students are conventionally escorted through the library facility in small groups; the tour must be repeated over and over, day after day, in a school of any size, before all the new students have been through. Schools with closed-circuit television that includes mobile production facilities may take their cameras into the library and produce a tape demonstrating the use of the card catalog, the chief reference volumes, the Reader's Guide to Periodical Literature, and the like. Experience indicates that students who have never been in the library can generally find their way around and utilize the services just as readily after watching a good video-tape orientation as can those who have had a guided tour. Many colleges and military institutions, including the U.S. Military Academy at West Point, have had success with this same kind of application.

11. ASSISTING IN RESEARCH AND DEVELOPMENT

Instructional systems, such as public school districts, have traditionally placed very little emphasis on research and development. Especially when new instructional programs are designed and implemented, the vital stage of development and validation is often overlooked. Most new equipment and techniques have been introduced to education from other fields, where they were developed for different purposes. Whatever experimentation has been undertaken within instructional systems has generally been made possible by outside funds such as special government or foundation grants. But within that limited activity, media have been involved both as a subject for research and as a tool of research.

During the decade extending from the mid-1950s to the mid-1960s, several hundred experimental projects were undertaken on television as a subject for research, usually comparing its effectiveness with that of conventional classroom teaching. There has also been some experimentation with film and some with the other relatively minor media. In most experiments the communication medium or media served as the subject for study in some one or combination of the uses previously described. The great majority of the studies have concerned information presentation. By undertaking an experimental program of some sort, many school systems acquired a modicum of communication-media equipment, usually television gear. In some cases when the source of experimental funds ran dry, pressures against instructional innovation prevailed and the media disappeared. In other cases uses were found. In a few examples, such as Washington County (Maryland), television became an essential part of the whole instructional system.

Recorded media can often play a very useful role in research on such subjects as instructional method, technique, curriculum, and instructional environment. A presentation of instructional stimuli, for example, can be recorded, stored, and reproduced at will at many different times and places. This identical reproducibility
permits a single set of stimuli to be applied in a wide variety of situations and to
a wide variety of learners, and the results can be analyzed at leisure. Audiovisual
media are used to record data such as the behavior of experimental subjects; films
are used to document levels of proficiency achieved in skills and learning experi-
ments; and of course no research would be possible without extensive use of all
manner of written and typed records.
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<td><strong>CLASS II: AUDIO-STILL-VISUAL</strong></td>
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<td><strong>CLASS III: AUDIO-SEMMOTION</strong></td>
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<td><strong>CLASS VII: AUDIO</strong></td>
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The Communication Media
(See Appendix for notes on this taxonomy)
IV. SELECTION OF THE MOST APPROPRIATE
MEDIA CLASS

What is appropriate to a given need may or may not be practicable as well. To be considered appropriate, a medium need only be capable of expressing the desired message information. A nonvisual medium, for example, would not be appropriate for cases in which the learning objectives involve visual recognition; a still-picture medium would not be appropriate for the demonstration of manual procedures in which special movements are critical.

Practicability of a medium, on the other hand, involves many other considerations such as convenience and accessibility, equipment reliability, interchangeability of software, acceptability to the people who must use it, special training required for its effective use, and finally, its cost relative to those of other equally appropriate alternatives.

Since appropriateness is a very general concept, it can be determined only for the general categories of media class, whereas practicability, which depends to a large extent upon the purely local conditions of a specific application, must be determined in terms of a specific medium or submedium within a class. Thus it would be correct to say, for instance, that media of the audio-motion-visual class (Class I) are appropriate for the demonstration of dance steps to music. And, by our definition, any of the media or submedia in this class (sound film, television, electronic video recording (EVR), video tape, etc.) are, given equal fidelity, equally appropriate.

They are not all equally practicable, however. For example, most of the submedia of Class I, such as 16mm film or television, would be too costly to be used in a low-enrollment course in a small institution. Possibly only 1/2-inch video tape, or Super-8 "home-movie" production would be inexpensive enough to be practicable for this situation. Under some conditions, it is often not feasible to use any communication medium at all. For example, a course that consists entirely of verbal or illustrated lectures might be very appropriately presented via the medium of film or video tape. If, however, the course were offered only once every 3 years and needed substantial alteration each time to bring it up to date, it would be impracticable to incur the cost of producing it on film or video tape; traditional face-to-face instruction would probably by the most practicable method.
Only the question of appropriateness will be considered here; practicability will be taken up in a forthcoming report. This means that we will consider media selection only as far as the choice of media class. Within any one of the eight classes of media, all of the subsumed media and submedia are capable of the same ways of representing information and thus, if they are also capable of the fidelity required, are all equally appropriate.

By *fidelity*, we mean realism; that is, the degree to which a representation of reality reproduces the original. Realistic color is of higher fidelity than black and white; three-dimensional presentations can be of higher fidelity than two-dimensional, if all other factors are equal. Thus, 16mm film in professional color could be equally appropriate with broadcast-standard color video tape for some medical applications, while 8mm film or inexpensive, portable, black-and-white video tape might be too low in fidelity to be usable.

THE ANALYSIS OF THE CURRICULUM

The nature of learning objectives often changes frequently during a course; what is appropriate for the teaching of one lesson or segment of a lesson may not be needed for the next. While analysis of the communication need may be applied to large increments of instruction if a gross estimate is required, it is preferable to analyze each lesson or lesson segment separately. When the instructional method changes within a lesson, as for example when a lesson begins with a lecture presentation and concludes with a period of individual performance, the lesson itself should be subdivided into lesson segments and each analyzed separately. After this method is applied to a whole course, the instructional time for which the use of each media class is appropriate may be determined. The resulting projected amount of use of each media class can then be useful in the determination of practicability.

WOULD ANY MEDIA BE USEFUL?

Before any selection among media classes is attempted, it must be determined whether or not any media at all are required. If, for example, the lesson segment consists entirely of laboratory performance, with no requirement for the presentation of information, no communication media are appropriate. However, a laboratory performance segment that begins with a demonstration or a period of directions and assignments should be considered as two separate lesson segments. The presentation of information is definitely involved in the direction or demonstration segment, and hence some class of medium will be at least appropriate, if not actually practicable in all instances.

The following simple question, then, forms the criterion necessary for determining whether communication media are appropriate: *Is the presentation of sensory information, or the sending of verbal messages, involved?*
Each of the eleven uses for communication media described in Section III is concerned with conveying some message from an instructor or instructional agent to the learner. Where media are used for response, the requirement also includes conveying messages from learner to instructor or instructional agent. Once it is determined that the conveying of a message is involved in a given lesson segment, the most appropriate class of media may be determined by following the simple decision model shown in Fig. 3.

The decision boxes in the center of Fig. 3 help determine whether the subject is concrete and can best be expressed in audial* and visual terms, or abstract, and best expressed in language. If the subject is something which can be neither seen nor heard, nor experienced directly through any of the minor senses, it is not a concrete subject and can be described only in words. The whole analysis of the use of audiovisual means in instruction hinges on this distinction between concrete and abstract, so further clarification is warranted.

There are two kinds of information which the human receives through his senses: (1) simple sensory information concerning physical characteristics, relationships, conditions, and changes in his environment; and (2) verbal/symbolic message information coming from a message sender, encoded in some sort of a language—verbal, mathematical, or composed of signs and gestures.

In the first case, the basis of the communication is pictures or sound, or both. If the student is learning to identify birds, for instance, he cannot be merely told about them; he must see the difference in appearance between one species and another, and he must hear the distinctive notes of their songs. The audial and visual representations of reality are basic to his learning. Words or other symbols may be used, but their purpose is mainly to support the audiovisual material, either directly as labels or captions, or indirectly as descriptive text. Narrative words can identify, orient, locate in space and time, explain, and generalize.

If the student is learning something abstract, however, the narrative words are basic. Pictures, line graphics, or various diagrammatic means are used only to support and illustrate what is being expressed in language. It is a complete reversal of the case where concrete subject matter is involved. Audiovisual materials used for these purposes can be properly referred to as "aids." A photograph of a political leader making a speech may be basic when the objective is to learn to recognize that particular man. If the objective is to learn the political system of the country involved, the photograph is merely an aid; the concept to be taught is conveyed primarily by the language.

Audiovisual-media producers working in such media as films and filmstrips are faced with the requirement (they believe) to constantly keep some kind of an image on the screen. This frequently leads to the use of the symbolic picture or the visual metaphor, both of which run the risk of distracting the learner's attention.

*For this and similar purposes, the word audial has been coined. The nearest existing words for the purpose are "audible" and "audio," neither of which is a counterpart of "visual." The term "audiovisual" is unbalanced and illogical but firmly entrenched, hence accepted, even if audial-visual would really make more sense.

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Fig. 3—Outline chart of the necessary decision points in selecting the simplest appropriate media class for a given instructional need. (Criteria for making each decision are shown on expanded charts in later figures.)
from the learning objective. Thus, the personality of the political speaker could distract if the political system was the subject. This has been less of a problem in the design and writing of books, since visuals can be used in a book intermittently, when they are needed, and the designer does not feel he must keep an image constantly on the page.

Visual aids that illustrate and support verbal discussion make up a large part of most audiovisual materials. Generally, these rely on diagrammatic expression, rather than symbol and metaphor; an organization chart showing the relationships between various governmental bodies, for example, shown while these relationships are discussed, would be a better choice of visual aid than a picture of a political leader speaking.

Referring again to Fig. 3, note that when the subject matter of instruction is basically concrete in nature (left side of chart), only five of the eight media classes are appropriate possibilities; the two semimotion classes and the print class are not capable of presenting realistic sensory information, but are used for conveying information through language, symbols, and diagrammatic representation alone.

Figure 4 is a more detailed chart of the first four decision boxes shown in Fig. 3. The ten criteria making up this chart, plus others which individual circumstances may dictate, lead to the following: (1) determining whether the instruction concerns concrete or abstract subject matter, and (2) if concrete, determining whether the need is for audio means alone, visual means alone, or audio and visual means together. A series of criterion questions have been suggested. These questions cover the most common criteria for choice of audiovisual means. There may, however, be other legitimate reasons for choosing one class over another. It is important that the designer recognize the reasons upon which he is basing his decision; he should also recognize whether his reasons can be supported by empirical evidence or are purely intuitive. He may, for example, base his decision on the attainment of affective objectives. The fact that many people believe that much of what purports to measure changes in emotional attitude and the achievement of new levels of receiving, responding, and valuing is invalid or unreliable does not necessarily eliminate affective objectives from consideration. However, before a visual media class, for instance, is selected on the intuitive feeling that it will be affectively more effective, the designer should recognize that in so doing he faces the danger of making his communication cognitively less effective by introducing extraneous and distracting stimuli.

DETERMINING IF THERE IS A PRIMARY NEED FOR VISUAL PRESENTATION MEANS (Fig. 4)

Four criteria are listed below as an aid to determining whether there is a primary need for visual presentation. An affirmative answer to any one of these questions, or to any other such criterion that the designer may have in mind, will
Fig. 4—Criteria for distinguishing between concrete and abstract subject matter (an expansion of the first four decision points in Fig. 3).
determine that the subject matter is concrete and requires one of the visual media classes for its presentation.

1. Is visual recognition and identification of objects, signs, or symbols other than language symbols an objective of the lesson or required for job performance? If aircraft recognition, the identification of spare parts, or the reading of meters, instruments, or technical manuals, for example, are objectives of the lesson, visual presentation is mandatory.

2. Is the recognition or recall of a procedure, the physical actions or positions of which are unfamiliar to the learner, one of the objectives of the lesson? If, for example, the purpose of the lesson is to enable the learner to achieve a subsequent performance objective, such as the skill of soldering, the action or sequence of actions he must learn must be demonstrated visually—it can hardly be adequately portrayed in words alone.

3. Is the understanding of two-dimensional physical or spatial relationships an objective? If the learner, for example, should acquire the ability to form a visual image of the terrain surrounding any particular position in a country, so that given the name of a village or other landmark he can point out the approximate direction of any other nearby landmark, visual presentation with the aid of a map of some sort will be required.

If the objective of the lesson is to acquire familiarity with the location of meters and controls for the operation of a piece of equipment, so that the learner may later be able to find any operating information he wants in a minimum length of time, this information must be presented visually.

4. Is the recall or recognition of the three-dimensional structure of some physical system or object required? This is closely related to Criterion 3, but it concerns three dimensions rather than two. If the objective is to relate one part of an object to another, recall the interior construction when shown the exterior, or otherwise demonstrate concrete specific knowledge of physical structure, visual presentation is required.

DETERMINING IF THERE IS A PRIMARY NEED FOR AUDIO PRESENTATION MEANS

If the answers to all visual criteria questions have been No, it still cannot be established that an abstract subject is involved. The designer must also determine whether there is a primary need for audio presentation. Two criterion questions are suggested below to help determine whether the subject must be heard, even if it does not need to be seen. These two questions are represented on Fig. 3 by the box containing the question, "Is subject audible?"

1. Is the recognition or recall of specific sounds an objective of the lesson segment? This includes natural sounds; musical melodies or harmonies; spoken for-
eign words or phrases; the sounds of musical instruments or performance
tiques; other artificial sounds and noises.

The need for audial presentation of information is very clear if the subject
of study emits distinguishing sounds, or is some kind of sound in and of itself. To
the physician or the mechanic, the recognition of the sounds of malfunctioning
organs or machines, for instance, is often crucial to diagnosis or troubleshooting.

2. Is the appreciation of musical compositions, spoken poetry, etc., an objec-
tive? This question is self-explanatory.

This leads to one final question before the subject can be determined to be
concrete or abstract. The emphasis in this analysis has been on vision and hearing,
our two major senses. But there are minor senses also, which could be required for
experiencing a concrete subject. Taste, for example, can be the means for determin-
ing the presence of a concrete substance that might be neither visible nor audible.
Tactile information alone can reveal to a physician the presence of a swollen gland.
Since the communication media now available for our use do not include taste,
touch, or other minor senses, an affirmative answer to the question, "Is any other
sense required?" leads to a stop: no presently available communication medium,
whether it uses visual means, audio means, or language, will be capable of represent-
ing a subject that must be sensed through one of the minor senses. The best that can
be hoped for is that highly artistic literary writing will stimulate vicarious sensations,
which may of course be different in different people, and nonexistent in some.
However, if the information to be received through a minor sense is considered to
be fairly simple (i.e., "the surface of the crystal is salty to the tongue," or "a hard
mass may be felt just below the epidermis"), it is probable that a minor sense is not
really required for learning the concept, and this question may be answered in the
negative. The subject is thus determined to be either clearly abstract in nature—
that is, capable of being adequately described in words—and the designer then goes
to the right hand side of Fig. 3, where the chart deals with abstract subject matter.
Figure 6, p. 39, displays the criteria used in making the first decision in this area.

If at least one of the four visual criteria is met, the subject is concrete and
requires visual means of expression. The next question we must ask is whether it
also requires audio means. This decision point is indicated on Fig. 3 by the box
marked "Audial too?" It will be noted on Fig. 4 that the same two audio criteria that
have just been applied to nonvisual subject matter are now applied to the visual as
well: "Is the recognition or recall of specific sounds an objective?" and "Is the
appreciation of music or oral literature an objective?" In addition, two further
criteria are proposed.

The first of these concerns a characteristic, not of the subject matter involved,
but of the expected learner population. A substantial number of learners may not
read very well. They may be too young, they may be educationally disadvantaged,
or they may have been psychological dropouts at an early point in their schooling.
Unless an objective of the lesson is to improve reading skills, audio narration can
frequently be more effective than print for these people, because for them spoken
words, at least in their own idiom, are more easily and quickly understood. Audio
narration can be most effective if the instructor speaks in the conversational mode. A person generally talks more naturally and in simpler language when conversing with one other person than when speaking to a group. It might prove effective to produce instruction by recording actual tutor explanations in a real teaching situation, then editing these and combining them into the required continuity.

Another important advantage of audiovisual means over straight visual is that in an audiovisual medium, audio narration may be used instead of print. Audio narration may accompany the picture, and the learner can look and listen simultaneously. With visual-only media, narration is presented in print and must be read; therefore, the learner is required to receive narration and visual stimuli sequentially. In some cases this can make considerable difference.

One such instance could be the explanation of a process that requires manual skill, such as soldering. In order to understand this process, the learner may require continuous viewing so that he does not lose orientation and can observe the real time it takes for each phase of the process, yet constant explanation may be required to point out important features of the rather complex action.

DETERMINING IF THERE IS A PRIMARY NEED FOR FULL MOTION

Moving down Fig. 3 to the next level of decisionmaking, the question "Motion?" faces the designer, whether he requires an audiovisual medium or a purely visual medium for his purpose. Figure 5 outlines the criteria on which these decisions may be based.

The most useful criterion is the simple question, "Could this information be presented as well in still pictures?" In terms of cognitive objectives only, the designer must determine if the fact of motion, manner of motion, sequence of motions, or any other aspect of motion which cannot be expressed in still visuals is actually required. This requirement is likely to be much less than most of us imagine; studies of training films have consistently shown them to contain a surprisingly small amount of relevant motion. In a large portion of the average instructional film, motion makes no significant contribution to its learning objectives which still pictures could not have made. In some cases, motion may add extraneous stimuli which actually distract attention from the central subject. Probably a large part of even the relevant motion in training films could be equally well presented in still pictures. In other words, motion visual and audio-motion visual media have in the past been applied to many purposes for which they are not the simplest appropriate media. Still visual or audio-still-visual media are capable of expressing motion in simulated or implied ways; a sequence of still pictures can describe a process or procedure; blurred images, symbolic whiz lines, and the like, can imply motion; and dotted

*McClusky in 1924, O’Conner in 1942, Keisler in 1945, and Irwin in 1950 made studies to determine the portion of the average educational film that contained motion relevant to the instructional objectives. Despite the 26-year spread, all these studies found that about 45 percent of film material was inherently no different from still pictures [8].
Fig. 5—The decision between motion and still presentation (an expansion of the last two decision points for concrete subjects in Fig. 3).

outlines can indicate past positions of a moving object, while solid lines show its final position. The very much greater practicability of still-visual media in most situations makes it mandatory that the instructional designer give this possibility very close thought. The following criterion questions can help in making this decision:

1. Is the recognition or performance of a procedure, the movements of which are unfamiliar to the learner, one of the learning objectives? The key word in this question is “movements.” In order for still-visual media to be inappropriate, a specific action or series of actions must be involved which could not be expressed by still pictures alone. For example, a simple procedure like filling out a form can be explained perfectly well in a sequence of still pictures—it is not necessary to see the words being written. If the subject is calligraphy, however, where the manner of holding and moving the pen or brush is important, the unfamiliar movements of each stroke can only be expressed in full motion.

2. Is the manner of movement of a subject an important characteristic for recognition or description of the subject? The way in which dials, needles and other
visual displays respond to emergency malfunction can often give the technician a clue to the source of trouble. Students of radar, sonar, and similar systems with visual display need great familiarity with the manner of movement of the display and with the sorts of changes that are an indication of the presence of ships or aircraft. As another example, peculiarities in a person's gait can reveal important information to a physician in diagnosing physical disorders.

3. Is slow motion or fast motion required to portray changes that take place too rapidly or too slowly to be otherwise comprehensible? Fast-motion photography and its extreme, time-lapse photography, which by speeding up time reveals the nature of movement that is too slow to observe normally, are familiar techniques. In some cases this continuous movement can reveal information that cannot be conveyed by a sequence of still pictures.

The use of slow-motion photography, on the other hand, can visibly demonstrate what actually happens in a process that is too rapid to be comprehensible. It is a means of extending human vision by stretching out the dimension of time. When rapid or complex action, such as a football play, can be analyzed in slow motion by the persons who have just performed it, much can be observed that would not otherwise be perceptible; correct responses can be reinforced, and errors analyzed.

If none of the preceding criteria concerning full motion are met, the designer should consider whether there are any other reasons for the use of full motion in achieving the particular objective he has in mind. If he does have a reason and he has empirical evidence to support it, he can justify full motion. If his reason is based only on intuition, his opinion must be very strong to justify proceeding without empirical support.

Motion can easily add much that is extraneous to the instructional purpose of a picture; there is considerable evidence to show that too many cues, too much realism, for instance, or too much irrelevant action can actually distract the learner from what he is intended to observe. The designer must thus return at this point to the essential first question about full motion: "Could this information be presented as well in still pictures?" If it could be presented as well, the chances are very high that still-visual will be a better means of instruction. Before a decision is made concerning the need for full motion, the designer should consider semimotion or a combination of semimotion with still-visual, since in many cases semimotion will suffice.

Many people hold the opinion that the ability to watch the animated face of a speaker, to follow his lip movements and expressions, makes his words easier to understand and enriches the content of his talk. There is an equally strong, even more commonly held opinion, at least among media practitioners, that to show the face of a speaker is a great redundancy and a waste of opportunity. The "talking face" is frequently disparaged in articles on how to produce effective television presentations. Both points of view have merit.

This issue arises when there is a need to use an audio-motion-visual medium but the presentation contains a segment in which motion is really not appropriate, or visual means are really not needed. At such a point in a presentation, then, the
producer is faced with the choice of either putting the camera on the speaker or
dragging in some sort of a visualization—a pictorial symbol of the concept being
discussed, perhaps, or merely a title or heading expressed in print on the screen. A
third alternative, letting the screen go blank so that the learner can concentrate on
the audio narration, is likely to be viewed with horror, if it is considered at all.

There are cases, however, where a speaker's face, manner of expression, and
gestures of head or hand do indeed enhance his expressivity. In such cases, watching
the speaker can be a very great advantage to the listener. The question of whether
to focus on the speaker, then, cannot readily be settled by the instructional designer
unless he is familiar with the speaker's qualities. Full motion might be indispensa-
ble for presentations by a very dynamic instructor, while the sight of a stiff, nervous,
or lackluster speaker could add distractions, and audio-only or carefully selected
still visuals might actually be preferable.

THE USE OF MEDIA FOR MESSAGES CONCERNING
ABSTRACT SUBJECTS

If the designer has determined that the subject matter of the lesson segment
he is analyzing is abstract and cannot be seen or heard, his subsequent decision
pattern should follow the right-hand side of the chart in Fig. 3.

Since there are only two means of conveying narration, spoken words and
printed words,* the basic decision here concerns which to use, or whether a combina-
tion would be more effective than either. The following points should be considered
in making this decision (see Fig. 6).

To begin with, poor readers may find spoken words far easier to understand
than printed words. (This point has been discussed in detail on p. 34 in connection
with the choice between audio and print narration when dealing with concrete
subject matter.)

Audio Narration:

The spoken word may also have some qualities that can only be simulated by
the printed word. These qualities can be summed up in the general statement that
the spoken word may be personal while the written word is almost always imper-
sonal.

Technique of expression is the factor that determines whether spoken narra-
tion is personal or not. A stiff, formal delivery, excessively precise and artificially
modulated speech, or a script that is obviously being read aloud from a written page
can make the voice as impersonal as print. Unfortunately, the possibilities of per-

*While narration can also be expressed in pantomime, this form would be used only in excep-
tional circumstances (e.g., schools for the deaf, or acting schools) and is excluded from the general
considerations of this study.
sonal narration have only rarely been utilized in instructional information presentation; the producers of most instructional software seem to feel that the formal, impersonal approach is required.

Spoken words and phrases are quite different from written words and phrases. Conversational words tend to be simpler, the phrases and sentences shorter; occasional fragmentary sentences often help the listener to understand. These characteristics are very unlikely to exist, however, if the spoken words are written first and are then either memorized before being spoken or recited directly from a script. If the possibilities of personal communication are to be realized, either a script must be professionally written in the style of extemporaneous speech, then presented by a skilled actor, or the speaker must be actually formulating his words and sentences as he is speaking. The latter, of course, is the mode of oral communication used by classroom teachers and university lecturers in face-to-face instruction,
where lectures are based on notes or simple outlines. Reading from a script is encountered only in the most formal briefing situations. When lesson presentations or lectures are transferred to the program software of communication media, however, it is generally felt that informality and spontaneity of expression are undesirable. As a result, the value of the personal approach is often lost.

This is not to say that the written word cannot also be informal and personal. The writer's personality can, in fact, shine brightly through from between the lines; and it is possible for instructional material to be written simply or informally without distracting from the communication—often to its very considerable advantage. A book on automobile repair written in this style, entitled "How to Keep Your Volkswagen Alive: A Manual of Step-by-Step Procedures for the Compleat Idiot," is a good example of effective informality in instructional writing. It is significant, however, that such an approach could be taken only in a book that was totally outside the official educational structure.

The effectiveness of the personal and the apparently interpersonal approach in communication is a strong factor in the usefulness of audio means for conveying feelings, attitudes, and other affective objectives. Thus, when an instructor has a particular enthusiasm for the subject he is presenting, the instructional designer should take maximum advantage of it. Most people can convey emotional feelings much better through oral expression than in writing. When the objective of a presentation includes communication of feelings, the much-maligned "talking face" can be even more effective than the voice alone.

Printed Narration

The primary advantage of the printed word over audio is that print is a non-time-based medium. Still-visual media (Class V) are the only communication media that do not have a fixed time dimension. Audio transmissions or recordings play or run at an established rate, and all listeners or viewers must receive information at that rate. Slowing down or speeding up regular audio reproduction machines will distort the sound. Means have been developed for compressing speech without raising pitch, but these have as yet found only limited applications in instruction. And even if speech is compressed, it is compressed for all listeners, so that the time dimension remains fixed.

Print, on the other hand, because it is intended generally for use in the individual mode, allows each reader to set his own pace. Print is intended to be read in a linear sequence, but all the paragraphs and sentences in a printed work are available simultaneously to the reader and may be consulted in any order, in any manner, at any rate of speed. This is why print media are generally preferred over audio media for study purposes when frequent repetition and review is needed; audio media are used mainly for initial presentation, particularly in the group mode.

The average rate for oral communication is around 175 words per minute. This is a fairly slow reading rate; most people can read with comprehension at 200 to 250 words per minute, and some can read considerably faster [9]. Thus, printed
narration when used in the individual mode allows for a more efficient use of instructional time, especially at higher educational levels.

Print loses this advantage, however, when it is used in the group mode. Group teaching in general has this drawback. Since most class groups have a wide range of backgrounds and abilities, the classroom teacher usually attempts to direct his presentation to the group average, knowing that some learners will be bored and others will be left behind. Media for group presentation have generally been designed to be as self-supporting as possible, with little requirement for classroom follow-up. Hence the tendency in visual-media presentations has been to keep print on the screen until even the slowest readers will have comprehended it, rather than to aim for the average of an average class. The usual producer's rule of thumb is to hold a title or caption on the screen long enough to read it three times. While this favors the slow reader, and may even encourage some amount of review on the part of average readers, it certainly is a waste of time for most members of an audience.

Audio and Print Narration in Combination

There is considerable difference of opinion as to whether narration of any sort, even when it is very brief, should be read and heard simultaneously. There seems to be general agreement, however, that when audio narration and a different print narration are presented simultaneously, something will suffer. Strangely enough, it seems that the presentation mode which is most difficult for the learner to follow is given the most attention in such cases and is retained the best [10]. Poorly made television commercials are a case in point. Not understanding the difference between a time-based and a non-time-based medium, some advertisers compress into a 30-second commercial as much information as they are used to putting into a newspaper advertisement. When the screen is filled they add further information via the audio track. The result is information overload. But when audio and video contribute complementary parts of the same presentation, one carrying the narration, for instance, while the other carries illustration, it is a different situation.

The question of whether the same words should be simultaneously heard and read, however, is mainly one of efficiency. Does simultaneous multimode narration contribute anything over the use of one mode alone? If not, could or should one of the channels be used for some other purpose? For average learners there is probably no significant instructional advantage to duplication of narration. Unless some other reason is found to justify such duplication, and if the use of visuals is inappropriate, quite possibly the second channel should not be used at all. Key words or phrases can be occasionally duplicated for emphasis, in two channels, but probably only one channel should be used at a time for narration.

There is one more possibility to consider: the case in which the subject being taught is some aspect of the oral or written language arts—for example, speaking or listening skills, composition, spelling, reading, or appreciation of literature. Naturally, if oral skills are being taught, audio will be required; if written, print is called for.

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If the subject is reading, with learners being taught the symbols that represent a familiar spoken language, both audio and print are required. Displaying of printed words as they are read aloud is a typical example of an effective simultaneous use of both narrative means.

**Visual Support for Audio Narration**

If it is determined that for at least one of the reasons described above, audio narration is required, the designer must next decide whether audio should be used alone or whether visuals or print, or both, might be needed to support it. Here, again, a series of criterion questions may be asked, any one of which, if answered in the affirmative, will lead to the decision to use supportive visual aids.

Note that the term "audio aids" is not being used in this discussion of abstract subject matter. Audio aids, in the usual sense, are used in the communication of audiovisual sensory information—definitive and descriptive sounds that are used to demonstrate something concrete. This use of audio and audiovisual media has been discussed in connection with the presentation of concrete subject matter. In conveying abstract information, however, sounds, except for speech and occasional other audible signs, can play no role.

Perhaps music in narrative communication might be considered an audio aid. Introductory music is said to be used to gain attention or set the mood; background music, to maintain a mood or convey a feeling about the subject. Whether music in these applications is of value to instruction is part of the whole issue of production quality, which is discussed in Ref. [5]. For most kinds of instruction involving abstract subject matter, however, music would probably not be used with print narration, although music is sometimes added to audio narration.

Visual aids, on the other hand, can often make audio narration much easier to follow and easier to recall later. It would be well to separate the term "visual aids" from descriptive pictorial matter about concrete subjects. The latter materials have been discussed in connection with communication of sensory information, where they are not aids at all but are the basic materials of presentation. The visuals we are now discussing are aids to language communication about abstract subject matter and hence are abstract in themselves. Many of the visuals used today for this purpose are simply various forms of print. Charts, graphs, diagrams, and sometimes pictorial materials are also included. When pictures are used for such purposes, however, there is a risk that they will distract the learner.

Whatever primary purpose pictures may have, they are also always representative of concrete subjects. Often images of concrete things are used as symbols (e.g., the Capitol building, the Supreme Court, and the White House, all surrounded by a gigantic chain, symbolizing the enforced unity of the three branches of government). While a visual metaphor may be logical and valid, the display of concrete images is often rendered in such detail that one imagines the artist probably thought his objective was to portray the objects themselves, not the concepts they symbolize. The result is that a large amount of distracting visual information is put before the
learner, often to the actual detriment of his ability to apprehend the intended message. Briefings and slide talks are frequently loaded with visualizations whose only reason for being is to keep something on the screen while the message is being carried orally.

Several criteria which may be used to help in deciding whether visual aids are required are diagrammed in Fig. 7. If none of these criteria, or similar criteria that the designer can think of, are met, then audio narration alone will be easier to understand than audio with visual aids.

![Flowchart](image)

Fig. 7—The visualization of audio narration (an expansion of the three decision points for audio narration in Fig. 3).
1. Are abstract concepts and relationships involved which could be expressed graphically? Not all concepts lend themselves as readily to charts and diagrams as hierarchical organizations, syllogisms, and systems. When this kind of visualization is possible, however, it can greatly aid in the expression and recall of abstract relationships.

2. Is the recall of a set of items an objective? Is the overview of the outline of a discussion useful to the learner? These two questions are intended to identify a need for one of the most common uses of visuals in instruction: The reinforcement of audio narration by repetition in print of key words, phrases, categories, classification headings, and the like. The advantage lies in the orientation that an outline or summary can provide, especially one that is continuously on display. As each item of a series is discussed, it may be added to the visual list, making it possible for the learner to constantly review and think about the preceding items on the list, to relate them to the new items as they appear, and to imprint them in his memory.

This same principle applies equally well to graphic means of expression other than the simple list or outline. The flow chart and the graphic conceptual model mentioned in Criterion 1 can also be used to reinforce audio narration. Such visualizations aid the learner in retaining and recalling relationships between abstract concepts. Graphs can visually express a wide range of values for a relationship between two or more parameters, allowing the learner to comprehend how changes in one factor can affect another. Charts can express proportional, comparative, sequential, and hierarchical relationships. For some learners, visual representation of an abstract function is required to make it comprehensible at all; for others, it is an enabling step leading to the ability to understand and use a purely abstract mathematical expression for the function.

If the decision is clearly in favor of the use of visual aids, the designer must next decide whether full motion* is required or still visuals will suffice. The chances are very much against full motion being necessary. Since realistic representation is not relevant to abstract subject matter, natural motion is not needed. The use of a motion picture to present a visual symbol or metaphor of an abstract idea is very likely to be destructive to the purpose of the communication. A still picture of a hand dropping a ballot into a ballot box may be a good symbol to use in expressing the idea of self-government; a still picture of the same subject which includes the head and feet of the voter would put much extraneous information before the viewer; if this picture were made in motion, a great many additional cues would be added, causing further distraction. If the simple hand close-up were to be shown in motion, probably few distractions would be added, but the action would be so short that its usefulness would be very limited; a still picture could be held much longer on the screen. Another alternative, a sequence of short shots of many hands going through the same motion, might easily add a cinematic enrichment which might again call attention to itself and away from the narration.

*See Glossary for definition.
Semimotion

While full motion, especially realistic photographic motion, may introduce distractions when used as an adjunct to a narration, semimotion may be a useful visual aid; in fact, it often has instructional advantages over still visuals. One type of semimotion is the motion of a pencil drawing a picture of the subject; another is the simple growth of the line that delineates a subject. This kind of motion is referred to as “buildup.” The designer should answer the following question to help determine whether semimotion is needed for his particular objective: Is the understanding of subject-matter concepts dependent on the sequential development of a symbolic structure?

Audio-motion-visual media such as television or film are often used merely to display equations as they are written on a blackboard. If this is the only need for visual action, full motion is not required, and a much simpler medium, such as telewriting, would be equally appropriate and probably far more feasible.

Semimotion allows an instructor to put an equation, a phrase, or a diagram together, piece by piece, as he is talking about it. What he has just discussed remains visible for comparison review, but there is nothing displayed that is not yet germane to the discussion. (A full-motion medium can avoid distraction by using the same method—building up the subject in handwriting or drawing, gradually panning the camera down line by line, or pulling a mask off to reveal prepared information.) Gradual buildup can also be effected with a still-visual medium by using a separate still-visual frame for each increment of information. The effect is known as "pop-in"—new elements suddenly appear. Beyond the fact that items not yet discussed do not appear and distract the viewer, there seem to be no instructional advantages in the buildup motion.

Another type of semimotion is "pointing," in which a pointer or spot moves across a still-visual, calling attention to various details. This again can be done by much simpler means than full-motion film or television. Pointing can have considerable value as a way of enhancing the effectiveness of still pictures.

Visual Support for Print Narration

If the earlier decision between audio and print narration has been made in favor of print, much the same sequence of decisions is required. If no good reason for the use of visuals can be found, of course they should not be used; a simple print medium such as teletype, as used in much computer-assisted instruction, will be quite adequate. The same purpose may be served by a book without illustrations, of course* (see Fig. 8 for a diagram of suggested criteria). Here again, motion is rarely useful for supporting printed narration. Because in print, narration and illustration are generally presented or at least perceived sequentially rather than simultaneously, the danger of visual aids causing interference and loss of attention is not as serious. Group presentation media, such as silent film, or filmstrip, are not good

*This is discussed below, under Alternative Media.

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means for presenting a lot of reading matter. They are time-based media, and hence some compromise in pace is necessary between fast and slow readers. The pace must be set slower than average, if such materials are to have maximum usefulness, and as a result most readers are bored by the pace of printed materials for group presentation.

Semimotion (Class VI) instructional media do not currently exist. The only current semimotion medium is telautograph, which is used solely to carry information. Thus, the question of the value of semimotion to printed narration is theoretical at present. If useful media are developed in this class, probably the same considerations that were discussed in connection with the audio-semimotion class will apply to audio narration as well.
ALTERNATIVE MEDIA

Even after determining the simplest media class that is appropriate for a particular lesson segment, the instructional designer has not exhausted his range of possibilities. Various other media classes or combinations of classes may also be appropriate. Class I media, for example, are universal in their application; since they contain all the audio and visual elements, they can be appropriately used for any purpose. However, such applications will make only partial use of the capabilities of the media and are less likely to be practicable than applications for which this class is the simplest appropriate.

Television systems, for example, have been used to produce and transmit programs which consist of news, announcements, or music, with no visual component, or a visual component that is static. Certainly, it would be infeasible to install a television system for audio or audio-still-visual programs alone. However, any communication system should be capable of a variety of uses, and there are lesson segments in nearly every curriculum in which visual or motion-visual components are either not required or not desirable. If the need for less than motion-visual presentation is rare, it would be impractical to construct an entire parallel system of a simpler media class; a television system can be applied in a partial use much less expensively. Thus, if the designer has determined that he needs a Class I medium for 40 percent of his instruction, Class II for 40 percent, and Class VII for 20 percent, he may decide to simply combine all these uses into one Class I medium. On the other hand, he may determine that Class II media will handle 80 percent of his need and Class VII will handle 18 percent, while Class I, the most complex of all, is really needed for only 2 percent of the planned instruction. In such a case, the designer may decide to reconsider those segments calling for audio-motion-visual media to see if they might be more practicable, perhaps, in a "face-to-face" situation without media at all. If so, he could then appropriately utilize a Class II media system.

However, if these figures represent only one course of study among fifty, say, and the other forty-nine would make sufficient use of Class I media to justify a system installation, it might be feasible to use a Class I medium for the given course, even though full motion was required for no more than 2 percent of its instructional time.

These are considerations of practicability, an area which is outside the scope of this Report. Our concern at this point is only in helping the designer to determine the various alternative media classes that can be appropriate to each need. After the appropriate media class or classes have been determined, many specific, purely local factors, such as situations arising from other uses of media, plus all relevant resources and constraints must be considered. This total process will then lead to the selection of the most practicable medium from the most appropriate class.

Alternative Appropriate Media Classes

The first set of alternatives to be considered are the alternative appropriate
media classes. The second set comprises multiclass combinations equivalent to media classes, and the third set is composed of new multimedia categories formed by multiclass combinations. Figure 9 lists the three sets of alternatives as they apply to concrete subject matter; Fig. 10 lists the alternatives that apply to abstract subjects. Since Fig. 10 includes all the alternatives that are listed in Fig. 9, plus many others, Fig. 10 will be referred to in the discussion that follows.

Each figure is headed by the list of communication-media classes that appeared at the bottom of Fig. 3, and each can be visualized as a continuation of that figure. The designer, at the point represented by the top of Figs. 9 and 10, has already arrived at the simplest appropriate media class for the particular instructional segment that he is analyzing. He may now find the appropriate media-class column in Fig. 10, and by reading down, encounter the alternative media classes that he can use, the multiclass combinations (if any) that would also be appropriate to his need, and the new multimedia categories formed by various multiclass combinations which could be used if they should turn out in later analysis to be practicable.

Because Class I (audio-motion-visual) media have more capabilities than any other class, there are no alternative media classes that can substitute for them. By the same token, however, Class I is an alternative to every other class, since media in this class can do everything media of any of the other classes can do.

Media Class I is the only appropriate alternative for the uses shown in the second, third, and fourth columns. All these uses, as has been previously noted, are partial uses of Class I media. When Class I media are used as an alternative for Class II (audio-still-visual) media, their capability to display semimotion or full motion is not used. When a Class I medium is used as an alternative for Class III (audio-semimotion), the capability to display pictorial materials and full motion is disregarded. When Class I media play the role of Class IV (motion-visual) media, the audio component is eliminated.

Class V (still-visual), which has no motion and no audio component, has two possible alternatives. Class I media such as sound film, and Class II media, such as sound filmstrip, can convey print, line graphics, and pictorial material, the three components of Class V.

Any of the three audiovisual Classes, I, II, and III, may alternate for Class VII (audio) if the screen is allowed to stay black.

Class VIII (print) has more alternate classes than any of the others. Any of the visual-media classes can display print; the only classes that cannot are III (audio-semimotion) and VI (semimotion), which can display handwriting or printing as it is being formed, but not prerecorded print; and VII (audio), which, of course, has no visual component.

**Alternative Appropriate Multiclass Combinations**

The second set of alternatives, the multiclass combinations, are shown in the next lower section of the chart. There are three multiclass combinations which, through the simultaneous use of two otherwise separate systems, can perform the functions of a media class that is more complex than either. Because these combina-
Fig. 9—Alternatives for expressing concrete subject matter.
Fig. 10—Alternatives for expressing abstract subject matter.
tions are relatively few, we shall discuss them individually, rather than in terms of media classes.

The capabilities of Class I media (sound, picture, line graphics, and print) may be obtained by combining silent film (Class IV) with a separate audio medium (Class VII). Such a combination system is currently being marketed by Bell & Howell to offer home-movie-makers an inexpensive way to produce sound movies. It consists of a silent-film camera and projector plus a portable cassette audio-tape recorder-playback unit. While these elements could be combined by anyone possessing some system in each class, constant synchronous sound would not be possible. The various motors of the separated units of equipment would be likely to run at slightly different rates, and these rates would themselves vary slightly from one moment to the next. Therefore, speech synchronized to lip movement could not be done; only nonsynchronized background music or narration would be possible. The Bell & Howell system, however, adds synchronizing pulses on a second audio track during filming and uses these to control the speed of the film projector during playback. This combination is far less satisfactory than sound-on-film, editing is next to impossible, and of course software is not interchangeable with any Class I medium. Nevertheless, the relatively low production cost of this method makes it useful in applications where regular Class I media would be out of the question.

This same combination of silent film and separate audio could be used in partial modes to perform the functions of any of the media classes. This is not to suggest, of course, that the whole combination should be assembled simply for the purpose of doing still pictures or audio alone; if it already existed, however, it could be put to these uses.

Class II (audio-still-visual) capabilities may be performed by a combination of a Class V (still-visual) medium with a Class VII (audio) medium. Some of these multimedia combinations can provide very practical and often quite inexpensive means of audio-still-visual presentation.

The most promising of these is a combination of audio tape and printed page. Sometimes called "audio text," this is an individual-use combination which bases instruction on audio narration. The visual component in a student workbook sometimes repeats the spoken words (to assist poor readers) but usually provides illustrative material. The workbook can readily be used for integrating student response of the constructed type. Reinforcement in such cases is achieved by providing the individual learner with the correct answer after he has committed himself on paper; he compares this with his answer and scores or evaluates his own results.

An increasingly widely used multimedia method combines sound radio with slides or filmstrips to provide an audio-still-visual combination called "Radiovision." Sets of slides, or rolls of filmstrips, are mailed to schools or other users in advance and are projected by an operator during the time the radio program is being broadcast.*

The components of a Class III medium, such as telewriting, may theoretically

*See Ref. 7, p. 97, for a more detailed description.
be assembled by combining the Class VI medium, Telautograph, with an audio medium.

Alternative New Multimedia Categories

The third set of alternatives is shown at the bottom of the chart, where five new multimedia categories that fall between the eight basic media classes established in the taxonomy are listed. Some of these are integrated combinations, others are not. The combination entitled "semimotion still-visual," for instance, makes it possible to point to things or draw diagrams on an otherwise still picture. This is an integrated combination. Motion-still-visual, on the other hand, is composed of two essentially separate elements. It is either one or the other on a given screen. If both are projected at once, two screens must be used.

Figure 11 summarizes the fourteen possible media-class combinations that appear to have promise of being useful in communication. Not all have been attempted. It will be noted that the first three are equivalent to the first three media classes, respectively, and hence may be used as appropriate alternatives for these media classes.

The other 11 combinations, however, provide capabilities which can be classified under five multimedia categories previously described:

Category 1, Audio-Motion-Still-Visual. Combinations 4, 5, 6, and 7 produce a multiclass combination we have called "audio-motion-still-visual." In this intermedia category still-visuals are combined with motion pictures, and each is used when it is most appropriate. Because the visual film must stop for still-frame projection, it cannot carry a sound track; hence the sound is separate from the picture. Some such systems consist of two or more projectors plus a tape recorder. Control pulses to operate the projectors in approximate synchrony with the sound may be recorded on the sound tape, utilizing a second, parallel audio track, or may be recorded on punched tape and run on a tape-reader control unit.

A significant new development is the motion-picture-filmstrip projector which projects motion or still frames from the same roll of film, while reproducing recorded sound.

Category 2, Audio-Semimotion-Still-Visual. Combinations 8, 9, 10, and 11 produce multiclass combinations we have classed as "audio semimotion-still-visual." This multimedia category is represented today by only one example: Telewritervision.* This is a combination of a Class III medium, telewriting, and a Class V (still-visual) medium, generally slides. The still-visual slides are integrated into the semimotion program at the point of reception and display. In the future, various semimotion methods will undoubtedly be added to still television, adding buildup and pointing motion to otherwise static visual material, and probably at very little extra cost. In the case of telemedia, pulses representing the vertical and horizontal

*See Ref. 7, p. 81, for a full description.
<table>
<thead>
<tr>
<th>Equivalent media class</th>
<th>Media class combinations</th>
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<tbody>
<tr>
<td>1 Class I</td>
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<td>IV</td>
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<td>2 Class II</td>
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<td>3 Class III</td>
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<td>VII</td>
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<tr>
<td>Multimedia category</td>
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</tr>
<tr>
<td>4 Audio-motion-still-visual</td>
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<td>5 &quot;</td>
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<td>8 Audio-semimotion-still-visual</td>
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<td>12 Motion-still-visual</td>
<td>IV</td>
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<tr>
<td>13 Semimotion-still-visual</td>
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<td></td>
<td>VI</td>
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<td>14 Audio-print</td>
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<td></td>
<td>VII</td>
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<td></td>
<td>VIII</td>
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</tbody>
</table>

Fig. 11—Multiclass combinations classified into multimedia categories.

components of semimotion, whether buildup or pointing, will require additional very narrow transmission channels or subchannels.

Category 3, Motion-Still-Visual. Combination 12, motion-visual with still-visual, produces a silent intermedia category, "motion-still-visual," exemplified by the Eastman MFS-8 system.

Category 4, Semimotion-Still-Visual. Combination 13, "semimotion-still-visual," is a multimedia category which has no current examples. It is the theoretical combination of Class VI (semimotion), which has only one current example (Telautograph), with some appropriate Class V (still-visual) medium. Multimedia of this category would probably find their most logical application in information transmission. Possibly a combination of Telautograph with silent still television would provide a useful vehicle, making possible the transmission of whole documents as well as written messages. The drawing of weather symbols on maps is an example. Probably the reason this combination has not been tried is that it does not
contain audio. Print narration would be required, and this would limit it to individual use, since print narration is not very practical in the group mode.

Category 5, Audio-Print. Finally, combination 14, "audio-print," produces a multimedia method which has been found useful in teaching foreign languages. A computer-assisted instruction system at Stanford University for the teaching of Russian combines a teletype display and response system in coordination with an audio tape. Words are typed out and spoken simultaneously; for response, words are given orally and the learner responds by typing. The combination of student workbook with audio cassette, sometimes called "audio text," has been finding increasing usefulness in many instructional areas.

CONCLUSIONS

It is thus clear that even after the instructional designer has followed through the decision logic and arrived at the most appropriate media class, his range of choice is still fairly broad.

In Class 1, for example, considerations of practicability will dictate his choice between some five or six media, some with many submedia variations, one multiclass combination (motion-visual with audio), and one multimedia category (audio-motion-still-visual). If his subject matter is abstract, three more multiclass combinations in the same multimedia category are also appropriate. This provides a total of at least eight or eleven alternatives, and many more if submedia (such as the various gauges of film and types of television cassettes) are included.

Not all of these alternatives would be practicable in every situation; some might be less practicable than their alternatives in every situation. The fact that these possibilities have been presented here for consideration and comparison may help the designer not to overlook the particular combination which best suits his needs. To make the proper choice from among the alternatives determined by following the decision logic in this Report, matters of practicability such as the specific resources and constraints of the using institution and the costs that would be incurred must be considered. Factors of a more human nature such as acceptability to learners, to staff, and in some cases, to the public at large must also be taken into account.

The decision logic for the selection of the most practicable media, from the alternative appropriate media will be the subject of a forthcoming Rand Report in this series on communication media.
Appendix

NOTES ON THE TAXONOMY OF COMMUNICATION MEDIA

In the first report of this series, RM-6070-NLM/PR, Communication Media: Properties and Uses, a taxonomy of communication media was developed. The classes of media were summarized in the Frontispiece to that report. Since the publication of RM-6070-NLM/PR (in September 1969), some minor changes have been made in the taxonomy. Those changes are reflected in the Frontispiece to the present report* and are discussed below.

There have been two changes in class name: Class III, which was originally called “Audio-Semivisual,” is now “Audio-Semimotion.” The latter title is more descriptive of the distinctive features of this class. The second name change occurs in the last class, which was formerly called “Type.” This class is now “Print.” Print was originally considered to be one of the visual elements; it has been found more useful, however, to think of print as other than a visual device. Print is understood to consist of alphanumeric characters, other similar symbols, and handwriting.

A new class of media, Class VI, “Semimotion,” has been inserted into the taxonomy. This class is represented, to the best of our knowledge, by a single device, the Telautograph.** Technically, the Telautograph is similar to the various telewriting systems, except that in this class, audio is not a component of the medium. Telautograph has a long history; it was invented by Elisha Gray, who, it is interesting to note, would have been known as the inventor of the telephone as well, had he arrived half an hour earlier at the Patent Office to file his disclosure. Telautograph is widely used in industry when frequent orders must be sent, and accountability requires that they remain in permanent written form for later reference. (In the Frontispiece, a small x is shown in the Motion column for both Telewriting and Telautograph to indicate semimotion—a capacity for buildup and pointing, but not full motion, which characterizes the class.)

* Reproduced on the inside front cover.

** Originally, Telautograph was a generic term, but it has recently become a company name.
The insertion of Semimotion in the taxonomy completes a series of three visual-media classes, repeating the visual elements of the previous series of three audiovisual-media classes. The numbers of the last two classes are thereby changed to Class VII (Audio) and Class VIII (Print).
GLOSSARY

Adaptivity: Capability of an instructional system to adjust to the specific needs of the individual learner.

Application: A specific instance of a general use (see use).

Audiovisual (A-V): Concerning both hearing and vision.

Bandwidth: The difference in frequency between the maximum and minimum boundaries of a telecommunication channel.

Broadcast: Transmitted via the public radio or television channels on a broad or nondirectional beam (see open circuit) and received on generally available apparatus.

Cartridge: A device that contains and protects a film or tape during storage and playback and obviates the necessity for threading the playback magazine. In some cases the material is also recorded upon while it is within the cartridge. A cartridge generally contains only one program unit (see magazine).

Cathode-ray tube (CRT): One of several types of vacuum tube used generally for display purposes (e.g., TV picture tubes, oscilloscope display tubes, computer graphic displays, etc.).

Closed circuit: Any transmission method by which reception is not available to the general public. It may be confined to wires, microwave beams, and the like, or it may require special receiving apparatus not generally available.

Communication: The sending and receiving of messages.

Communication aids: Devices and materials that assist a communicator in expressing his message (see instructional aids).

Communication medium: A system for conveying messages through reproducible and self-contained programs (see instructional medium).

Computer-assisted instruction: Applications of computers to the many aspects of the instructional process.

Constructed response: Any response which is not finally effected by choosing one of two or more possible choices (see selected response). Examples are spoken or written words or phrases, drawings, and performance of actions and procedures.

Criterion objective: A major point in a course curriculum, essential to mastery of the course itself.

Cross media: Multimedia.

Electron Beam Recording (EBR) (trade name): A method of recording television signals on motion-picture film by scanning the film with an electron beam rather than by focusing an image upon it.

Electronic Video Recording (EVR) (trade name): A motion-picture system by means of which two tracks of picture and magnetic sound are distributed on a film 8.75 mm wide.

Enabling objective: A minor point in a course curriculum, necessary to the mastery of a major objective (see criterion objective).

Facsimile: A transmission-recording system in which pictures or print are transformed into electrical signals, in the manner of television, except very much more slowly and thus needing a very much narrower bandwidth for transmission. The output of the system is hard copy.

Filmstrip: A communication medium involving static graphic materials which are recorded on a roll, usually of standard sprocketed motion-picture film, and projected frame-by-frame for group viewing.

Frame: (1) A single still picture isolated from a sequence of still pictures, in still-visual or motion-visual media. (2) A discrete increment of information presented to a learner by an instructional program.

Full motion: Any kind of motion except "buildup" or "pointing."

Hard copy: Printed material of any kind ordinarily read by the unaided eye.

Hardware: Equipment as distinguished from materials; machinery, tools, and devices (see software).

Independent access: A term that applies to a multiuser storage system in which the method and time required for any one user to gain access to a piece of information are apparently independent of the number of and actions of all other users (see random access, sequential access).

Individual mode: One person alone, using materials at will, with control over the materials to a lesser or greater extent and limited interaction with other users.

Information: (1) Statements in language on abstract subjects (conveying concepts, relationships, values, etc.). (2) Percepts or observations of concrete subjects: physical properties, actions, conditions, changes, and the
like. (3) Combinations of (1) and (2), e.g., audiovisual information presentation.

**Information medium:** A system for transmitting, or for recording, storing, and retrieving information.

**Instruction:** Teaching and learning; the systematic attempt to impart knowledge and skills and to instigate learning.

**Instructional aids:** Communication aids used by an instructor generally in the presentation of information. They are not self-supporting. Many so-called "audiovisual aids" are really communication media, since they can be self-supporting (see learner aids).

**Instructional devices:** Training devices; items of standard on-the-job equipment used in instruction (see instructional aids, learner aids).

**Instructional medium:** Any component of the learning environment which provides or helps to provide stimuli to learning (see communication medium for distinction).

**Instructional method:** A structured activity for achieving learning.

**Instructional program:** (1) The information presentation component of a lesson (e.g., an instructional television program). (2) A lesson or other segment of programmed instruction which presents information in small increments, elicits learner response, and provides the learner with knowledge of results.

**Instructional technology:** Tools, materials, devices, machines, and the procedures of their systematic use to achieve learning.

**Instructional television (ITV):** Any audio-motion-visual system, using teletransmission, that is used primarily for formal instruction.

**Instructional Television Fixed Service (ITFS):** A television wireless transmission/reception system utilizing special frequencies which are allocated for instructional transmission purposes only, such as between a central transmitter and several school buildings. ITFS may be used in an instructional system for administrative communication, data transmission, studio-transmitter links, and interstation relay.

**Interaction:** Mutual or reciprocal action or influence.

**Kinescope recording (kinerecording):** A system for recording television sound and image on photographic film. Basically, it consists of a film camera focused on a kinescope tube (television picture tube). An ordinary motion-picture film results, which can be projected on a screen or transmitted by television in the normal manner.

**Knowledge:** The body of integrated and retrievable information possessed by an individual.

**Learner aids:** Devices that aid a learner, generally in drill and practice activities, with or without the assistance of an instructor. The learner uses or
interacts directly with the device. Includes tools such as pencil and paper, and simulators for individual or team practice.

**Light pen:** Input device for a computer system; a stylus whose position when held against the face of a CRT can be determined by the computer.

**Line graphics:** Charts, diagrams, maps, and drawings which do not attempt realism.

**Live:** In real time; that is, the message originates simultaneously or nearly simultaneously with its display and perception.

**Magazine:** An adjunct to a projector or other playback device holding a set of program materials consisting of many individual units and generally accessed automatically, e.g., a slide magazine (see *cartridge*).

**Mass medium:** A telemedium or recording medium which generally involves a large number of message receivers per sender and generally does not involve simultaneous interaction. It is available to the general public.

**Medium (pl. media):** A means of effecting or conveying something. *Medium* is a general term roughly comparable in many ways with tool, instrument, vehicle, means, etc. (see *communication medium*).

**Message:** An organized amount of information which has been formulated by one person with the intent of its immediate or ultimate transmission to other persons (or to himself), e.g., statements, questions, or commands.

**Microfiche:** A microform system using transparent chips (cards), usually 4 x 6 inches in size, onto which up to 3200 pages of printed material may be photographically recorded. Can be read with magnifying or projection devices (see *ultramicroform*).

**Microfilm:** A microform system using roll film on which photographic images of printed materials, usually, are reproduced. Can be read with magnifying or projection devices.

**Microform:** Any recorded image of printed materials in which the reduction ratio is at least 12 to 1, usually 20 to 1 or greater.

**Mode:** (1) (General). Manner of being, doing, etc.; way; method. (2) Manner of reception of a communication, e.g., individual or group mode. (3) Manner of operation of equipment, e.g., recording or playback mode. (4) Manner of utilizing the possible ways of representing information via a medium, e.g., full or partial modes of use.

**Multi-image (Multimedia):** Two or more images, still or motion, projected as one display.

**Multimedia:** More than one medium used in a single communication, either sequentially or simultaneously.

**Network:** (1) Telemedia: A series of reception, display, or redistribution points that are interconnected so they may simultaneously share the same pro-
grams. (2) Recording media: A series of points as in (1) above that share programs by transporting recordings between them. (3) Various combinations of (1) and (2).

*Open circuit:* A broadcast transmission method in which the receiving equipment and programs are available to the general public. Open-circuit programs usually can be, with the necessary equipment, received anywhere within range of the broadcast station. ITFS transmissions, by contrast, are not open circuit.

*Picturephone* (trade name): A system of transmitting video and audio information via relatively narrow bandwidth, involving digital encoding. Intended as a two-way system to enhance telephone intercommunication.

*Practicable:* Something that can easily or readily be effected by available means or under current conditions.

*Print:* A way of representing information using symbols such as alphanumeric characters, pictographs, logograms, ideograms, hieroglyphics, and handwriting. Does not include line graphics or pictures.

*Production:* Encoding of a message into the form of a program appropriate to the medium being used; the process of creating programs. May include such phases as program planning, preparation, script writing, rehearsal, and recording and/or live transmission. May also include testing, revision, and validation.

*Program:* (1) Any prearranged plan or course of proceedings: an organized sequence of events. (2) A unified presentation occupying a discrete period of time and having a beginning, a middle, and an end. *Program* is a general term covering entertainment, fine art, general interest, and instruction. Program as used here refers to the content of a medium, and consists generally of a message expressed in the terms and techniques of the medium (see also *instructional program*).

*Radiovision:* An instructional media system presenting static visual materials and sound. The sound portion is transmitted by radio, while visual materials are projected at the point of local reception.

*Rand Tablet:* An input device for a computer system consisting of a printed-circuit surface electrostatically coupled to a stylus. The computer senses the position of the stylus and thus makes possible the input of two-dimensional line drawings.

*Random access:* Direct access; a method of storage in which any unit of information may be accessed directly, regardless of the location of the previous piece of information retrieved. An example would be the type of slide projector in which any slide could be projected promptly by pressing a corresponding button (see *independent access, sequential access*).
**Recording media:** Media capable of recording programs, storing them, then playing them back at later times or, after transportation, at later times and at different places.

**Selected response:** A response that is finally effected by choosing the best answer from two or more possibilities which have been prepared for the learner and presented to him. Selections may be made by pencil on paper, keyboard, light pen, or the like (see *constructed response*).

**Self-instruction:** Independent study structured and carried out by the learner himself and performed in the individual mode. Self-instruction may incorporate heuristic methods such as inquiry, search, and discovery.

**Self-study:** Individual study. Any learning activity carried on by the learner that is not coordinated with other persons.

**Sequential access:** A method of storage in which the items of information stored become available in a one-after-the-other sequence, whether all the information or only some of it is desired. An example would be a normal slide projector, in which a desired slide can be projected immediately only if it happens to be next in sequence (see *independent access, random access*).

**Slide set:** A set of slides, usually contained in a magazine, for projection in an automatic projector.

**Slow-scan television:** A transmission system which transmits still pictures in near real time, generally at a rate of six or less frames per minute, to be displayed on a CRT; a communication medium based on slow-scan transmission.

**Software:** (1) Telemedia: Transmitted programs and/or messages. (2) Recording media: Recorded program materials, e.g., film, tapes, books, discs, etc., containing recorded messages. (3) Both: Working materials from which a program is created. May include scripts, written narration, audio or visual aids, etc., especially created or assembled for the production.

**Sound-on-slide:** An instructional media system involving slides mounted in special holders or cartridges that include up to a minute of magnetic recording material, so that sound may be recorded "onto the slide itself" and played back from the slide during projection.

**Sound page:** An instructional media system involving separate pages of hard copy with sound recorded on the back of each page. The page is placed on the top of a record/reproduce machine; the learner views the page and hears the sound.

**Subsidiary Communications Authorization (SCA):** A broadcasting system which makes it possible to transmit up to five simultaneous programs on a single FM radio channel. One of these is the main channel, the
others are multiplexed subchannels (subcarriers).

**Teaching:** The art of assisting or instigating another to learn; it includes the presentation of information and the providing of appropriate situations, directions, or activities designed to facilitate learning.

**Telecommunication media (telemedia):** Electronic media capable of transmitting programs across distance in real time.

**Telelecture:** An instructional media system involving the use of static visuals and sound. The sound portion is transmitted by telephone while the synchronized visual materials are projected at the point of local reception. Since standard telephone facilities are used, a feedback channel is also available.

**Telewritevision:** An instructional media system incorporating telewriting plus static visual materials projected by the telewriting display equipment at the point of viewing.

**Telewriting:** An instructional media system which transmits sound and writing as it is being written. The principle is basically that of the Telautograph: The vertical and horizontal components of movement of the sending stylus are transferred to electrical impulses which are then transmitted on different channels to a receiving stylus which moves in accordance with the signals it receives, and reproduces, simultaneously, the original writing. This may then be projected on a screen for group viewing.

**Terminal:** Interface equipment between user and machine in a computer system: input-output equipment, usually in the form of teletype and/or CRT.

**Time-shared television:** A proposed transmission system which would utilize one television channel to transmit, for instance, 300 still pictures to 300 different viewers each 10 seconds, instead of the usual 300 successive frames of a single moving picture.

**Transducer:** A device that transforms one kind of energy into another kind of energy, e.g., an audio speaker which transforms electrical vibrations into sound.

**Transmission:** An electrical or electromagnetic process whereby a properly encoded message may cross space to a decoding apparatus in real time.

**Ultramicroform:** Any microform in which the reduction ratio is greater than 40 to 1.

**Use:** A manner of employing a communication medium, named for the general purpose or objective which it helps to attain. Uses are general and abstract; applications are specific and concrete (see also application, utilization).

**Utilization:** Use at the receiving end of a media system; utilization of communication in an instructional system refers to the manner in which an instructional program is integrated into the whole instructional sys-
tem; that is, how it is coordinated with other instructional activities.

Video file (VTR file): An information storage and retrieval system using video tape as the storage medium.

Video tape: Thin (0.5 to 1.5 mil) acetate or mylar tape of various widths (normally between 1/4 inch and 2 inches), coated with magnetic material, used to record and store video and audio information.

Video tape recording (VTR): A recording system which stores video and audio information by transferring electrical signals directly into a magnetic pattern on the emulsion coating of a thin (usually mylar) tape.
REFERENCES


