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Principles and Techniques of INSTRUCTION

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PRINCIPLES AND TECHNIQUES OF INSTRUCTION

This manual presents basic teaching principles and their application in Air Force teaching-learning situations. The text covers an understanding of how people learn and how they communicate. It discusses various teaching methods and techniques, and ways to evaluate learning and the reasons for such evaluation. The manual is for instructors engaged in OJT and informal instruction as well as those assigned to Air Force schools.

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part one

PROFESSIONAL BACKGROUND

The good instructor knows and understands far more than he actually teaches his students. If he is to understand himself as a teacher, the Air Force instructor needs to understand his own role and responsibilities in the Air Force. If he is to understand his students, the instructor must have some knowledge concerning their learning habits, their patterns of behavior, the many skills required to guide and counsel them, and how to judge their performances. Part One of this text examines some of these areas.

CHAPTER 1

Roles and Responsibilities of the Air Force Instructor

It is no accident that about one-third of all people in the Air Force are in some kind of training. This is a result of our mission to maintain national security through aerospace power. New technical developments create a need for more and better trained people, which in turn, imposes a tremendous responsibility on the Air Force instructor.

Teaching skill must be acquired in one of the largest organizations in the world. Each year the annual expenditures of the Air Force approximate those of General Motors, Standard Oil of New Jersey, American Telephone and Telegraph, United States Steel, and DuPont combined.

Though larger in many ways, the Air Force resembles these great enterprises. At the top levels in civilian industries or in the Air Force, an executive or commander formulates missions

and programs to obtain certain objectives. In a civilian enterprise, the objective is to make profit; in the Air Force, the objective is to maintain peace and the security of our nation. Before any program or mission can be accomplished in either instance, policies must be translated into practices; that is, the working forces—the "doers"—must be trained.

Training is the factor of management that insures standard procedures, overall efficiency, and mutual understanding. It is the medium used by the executive or commander to pass on the why, what, and how of the job to be done.

Marshal Foch, Allied Commander in World War I, made this statement: "No study is possible in battle. One does there simply what he can to apply what he has already learned. Therefore, in order to do even a little, he has to know a great deal and know it well."

These words of Marshal Foch, which were true for the fighting man of 1917, are true for the man who must perform the technical and complex military jobs in the Air Force today.

The Air Force must be ready at all times. This standard of readiness recognizes the existence of an opposing ideology which seeks to conquer and destroy western civilization as we know it. One of the chief deterrents to world communism is our aerospace power, and the effectiveness of the Air Force depends upon the quality of its training. Training, then, assumes a role that is vital to the Air Force and to the free world as well.

Obviously, the Air Force instructor is an important individual. If he is technically competent and an effective teacher, he can multiply his own skill by tens, hundreds, or even thousands. In doing this, he helps insure the readiness of organizations or units to stand the test of battle.

SENSE OF PURPOSE

The first requirement for the Air Force instructor is that he must have a strong sense of purpose. His purposes, if they are to be of value, however, must be definite, worthwhile, and attainable. History and scientific development are rushing forward at an ever-accelerating rate. The sum total of human knowledge is so great that no single mind can encompass all of it. The time is long past when students or teachers can "know everything about everything." Therefore, the Air Force instructor must define his purposes. He must select his target and zero in on it.

When a tactical fighter pilot is firing on a target range, he has a well defined physical object at which he aims. He is trying to hit one physical object with another. For the Air Force instructor, the problem is different. He deals with ideas, insights, and with the application of creative intelligence to complex problems.

How, then, does the Air Force instructor define his purposes? One way is by asking a series of questions about the purpose of the teaching assignment itself: What is the mission of my school? How does the mission of my school tie in with the overall Air Force mission? What is my relationship, as a teacher, to the mission of my school? For what aspects of student learning am I responsible? Finally, how is the subject I teach directly related to the actual jobs my students perform in the Air Force? The instructor must find valid answers to each of these questions. Moreover, he should have the answers firmly in mind before he teaches the first lesson.

Well-defined purposes are of no value, though, unless they are worthwhile. If he is to keep abreast of the rapid developments of aerospace science, the instructor will see to it that every hour and every dollar he devotes to Air Force training will pay off in national security. Of course, some purposes, no matter how worthwhile and definite, are unrealistic if they are beyond the capacities of the students.

There are two characteristics of personality of which the instructor needs to be aware. The first is the individual differences in people. Although people are generally similar in the fundamentals which make them human beings, they are greatly dissimilar in intelligence, insight, imagination, and interest. A second characteristic of personality is that man is complex, not simple. Within himself, each individual varies in many ways—in intelligence, interest, spirit, drive, and imagination, to suggest only a few.

So the instructor has to work creatively with the fact that any one student in his class is a complex combination of strengths and weaknesses, interests and abilities, drives and curiosities. Thus, a student may be excellent in English but poor in mathematics. He may have an overpowering drive to fly an airplane, yet care next to nothing about scientific research. Most ordinary mortals have this kind of personal makeup.

The responsibility of the instructor in regard to purpose resolves itself to this: the instructor's

purposes must be firmly fixed in his mind. They are the goals toward which he must constantly move.

ETHICAL RESPONSIBILITIES

Every profession has its code, its standard of ethical conduct, which forms the basis of public confidence and creates an atmosphere of mutual respect and solidarity within the profession itself.

Ethical standards have always loomed large for members of the profession of arms. The Code of Conduct for Members of the Armed Forces of the United States, prescribed by President Eisenhower in 1955, sets standards for men in combat. It is a series of ethical obligations which are rooted in American ideals and military tradition.

A Code of Ethics for the Air Force Instructor appears at the end of this chapter. This code prescribes educational responsibilities and ideals of the instructor in definite, attainable terms.

The Air Force instructor can be further guided by the code of conduct formulated by the National Education Association. First, teachers are responsible for dealing justly and impartially with students, regardless of their physical, mental, racial, or religious characteristics. Second, teachers should practice integrity and loyalty to other members of the profession. Finally, teachers should give wholehearted support to the programs of their schools.

An ethical principle which all of us can practice is "Do unto others as ye would have them do unto you." At least two good consequences result from the application of this standard of conduct to the job of teaching. To begin with, conformity to this standard enables the instructor to carry on his work in a healthy atmosphere of mutual confidence and respect. And that very atmosphere is conducive to effective teaching on the part of the instructor and to vital learning on the part of students.

LEADERSHIP RESPONSIBILITIES

A third responsibility of the Air Force instructor is to be a leader. The word "education" is derived from the Latin word *educare*, which is a result of the combination of *e*, meaning "out," and *ducere*, "to lead." Ideally, education is a process by which man is "led out," in a quest for greater knowledge, deeper insight, and increased wisdom.

This definition of education poses the difficult problem of determining what an instructor ought to know and do if he is to "lead students out." Part of the answer is to be found in the nature of leadership itself. A good leader gets the most and best from his subordinates, but no effective leader should do his subordinates' work for them. Instead, he should guide, direct, and point the way. It follows, therefore, that instructors must see that students put serious effort into the learning enterprise. Whatever the learning goals are, they can be attained only by application on the part of students. Students must pay a price for learning. That price is work. The instructor-leader will not forget this.

In the final analysis, students learn one by one. Learning is modification and growth that goes on in the individual. Students bear little resemblance to a product that comes off the end of an assembly line. Each student is composed of drives, anxieties, frustrations, abilities, hopes, and potentialities. As such, he is the challenge, responsibility and opportunity of the Air Force instructor.

THE UNITED STATES AIR FORCE INSTRUCTOR'S CODE OF ETHICS

I am an Air Force instructor. I hold a position of public trust in Air Force education. In discharging the duties consequent to that trust,

- I will seek and share the truth.
- I will govern my behavior by those principles which my conscience establishes as ethically sound.
- I will maintain a high standard of professional integrity.
- I will recognize in each student a unique human personality and will strive to help every student reach his highest potential.
- I will deal impartially with students, regardless of their physical, mental, social, racial, or religious characteristics.
- I will strive to broaden my understanding and deepen my knowledge so that I may be a better Air Force educational leader.
- I will contribute to, and loyally support, the educational program of my school.
- I will always be conscious of my privilege and responsibility to preserve and strengthen the United States, its Constitution, and ideals.

SUMMARY

The United States Air Force is a vast organization deployed on a global basis, operating under the constant challenge of a crucial mission. The success with which we accomplish this mission depends to a large extent upon the effective discharge of our responsibilities as instructors. In the light of this mission, emphasis has been placed in this chapter upon the responsibilities of the Air Force instructor.

He must have purposes which are worthwhile, definite, and attainable; he must live and teach by a high standard of ethics; and he must be a leader.

In measuring up to these challenges and responsibilities, Air Force instructors have an opportunity to develop the best in each of his students. The instructor has the responsibility for planning and leading an orderly process of learning growth by which students educate themselves to the limit of their capabilities.

CHAPTER 2

Psychology of Learning

The expert instructor is master of many skills and bodies of knowledge. What he teaches demands extensive competence in subject matter. But how he teaches depends largely on his understanding of how people learn, and his ability to apply that understanding. In large measure this entire text could be viewed as a study of applied educational psychology, for the subject underlies virtually everything with which the instructor is concerned. In this chapter, however, only that branch of psychology dealing directly with learning is considered.

WHAT IS LEARNING?

One of man's outstanding characteristics is that he is a learner. He learns continuously from the time he is born until he dies. To define learning, it is necessary to analyze what happens to the individual. As a result of a learning experience, he may change his ways of perceiving, thinking, feeling, and doing. Thus learning can be defined as a change in behavior as a result of experience. The behavior can be physical and overt, or it can be intellectual or attitudinal, not easily seen. Psychologists generally agree, however, on some characteristics of learning. The instructor should understand these and turn them to good use.

CHARACTERISTICS OF LEARNING

Purposeful

Each student sees the classroom situation from a different viewpoint, because he is a unique individual whose past experiences affect his readiness to learn and his understanding of the requirements involved. If there is an assignment for a practice speech, for example, one individual may respond with a sincere effort to deliver a well organized, meaningful presentation. Another may make minimum preparation and "just talk" for his allotted time, because it is only practice and he feels that it doesn't count. Still another may be afraid of "freezing up," and deliver a memorized speech copied directly from a textbook. The responses differ because each person acts in accordance with the requirements *he* sees in the situation.

From experience and deliberation, most people have fairly definite ideas about what they want to do and achieve. Their goals sometimes are short term, a matter of days or weeks. On the other hand, they may be carefully planned goals for a career or a lifetime. The student brings his purposes and goals into the classroom. Some of his purposes may be unique and others may be shared with his classmates. A student learns from any activity that tends to further his own purposes. His individual needs and notions may determine what he learns quite as much as what the instructor is trying to get him to learn. In the act of learning, the learner's purpose is of paramount significance. The effective instructor seeks ways to relate new learning to the student's goals.

Comes Through Experience

Learning is an individual process. The instructor cannot do it for the student; he cannot pour knowledge into the latter's head. The student can learn only from that which he experiences for himself.

"Learning" and "knowledge" cannot exist apart from a person. A person's knowledge is a result of his experience, and no two people have had identical experiences. Even when observing the same event, two people react differently; they learn different things from it, according to the

manner in which the situation affects their individual needs. Previous experience conditions a person to respond to some things and to ignore others.

All learning is by experience, but it takes place in different forms and in varying degrees of richness and depth. For instance, some experiences involve the whole person; others, only his ears and his memory. Therefore, the instructor is faced with the problem of providing experiences that are meaningful, varied, and appropriate. For example, by repeated drill a student can learn to say a list of words, or by rote he can learn to recite the principles of leadership. But he can make them part of his life only if he understands them well enough to apply them correctly in real situations, which he can do if his learning experience has been extensive and meaningful. If an experience challenges the learner, requires involvement with feelings, thoughts, memory of past experiences, and physical activity, it is more effective than an experience in which all the learner has to do is commit something to memory.

It seems clear enough that the learning of a physical skill requires actual experience in performing that skill. A student learns to fly an airplane only if his experiences include flying one. Mental habits are also learned through practice. If the graduate is to use sound judgment and solve problems well, he must have had learning experiences in which he has exercised judgment and applied his knowledge of general principles in the solving of realistic problems.

Multi-Faced

Later in this chapter, there is a discussion concerning the various kinds of learning—learning skills, learning concepts, learning generalizations, and so on. The separation is an expedient that may seem to suggest that learning is compartmentalized. Actually, the student's full set of learning equipment is always involved.

A student studying radar maintenance may be learning to perform a specific operation, such as changing the radar antennae on a certain aircraft. But in the process, he is learning new concepts and generalizations, perhaps learning new applications of electronic principles. He increases his interest in "black boxes." He learns something about handling electronic equipment in general. So, his experience results in changes in his ways of seeing, feeling, thinking *and* doing, although his instructor may have been primarily concerned with his ability to change radar antennae.

If a teacher sees his objective as being only to train the student's memory or muscles, he underestimates the potential of the teaching situation. The student may have learned much that the teacher had not intended, for the student did not leave his thinking mind or his feelings at home, just because they were not included in the teacher's plan.

Psychologists sometimes classify learning by types: verbal, conceptual, perceptual, motor, problem solving, and emotional. However useful these divisions may be, they are artificial. For example, a class learning to apply the scientific method of problem solving may learn the method by trying to solve real problems. But in doing so, it also engages in "verbal learning," and "sensory perception" at the same time. Each student approaches the task with preconceived ideas and feelings, and for many students these ideas change as a result of experience. The learning process, therefore, may include verbal elements, conceptual elements, perceptual elements, emotional elements and elements of problem solving, all taking place at once.

Learning is multi-faced in still another sense. While learning the subject at hand, students may be learning other things as well. They may be learning cooperation and group dynamics. They may be developing attitudes about the Air Force—good or bad, depending on what they experience. Under a skillful instructor, they may learn self-reliance. The list is seemingly endless. This learning is sometimes called "incidental," but it may have a great impact on the total development of the student.

Active Process

The student does not soak up knowledge like a sponge absorbs water. The instructor can not assume that the student remembers a thing just because he was present in the room when the instructor "taught" it. Neither can he assume that the student can apply what he knows, just because he can quote the correct answer from the book. For the student to learn, he must react and respond, perhaps outwardly, perhaps only inwardly, emotionally or intellectually. But if learning is a process of changing behavior, clearly that process must be an active one.

KINDS OF LEARNING: THE BASIS FOR METHOD

One of the more significant problems that face instructors is that which involves the instructional method. What is the best approach? What technique will best achieve the purposes at hand? These questions can be answered sensibly only if the instructor has a clear understanding of the *nature* of what the student is to learn. Even though the process of learning has many aspects, the main objective or purpose for most Air Force instruction is usually, but not always, the learning of a skill, or of a concept or generalization. In planning a lesson, the instructor needs to understand how students achieve such learning outcomes.

Learning Skills

The process of learning a skill appears to be much the same, whether it is a motor (physical) or a mental skill. Most research on skill development has been in the area of motor skills, however, and this section deals with that type. Before reading further and to provide a real illustration of motor learning, please follow the directions below:

> Write the word "learning" 15 times with your left hand (or with your right hand, if you are left handed). Try to improve the speed and quality of your writing.

In the learning task just completed, several principles of motor learning are involved and are discussed in subsequent paragraphs.

Physical Skills Involve More Than Muscles

The above exercise contains a practical example of the multi-faced character of learning. It should be obvious that, while a muscular sequence was being learned, other things were happening as well. The perception changed as the sequence became easier. Concepts of how to perform the skill were developed and attitudes were changed.

Desire to Learn

Thinking back over his experiences in learning to perform certain skills, the student might be surprised at how much more readily he learned those skills that appealed to his own needs. Shorter initial learning time and more rapid progress in improving the skill normally occurred. Conversely, where the desire to learn or improve was missing, little progress was made. A person may read dozens of books a year, but his reading rate will not increase unless he deliberately sets out to increase it. In the preceding learning exercise, it is unlikely that any improvement occurred unless there was a clear intention to improve. To improve, one must not only recognize his mistakes but he must also make an effort to correct them. The person who lacks the desire to improve is not likely to make the effort. Consequently, he continues to practice his errors. The skillful instructor relates the lesson objective to the student's intentions and needs. In doing so, he builds on the student's natural enthusiasm.

Patterns to Follow

Logically, the point has been emphasized that the best way to prepare the student to perform a task is to provide him with a clear, step-by-step example. Having a model to follow permits the student to get a clear picture of each step in the sequence—what it is, how to do it. Often the instructor himself provides a demonstration, emphasizing the steps and the techniques. Sometimes an outside expert is used, either in person or in a film. In any case, however, the student needs to get a clear impression of what he is to do.

Perform the Skill

Since you have now experienced writing a word with the wrong hand, consider how difficult it would be to tell someone else how to do it. Indeed, even demonstrating how to do it would not result in his learning the skill. Obviously, practice is necessary. The learner needs coordination between his muscles and his visual and tactile senses. Sometimes that requires extensive practice.

There is another benefit of practice. As the learner gains proficiency in a skill, verbal instructions mean more to him. Whereas a long, detailed explanation is confusing before he begins performing, specific comments are more meaningful and useful after he has begun to master the skill.

Knowledge of Results

In learning some simple skills, the student can discover his own errors quite easily. In learning others, mistakes are not always apparent, or the learner may know that something is wrong but not know how to correct it. In any case, the instructor provides a helpful and often critical function when he makes certain that the student knows how well he is doing. It is perhaps as important

for the student to know when he is right as when he is wrong. He should be told as soon after the performance as possible, for he should not be allowed to practice mistakes. It is more difficult to unlearn a mistake and then learn correctly, than it is to learn correctly in the first place.

One way to apprise the student of his progress is to repeat the demonstration or example and to show him the standard against which he can compare his performance.

Progress Follows a Pattern

The experience of learning to write a word with the wrong hand probably confirmed what has been consistently demonstrated in laboratory experiments on skill learning. The first trials are slow, and coordination is lacking. Mistakes are frequent, but each trial provides clues for improvement in subsequent trials. The learner modifies different aspects of the skill: how to hold the pencil, how to execute finger and hand movements, etc.

Graphs of the progress of skill learning usually follow the same pattern. (See Fig. 1) There is rapid improvement in the early trials. But the curve levels off and may stay level for significant periods of effort. Further improvement may seem unlikely. Such a development is a learning plateau and may signify any of a number of conditions. The learner may have reached the limits of his capability; he may be consolidating his level of skill; his interest may have waned; or he may need a more efficient method for increasing his progress. Keep in mind that the apparent lack of increasing proficiency does not necessarily mean that learning has ceased. The point is that, in learning motor skills, a leveling off process is normal and should be expected after an initial period of rapid improvement. The instructor should prepare the student for this situation to ward off discouragement. If the student knows this may occur his frustration may be lessened.

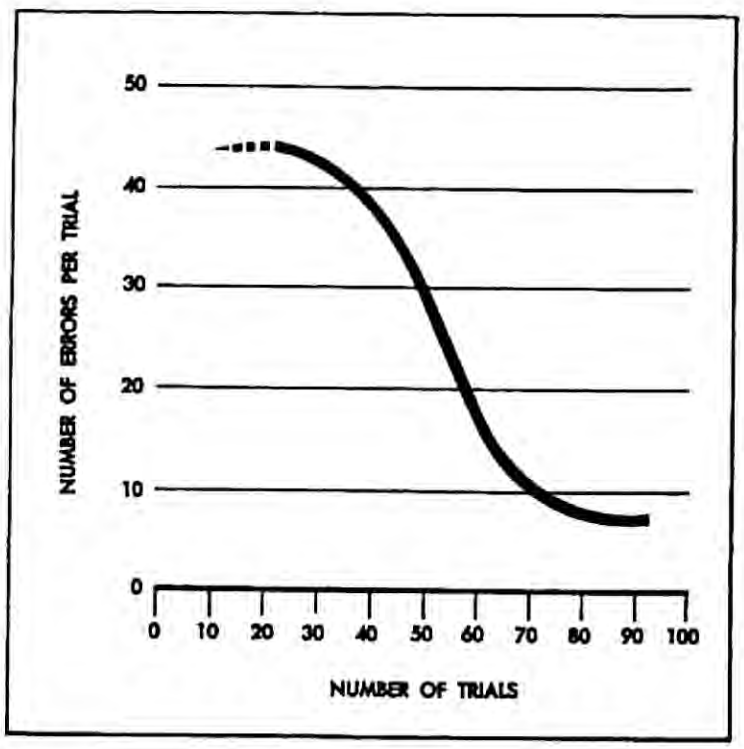


Figure 1. Typical Learning Curve for Motor Skills

Duration and Organization of Lesson

In planning for student performance, a primary consideration is the length of time devoted to practice. A beginning student reaches a point where additional practice is not only unproductive but may even be harmful. When he reaches this point, his errors increase and his motivation may go downhill. But as he gains experience he can profit from longer periods of practice.

Another consideration is the problem of whether to divide the practice period (and perhaps even the instruction) into segments, or whether to plan on one continuous, integrated sequence. The answer depends on the nature of the skill. Some skills are composed of closely related steps, each dependent on the preceding one; for example, learning to parachute out of an aircraft. Other skills are composed of related sub-groups of skills; for example, learning to fly an airplane.

Evaluation vs Critique

If a teacher were to evaluate the fifteenth writing of the word "learning" he could give only limited help towards further improvement. He could judge whether the written word was legible and evaluate it against some criteria or standard. He might even assign it a grade of some sort. But none of these actions would be particularly useful to the beginning learner. He can profit by having someone watch him perform, criticize him constructively, help him eliminate his errors, and explain what he is doing correctly.

In the initial stages, practical suggestions are more valuable to the student than a grade. Early evaluation is usually teacher oriented. It provides a check on teaching effectiveness, it can be used to predict eventual student learning proficiency, and it can help the teacher locate special problem areas. The observations on which the evaluations are based can also identify the student's strengths

and weaknesses, a prerequisite for making constructive criticism.

Application of Skill

The final and critical problem is use. Can the student use what he has learned? It is not uncommon to find that students devote weeks and months in school learning new abilities, and then they fail to apply these abilities on the job. To solve the problem, two conditions must be present: (1) the student must learn the skill so well that it becomes easy, even habitual for him to perform it; (2) he must recognize the types of situations where it is appropriate to use the skill. This second condition involves the question of transfer of learning, which is discussed later in this chapter.

LEARNING CONCEPTS AND GENERALIZATIONS

Teaching for intellectual learning offers a challenge, because this type of learning can be only inferred, not observed. A vast amount of literature on experimental psychology deals with the manner in which people learn concepts and generalizations—the ideas to be known, understood, or even applied. Briefly, a concept is a mental picture of a group of things with common characteristics. A generalization is a person's idea of the relationships between two or more concepts. For example, the definition of learning in the preceding section involves a concept of learning. The characteristics of learning, on the other hand, are generalizations.

A *concept* is an abstract idea about a class of particular things. It involves consideration of the characteristics of those things which identify them as belonging to that special class. Concepts are formed by generalizing one's experiences with a particular thing. Any "thing" that seems to have the identifying characteristics belongs to that class and adds to a fuller meaning of the concept. On the other hand, a new "thing" that is identified as belonging to that class may have a previously unknown characteristic which adds to a fuller meaning of the concept. Concepts represent concrete objects (airplane, book, dog) or abstract ideas (honesty, leadership).

A *generalization* is a statement of relationship, usually of wide application. Ordinarily, it is a statement about the relationship of two or more concepts. For example, a person may have formed the concepts of *jet aircraft* and of *loudness*. Through experience he forms the generalization that "jet aircraft are loud." Not all generalizations are verbalized. A person may develop the generalization that a certain type of situation brings him satisfaction. He may seek out that situation but not know specifically why. (Generalizations are not always true. People sometimes have wrong ideas about the world in which they live.) Natural laws are stated as generalizations. So are the rules or principles of any body of knowledge. The teaching of generalizations is a point of emphasis for educational systems in and out of the Air Force.

How Concepts are Formed

Concept formation is a process of classification, the naming of categories. Through experience, the individual builds up his concept of the characteristics of various categories of things. Consider how a child forms his concept of DOG. First, he learns that the family collie is a DOG. This DOG has four legs, long fur, long snout, short upright ears, and a long bushy tail. It barks and is friendly. It is also quite large (bigger than he is, but smaller than his father). Secure in his notion of DOG, the child then confronts a bull dog and finds he must adjust his concept. Dogs can be of different sizes. They may have short hair and almost no tail. They may have short, ugly snouts. They still bark, are friendly, and have upright ears. Then one day the child learns that there is such a dog as a Mexican hairless. An almost radical change occurs in his concept of DOG, but the resulting picture is a more valid view of the whole class.

Eventually, of course, the child gets a wide range of experiences and his concept of DOG is complete. He reaches the point where he can see new animals and correctly classify them as dogs or not-dogs. He knows a dog when he sees one.

From the foregoing, it is evident that a great deal of concept formation occurs without the specific aid of teachers. Frequently concept formation does not depend on the depth of experience so much as on the width and amount of it. Extensive experience with a wide variety of encounters builds up valid concepts. What then is the role of the instructor?

First, the instructor can identify and organize those experiences which provide the basis for forming the concepts the student needs. That, of course, presumes that the instructor has identified the desired concepts. The instructor helps the

student organize his knowledge and identify the critical features of the concept category. As the student develops greater experience resources to draw on, he reaches the point where he can profit from vicarious experience: by listening to well taught lessons, and by comparing experiences with other students. The key word is "experience." Valid, meaningful concept formation must be based on a hard core of firsthand experiences.

That statement leads to the second function of the teacher. He should actively guard against the student accepting "ready-made" concepts, in other words, simply accepting the description of a concept from another person. The student has no basis of experience for such a concept; he merely memorizes the words and repeats them on occasion. His handicap becomes evident if he is confronted with a new situation involving the concept. Returning to the concept of DOG, the problem might be described thus: "I know that collies are dogs, and pointers are dogs and boxers are dogs, but what is a St. Bernard? He looks like a horse to me!" There is the temptation to believe that the student who can recite the key ideas understands the concepts involved. Unfortunately, this is not necessarily true, a fact that most teachers surely realize. Yet, there are instructors who still try to teach mostly with words and with too few meaningful learning experiences.

How Generalizations are Developed

As with concept formation, generalizations are formed out of the experiences of the learner. In fact, the process of concept formation may proceed at the same time that the learner is developing generalizations about the concepts. It is possible to have a well established generalization in mind, and still be a bit hazy about some of the concepts involved. For example, a person forms the concept that "The republican system of government is better than any other system in the world." But he does not have too clear an understanding of what the concept, "other systems," means. And, for that matter, he has only a general notion of what the concept, "republican system," really means. In this case, the generalization is correct, but the basis for it is not strong. Such a situation is not desirable, but it can happen!

Concept formation depends on the amount and variety of experiences, more than on the depth and significance of them. The development of generalizations requires not only extensive and varied experiences, but meaningful and significant experiences as well. For this reason, the role of the instructor is of increased importance in this area. People develop inaccurate generalizations when they have too little information and experience to use or when they allow their prejudices or biases to influence their interpretation of what they have experienced. They may even wish to believe a particular point of view so strongly that they are misled into accepting it. All of these conditions present challenges to the instructor.

Conceivably, learning may be on the verbal plane only; the concepts may be devoid of meaning. Before reading further and to illustrate this point, please memorize the following generalization:

> Glunders should be delped ordly.

Now, to test your grasp of the principle, please answer the following questions:

> What should be done to "Glunders"?
> How should it be done?

If you memorized the principle well and studied the questions carefully, you probably answered that "Glunders should be delped," and that "they should be delped ordly." Of course, you still do not have the slightest notion of *what* Glunders are, or *how* they are "delped ordly." The concepts are devoid of meaning; therefore the generalization is pointless. It has no applicability to your life or problems. Instructors must be constantly aware of this criterion of meaning.

Meaning in Conceptual Learning

- Reduce the number of concepts and generalizations taught so that the student can thoroughly master what he does learn. There is little point in requiring the student to memorize 100 principles to pass the final test, if he is likely to forget 95 of them as soon as he is graduated. It would be better to teach only 10 principles that the student can learn so well he always remembers and uses them.
- Teach concepts and generalizations "from the ground up." Provide practical and varied learning experiences so that the student can build a solid basis for his concepts. Provide wide enough and significant enough experiences for the student to develop clear and useful generalizations.
- Be constantly aware of the individual differences among the students. Their range of experience and of learning readiness presents a challenge

to the instructor in planning for their individual needs. The good instructor always remembers that his lesson objective is "for *each* student to learn."

"LAWS" OF LEARNING

One of the pioneers in educational psychology was Professor Edward L. Thorndike, Teachers College, Columbia University, New York. Early in this century Professor Thorndike postulated several "laws" of learning. These rules or principles seemed generally applicable to the learning process. In the years since, other psychologists have found that learning is a more complex process than some of these "laws" suggest. While Professor Thorndike's laws seem to have significant exceptions, they still provide an insight into the learning process and are included in this chapter for that reason.

The "laws" that follow are not necessarily as Professor Thorndike stated them. During the years they have been restated and supplemented, but in essence, they may be attributed to him. The first three are the basic laws, as originally identified: the law of readiness, the law of exercise, and the still generally accepted law of effect. The following three laws were added later as a result of experimental studies: the law of primacy, the law of intensity, and the law of recency.

Law of Readiness

A person learns best when he is ready to learn, and he does not learn much if he sees no reason for learning. Getting a student ready to learn is usually the teacher's responsibility. If a student has a strong purpose, a clear objective, a well-fixed reason for learning something, he makes more progress than if he lacks motivation. Readiness implies a degree of single-mindedness and eagerness. When a student is ready to learn, he meets his teacher at least halfway, and this simplifies the teacher's job.

Under certain circumstances, the teacher can do little, if anything, to inspire in a student a readiness to learn. If outside responsibilities, interests, or worries weigh too heavily on a student's mind, if his schedule is overcrowded, if his personal problems seem insoluble, a student may have little interest in learning. Health, finances, or family affairs can overshadow a student's desire to learn.

Law of Exercise

This law states that those things most often repeated are best remembered. It is the basis of practice and drill. The human memory is not infallible. The mind can rarely retain, evaluate, and apply new concepts or practices after a single exposure. A student does not learn touch typing at one sitting. He learns by applying what he has been told, and every time he practices, his learning continues. The teacher must provide opportunities for students to practice or repeat, and he must see that this process is directed toward a goal. Repetition can be of many types, including recall, review, restatement, manual drill, and physical application.

Law of Effect

This law is based on the emotional reaction of the learner. It states that learning is strengthened when accompanied by a pleasant or satisfying feeling, and that learning is weakened when associated with an unpleasant feeling. An experience that produces feelings of defeat, frustration, anger, confusion, or futility in the student is unpleasant for him. If an instructor pilot attempts to teach aerobatic maneuvers to a student on his first flight, the student is likely to feel inferior and to be dissatisfied. As a demonstration that shows the student his goal, the aerobatics might motivate the student. But as something to be learned immediately, the aerobatics would be frustrating to him. In terms of the learning objective, this experience would be unpleasant.

Teachers should be cautious about using negative motivation in the classroom. Impressing students with the seeming impossibility of a problem can make the teaching task difficult. Usually it is better to show students that a problem is not impossible at all, but is within their capability to understand and solve. Whatever the learning situation, it should contain elements that affect the student positively and give him a feeling of satisfaction. Every learning experience does not have to be entirely successful, nor does the student have to master each lesson completely. But a student's chance of success is increased if the learning experience is pleasant.

Law of Primacy

Primacy, the state of being first, often creates a strong, almost unshakable, impression. For the teacher, this means that what he teaches must be

right the first time. For the student, it means that his learning must be right. "Unteaching" is more difficult than teaching. If a new piano pupil learns incorrect finger positions, his teacher will have a difficult task in unteaching the bad habits and reteaching good ones. Every student should be started right. His first experience should be positive and functional so that it can prepare him and lay the foundation for all that is to follow.

Law of Intensity

A vivid, dramatic, or exciting learning experience teaches more than a routine or boring experience. A student of literature is likely to gain greater understanding and appreciation of the play *Macbeth* from seeing it performed than from merely reading it. He can learn more about fire-fighting from watching someone fight a fire than from listening to a lecture on the subject. The law of intensity, then, implies that a student will learn more from the real thing than from a substitute. Since the classroom imposes limitations on the amount of realism that can be brought into teaching, the teacher should use imagination in approaching reality as closely as possible. Mockups, colored slides, movies, filmstrips, charts, posters, photographs, and other audio-visual aids can add vividness to classroom instruction. Demonstrations, skits, and panels do much to intensify the learning experiences of students.

Law of Recency

Other things being equal, the things most recently learned are best remembered. Conversely, the farther a student is removed time-wise from a new fact or understanding, the more difficulty he has in remembering it. It is easy, for example, to recall a telephone number dialed a few minutes previously, but it is usually impossible to recall an unfamiliar number dialed a week earlier. The teacher recognizes the law of recency when he carefully plans a summary for a lesson or an effective conclusion for a lecture. He repeats, restates, or reemphasizes important matters at the end of a lesson to make sure that the student remembers them. The law of recency often determines the relative positions of lectures within a course of instruction, and it is followed in scheduling briefings immediately before missions.

All the laws of learning are not apparent in every learning situation. These laws manifest themselves singly or in groups, and for purposes of this text, it is not necessary to determine which law operates in what situation. However, if a teacher understands the laws of learning, he can deal intelligently with motivation, participation, and individual differences, the three major factors affecting learning.

FACTORS THAT AFFECT LEARNING

Motivation

The factor that has perhaps the greatest influence on learning is motivation, the force that causes a person to move toward a goal. This force can be rooted in any or all of the personal-social needs of the student; for example, the need for security, for new experience, for recognition, for self-esteem, for conformity, or the need to help others. Such needs compel people to act, to move, to start working toward an objective, or to achieve a purpose. The teacher's responsibility is first to recognize and identify these needs in his students and then to seek ways of satisfying them through his teaching.

To be successful, the student must have a need to know, to understand, to believe, to act, or to acquire a skill. The wise teacher realizes that these needs are not separate and distinct from the personal-social needs of the student. The teacher must make students want to learn, and in some cases, must remove obstacles that students have placed in the paths of their own learning. The student must have a reason for learning, and if he cannot find it for himself, the teacher must find it for him.

A need to learn presupposes goals or objectives. If the motivation is right, the student knows what these goals are and how he can reach them. In the learning situation, the teacher usually establishes a clear and specific objective for the students. Without an objective, neither the student nor the teacher can measure progress or evaluate achievements.

Illustrations of weak and strong motivations are all around us. Consider, for example, the student who attends a required course in communications-electronics without any prospect of using what he studies. Since his interest in the course is academic and communications-electronics has nothing to do with his job or his future, it is difficult for him to learn much from the course. If, on the other hand, a student knows that at the end of this same course he will be assigned to a job requiring the

knowledge of communications-electronics, he has a goal. He can partially satisfy his need for recognition, for security, for self-esteem, and for a new experience by mastering the course material. In this latter instance, even though the need and the desire to know are built in, the student needs and wants to know the objective of the course and to believe that he can reach it.

In meeting his responsibility to motivate learning, the teacher can capitalize on whatever built-in motivations he finds in his students. The big challenge is to shape personal-social motivations to make them serve the learning situation. The teacher must first establish learning objectives and then activate forces that cause the student to work toward them. This is motivation.

Participation

Students learn best when they are active. Participation in a lesson is action. This action profoundly influences learning. Because the competent teacher realizes that idleness, either mental or physical, is detrimental to learning, he plans a variety of activities for his students. Activity takes many forms: thinking, listening, observing, recalling, reasoning, generalizing, imagining, writing, discussing, answering, questioning, believing, disagreeing, feeling, touching, moving, doing, and speaking. All of these help the student learn.

Whatever the activity, the effective teacher makes sure that his students have something to do. There is a correlation between doing and learning. How much a student learns is in direct ratio to how much he does, or how much he becomes involved in what he does. Stated simply, the more of the five sense a student uses to learn something, the more effective his learning will be. Consider flag-folding as an example.

A student can learn how to fold a flag simply by reading about it. He cannot, however, learn this skill as effectively as he could if, in addition to reading about it, he has someone explain it to him. The instruction could go a step further to provide a demonstration of flag-folding. Following that, the student might actually fold the flag. In each step of the instruction he uses another sense, adds another dimension, and consequently learns more. Finally, he might be asked to write all he knows about flag-folding, or better yet, to teach someone else how to fold a flag. In this complete sequence, the student progressively uses as many senses as can be used in learning to fold a flag.

This kind of participation can make learning permanent. A student who is required to think imaginatively and reflectively learns more than one who merely absorbs knowledge passively. A student who learns through his senses of touch, taste, sight, sound, and smell, learns better than if he learns through one sense alone. If a student reads something, then thinks about it, questions it, writes it down, talks about it, and listens to what others say about it, his learning is more effective than if he merely reads and stops there. Since participation improves learning, it is the teacher's responsibility to make participation possible.

A teacher can encourage students to take notes. He can pose problems and require solutions. He can assign writing, reading, and research projects; form discussion groups; invite disagreements; and require students to evaluate one another's work. All of these are forms of participation that enhance the student's chances of learning success.

Individual Differences

A new teacher may be discouraged when he discovers that a well-planned lesson does not teach all of his students with equal effectiveness. However, he soon sees that this is a natural and predictable state of affairs. Students seldom learn at the same rate. Differences in rates of learning are based on differences in native intelligence, background, experience, interests, desire to learn, and countless other psychological, emotional, and physical factors. That students are different is a fact that teachers must recognize as influencing how much can be taught at what rate and when.

Since students do not learn at the same rate, it follows that the levels of student understanding are not the same at any given moment. In other words, all students do not learn the same thing to the same degree. The teacher must determine the individual levels of understanding, how much each student learns. Otherwise, he cannot know how well he has taught, whether or not his job is finished, and what he should do next.

The teacher can measure a student's understanding or mastery of a lesson in several ways. Student discussions are helpful and generally reliable. A study of test and achievement scores sometimes provides objective assessments. Personal conferences, contacts in the classroom, writ-

ten assignments, and informal talks can also indicate a student's progress.

Once he has determined the individual differences, the good teacher attempts to compensate for them. He tries to equalize the different levels of understanding. Ideally, he raises the level of some students without retarding the progress of others. This is one of the great challenges of teaching, and a teacher can meet it in a number of ways.

The teacher can plan semi-independent classroom activities in which the student works alone or as a part of a small group. The teacher is available to give help, but only when requested or needed. The student works on his own, aware that help is there if he needs to call for it.

The teacher can provide for supervised study, which requires his presence and guidance. The teacher gives personal and individual instruction where needed. This often reaches students who are hesitant to speak out in the presence of their classmates, but feel free to talk with their teacher. A student sometimes has special problems that do not concern the class as a whole, and certain students will not air their problems before a group. Supervised study gives these students a chance to deal with their problems in private. By using this device, a teacher frequently discovers that what a student considers a special or unusual lack of understanding is not special or unusual at all but common to the group.

The teacher can compensate for individual differences through flexible assignments in which the workload is adjusted to the capabilities of individual students. When circumstances permit it, this plan creates an ideal learning situation in which each student progresses at his own pace. Assigning the same work to every student has its pitfalls. It can push the poor student beyond his capability and, at the same time, fail to offer the capable student a challenge. Through flexible assignments tailored to individual capabilities, the teacher can capitalize on the specialized interests and aptitudes of all students.

The teacher who is not aware that students learn at different rates, that no one lesson has the same effect on everybody, that individual reasons for learning are different, finds himself in a quandary whenever he fails to meet the objectives of the lesson. In every normal classroom he finds the daydreamers and the idealists who respond best to ideas and abstractions. He is confronted with the student who likes experimentation and demonstration for what it proves on the spot rather that for its contribution to a universal truth. Some students want to *do* more than they want to *know*. Some are in a hurry and others refuse to be rushed. Some are practical and others, impractical. Some want to recite, whereas others are content to listen. Some like to write, and others find writing a drudgery. The differences are endless. Yet the teacher must teach the same lesson to a group of students with these countless differences, and attempt to achieve the same objective for all.

RETENTION

This section and the next deal with two related aspects of the learning process: permanency of learning and transfer of learning. In some ways it is difficult to separate the two. Generally, transfer of learning means taking a thing out of its learning environment, and using it in another situation. Obviously, a student cannot transfer his learning to a new situation unless he remembers it. Therefore, what the instructor does to help a student remember also helps him to transfer his learning.

Theories of Forgetting

A consideration of why people forget may point the way to helping them remember. Several theories account for forgetting.

DISUSE. It has long been argued that a person forgets those things which he does not use. The high school or college graduate is saddened by the small amount of factual data he retains several years after graduation. Since the things he does remember are those he uses in his job, he concludes that forgetting is the result of disuse. But the explanation is not quite so simple. Experimental studies show, for example, that a hypnotized person can describe specific details of an event which he is not normally able to recall. Apparently the memory is there, locked in the recesses of the mind. The difficulty is in summoning it up to conscious thought.

INTERFERENCE. One theory holds that people forget a thing because a certain experience has overshadowed it, or that the learning of similar things has intervened. This theory might explain how the range of experiences after graduation from school causes a person to "lose" knowledge.

In other words, new events displace many things that had been learned. From experiments, two conclusions about interference may be drawn: (a) Closely similar material seems to interfere with memory more than dissimilar material. (b) Material not well learned suffers most from interference.

REPRESSION. Freudian psychology advances the view that some forgetting is due to the submersion of ideas into the unconscious mind. Material that is unpleasant or produces anxiety may be treated this way by the individual, but not intentionally. It is subsconscious and protective. The repression theory does not appear to account for much forgetfulness of the kind discussed in this chapter, but it does tend to explain some cases.

Retention of Learning

Each of the above theories implies that when a person "forgets" something, it is not actually lost; rather it is unavailable for recall. The teacher's problem, then, is how to make certain that the student's learning is always available for recall. The following suggestions can help.

- Teach thoroughly and with meaning. Material thoroughly learned is highly resistant to forgetting. This is suggested by expermental studies; it is also pointed out in the sections on skill and concept learning. Meaningful learning builds patterns of relationship in the student's consciousness. Whereas rote learning is superficial and is not easily retained, meaningful learning goes deep, because it involves principles and concepts anchored in the student's own experience.
- Help the student understand a reason for remembering. A desire to remember increases the chances of remembering. It follows, then, that a lack of such a desire increases the chances of forgetting.
- Help the student develop good study habits. Just as the teacher should teach meaningfully, the student should be encouraged to study for meaning, not just for rote memory. The student should apply himself toward thorough understanding and proficient skills.
- Help the student to develop an organized program of review. Short spaced periods of review, recitations, and quizzes are helpful. Frequent opportunity for practice is probably the best of all.

TRANSFER OF LEARNING

During a learning experience, the student may be aided by things he has learned previously. On the other hand, it is sometimes apparent that previous learning interferes with the current learning task. Consider the learning of two skills, A and B. If the learning of A helps to learn B, positive transfer occurs. If learning A hinders the learning of B, negative transfer occurs. For example, the learning of addition probably helps the learning of multiplication; learning how to shoot a bow and arrow may help to learn how to shoot a rifle. On the other hand, learning to drive an automobile in U. S. traffic may hinder learning to drive in British traffic, because Britons drive on the left side of the road. For some people, the study of Spanish first makes it more difficult to learn French. Perhaps it should also be noted that the learning of B may affect the retention or proficiency of A, either positively or negatively. While these processes may help to substantiate the interference theory of forgetting, they are still concerned with the transfer of learning.

It seems clear that some degree of transfer is involved in all learning. That is so because, except for certain inherent responses, all new learning is based upon previously learned experience. People interpret new things in terms of what they already know.

Many aspects of teaching profit by this type of transfer. It may explain why students of apparently equal ability have differing success in certain areas. Negative transfer may be hindering the learning of some; positive transfer may be helping others. This points to a need to know more about each student, what his past experience has been, what he has already learned. In lesson and curriculum planning, instructors should plan for transfer by organizing course materials and individual lesson materials in meaningful sequence. Each phase should help the student to learn what is to follow. Materials should not be placed in a sequence that will jeopardize subsequent and more complex learning.

The student is frequently confronted with the need to adapt what he has learned to situations that differ from the original learning experience. The purpose of any Air Force school is to prepare its students to function in the situations they will face after they are graduated. A school can sel-

dom simulate completely all the conditions that the student will meet. Therefore, the instructor must teach in such a manner that the student can use what he learns even when conditions change.

The cause of transfer and how it operates have not yet been identified and explained. But no one disputes the fact that transfer does occur. The significance of this ability for the instructor is that he can and should help the student achieve it.

The following suggestions are representative of what educational psychologists believe should be done:

- Plan for transfer as a primary objective. As in all areas of teaching, the chance for success is increased if the teacher deliberately plans to achieve it.
- Make certain that the student understands that what he learns can be applied in other situations. Prepare him to seek other applications.
- Insure thorough, high-order learning. Overlearning may even be appropriate. The more thoroughly the student understands the material, the more likely he is to see its relationship to new situations. Avoid rote learning, for it does not foster transfer.
- Provide meaningful learning experiences that build the student's confidence in his ability to transfer learning. This suggests activities that challenge him to exercise his imagination and ingenuity in applying his knowledge and skills.
- Use instructional materials that help form valid concepts and generalizations. Use materials that make relationships clear.
- Educate the student to use discrimination and judgment in the application of his generalizations.

SUMMARY

This chapter is no more than an entry-level look at the field of educational psychology, which contains many significant areas. The chapter itself is but a summary of one area: learning.

Learning is a change in behavior as a result of experience. Learning is purposeful and comes only through experience. Learning is multifaced; the learner's full set of learning equipment is always involved. Learning is an active process.

In planning for teaching, the teacher should use methods which reflect the nature of what is to be learned. There are definite principles involved in the learning of skills; nine of them are described. The learning of concepts and generalizations depends on a broad range of student experience and careful guidance by the teacher.

The laws of learning provide useful insights into the learning process. The law of effect is especially significant—it states that learning is strengthened when accompanied by satisfying or pleasurable conditions.

A knowledge of the laws of learning helps the teacher to understand and to take advantage of three factors that affect learning: motivation, participation, and individual differences. The student must have a need to know, to understand, to believe, to act, or to acquire a skill. All of these needs, which make up motivation, are inseparable from the personal-social needs of the student. A student learns best when he is active, when he participates. When purposeful activity is associated with learning, it makes the learning more permanent. Because of differences in experience; background; intelligence; interests; desire to learn; and psychological, emotional, and physical factors, students learn at different rates. The teacher must recognize these individual differences and gear his teaching to reach all students, whatever their capabilities and abilities.

The central questions in education deal with retention of learning and transfer of learning. Disuse, interference, and repression may account for forgetting. Transfer of learning is involved either when the learning of one task affects the learning of another, or when the learner adapts what he learns for use in new situations. The key to both is thorough learning of a relatively few really important concepts and generalizations. This leads to meaningful learning, anchored in the student's experience.

CHAPTER 3

Guidance and Counseling

For a school program to be effective, all activities relating to the learning situation must be integrated and organized to support each other. A workable guidance and counseling program is essential to a strong educational program. An efficient program helps the student adjust to the learning environment, directs him toward the attainment of his goals, and helps educational planners shape curricula to meet student needs.

GUIDANCE PROGRAM

Air Force schools follow a systematic process in providing students with certain services to help them adjust to their environment and to make intelligent decisions. To serve the needs of the student and the best interests of the Air Force, these guidance activities are coordinated into a well-planned and clearly defined program.

Characteristics of Good Guidance

An effective guidance program should have certain characteristics. Familiarity with these characteristics is an aid to understanding the purpose and scope of the guidance program in the Air Force.

First, guidance is a service. Its function is not to teach; instead, the program helps the student by enabling him to solve his personal problems so that he is free to devote his attention and efforts to his studies.

Second, guidance serves all students. A good guidance program reaches and assists every student in the school. Its services are not confined to the poor student and the student with serious emotional problems. In fact, the program should not be identified with the problem student. If it is, other students may hesitate to seek help for fear of being classified as inferior students.

Finally, guidance services are supplied by many people. The guidance program is not the exclusive responsibility of instructors, counselors, administrators, and specified members of the evaluation and curriculum planning staffs. Specialized problems are often referred to personnel such as medical officers and chaplains who are part of the overall guidance effort.

Goals of Guidance

The guidance program in the Air Force must deal with the actual needs of students. The immediate objective is the increased ability of the individual student to cope with his own problems. By strengthening the individual student, the program ultimately strengthens the capabilities of the entire Air Force. In striving toward this broad objective, guidance personnel keep three goals in mind: to identify student needs, to meet these needs, and to insure continuing benefits to individual members of the Air Force.

DETERMINING STUDENTS' NEEDS. Civilian schools determine their students' needs to help each student make intelligent decisions about his educational program, his social activities, and his future occupation. Air Force schools are also concerned with these problems. But they must always consider the best interests of the Air Force, as well as those of the student. This additional requirement places a heavy responsibility upon the Air Force guidance program—to satisfy the needs of the students and at the same time meet the objectives of the Air Force. The scope of the guidance program in any Air Force school is determined largely by the length of the course, the mission of the course, and the relation of the subject matter of the Air Force mission.

MEETING THE NEEDS. When working in the guidance field, instructors must not make decisions for their students. Instead, they must see that the students become well enough informed to make their own decisions. Giving a student too much help is as bad as not helping him at all. The over solicitous instructor is likely to make the student dependent rather than self-reliant.

INSURING CONTINUING BENEFITS. Any course of action suggested to a student should be based upon careful consideration of his abilities, aptitudes, and career interests. The student's service record provides valuable information on his background and interest. A system for recording data on each individual is an essential part of every efficient guidance service. In combination, all the records on an individual provide a complete study of his development. These records can be useful to guidance personnel who are responsible for assessing the student's growth, achievement, and potential, and for helping him develop his latent abilities.

Guidance Services

The services offered by a guidance program vary from one Air Force school to another. These services are tailored in each instance to fit the objectives of the school and the needs of its students. Frequently included are such services as orientation, individual inventory, career information, referral, followup, and counseling.

ORIENTATION. When a student enters a school, he is faced with many problems. Often he is away from his permanent duty station and must orient himself to new surroundings. He must make friends and learn the rules under which the school operates. Sometimes, he is unsure of his ability to handle the academic situation. Through an effective orientation program a student is helped to understand course requirements, to learn school policies and procedures, to meet fellow students, and to gain a sense of purpose and belonging. The orientation program meets these objectives through carefully planned and prepared briefings given by staff and faculty members, and written instructions which guide the student as he adjusts to the school situation. The orientation program also offers assistance to new instructors.

INDIVIDUAL INVENTORY Through the guidance program there is a continuing evaluation of each student's aptitudes, interests, potential, and performance. This information is a basis for effective counseling. In addition, it is available to instructors as a means of gaining the greatest possible understanding of their students. Those persons responsible for the guidance program must determine what types of evaluations are needed and must make arrangements and schedules for obtaining them. These same people must also establish a system for disseminating the information to instructors and counselors.

CAREER INFORMATION. By collecting and disseminating all current information on matters relating to career areas, guidance program personnel help students make intelligent choices about their careers in the Air Force. The centralization of this responsibility in the guidance program insures the student more reliable and up-to-date information than each instructor would be able to collect on his own.

REFERRAL SERVICES. Sometimes students have problems that lie in areas beyond the instructor's field of knowledge. For example, students may need medical or legal assistance. Such special cases should be referred to professional personnel capable of handling them. Doctors, lawyers, chaplains, personal and family service officers, Red Cross personnel, educational advisers, and other specialists are normally available on an Air Force base. Knowing what services are available, knowing where and how to obtain them, and establishing and maintaining good working relations with the individuals or organizations concerned is another service of guidance program personnel.

FOLLOWUP. The guidance program of each school should have a system of followup contacts with organizations to which its graduates are assigned and with the graduates themselves. On the basis of information from these sources, the school can determine how well it is fulfilling its mission. If these sources indicate a need for new material or the obsolescence of a particular phase of the course, the school can change its curriculum as necessary to give future students the knowledge they will actually need on their jobs.

COUNSELING. Counseling occurs in every situation which brings the individual student and the faculty member together for the purpose of helping the student solve a problem. This service is a primary factor in determining the success of any guidance program. For that reason, the next section of this chapter discusses counseling in some detail.

COUNSELING: KEY TO SUCCESSFUL GUIDANCE

Counseling employs techniques and relationships that differ from those used in the classroom. All counseling sessions must be skillfully conducted to insure a successful guidance program. Since effective guidance depends on the quality of the counseling available and since instructors usually do much of this counseling, they must understand the purpose, nature, and practice of counseling.

Purpose of Counseling

In the Air Force school the primary purpose of the counseling program is to make students more effective learners by helping them cope intelligently with their own problems. The effective counselor can do much to promote a pleasant, relaxed learning situation. The effect of a pleasant atmosphere on learning is discussed in the chapter on Human Relations.

Responsibility for Counseling

Industry, civilian colleges, large public schools, and many other enterprises use specially trained counselors to help their people with personal problems. Some experts believe serious counseling should be attempted only by people with special training, facilities, and responsibilities for counseling. Others believe that the teacher—who has daily contacts with the student, who knows the student's habits, who can see significant changes in the student's behavior—is in an ideal position to give the student valuable counsel.

The Air Force has few counseling specialists in its schools. It places the responsibility for counseling directly on instructors and supervisors. For this reason, the Air Force instructor must understand his role as counselor in the educational program and must master the techniques that help him fill that role.

Requisites of a Good Counselor

The counselor's attitude must motivate the student to cooperate. He must be able to inspire the student's acceptance of him as a desirable individual, as a person worthy of authority, and as a leader in his profession. A sincere desire to help the student is a primary requisite of the counselor. But this is not enough; other qualities are essential. The counselor must understand human behavior. He must be able to listen patiently, without prejudice, to the student's confidences. He must be able to communicate his advice, ideas, and suggestions so that the student has no doubt about his meaning.

Approaches to Counseling

The counselor must understand behavior if he is to select the best approach to each counseling session. Two extreme approaches and one middle course are available. The counselor should be familiar with the three approaches so that he can shift from one to the other as the occasion demands. He should avoid stereotyped counseling, because no two students react in exactly the same way to similar circumstances or problems. Each counseling session presents its own unique challenge, and the counselor must determine which approach will best accomplish its purpose.

DIRECTIVE APPROACH. This approach is counselor-centered. Edmund G. Williamson, University of Minnesota, a leader of the "directive school," defines counseling as one of the personal and individual processes designed to help a student learn school subject matter, citizenship traits, social and personal values and habits, and all the other habits, skills, attitudes, and beliefs which make up a normally adjusted human being. He further states that counseling helps individuals to eliminate or modify those disabilities which are obstacles to learning, and includes all efforts on the part of both counselor and student to face, clarify, and solve immediate problems.

In their book, *Student Personnel Program: Its Development and Integration in the High School and College,* Maurice and Jeanne Woolf state that these assumptions underlie all directive counseling: (1) it is essentially an intellectual process; (2) maladjustments in normal persons leave a large percentage of the mind intact and therefore the mind can be used in learning or relearning; (3) the counselor has superior information and experience and is competent to give advice concerning the manner in which a problem can be solved.

The advocates of directive counseling lay great stress on diagnosis. The counselor assumes the initiative and responsibility for the success of the counseling session. In attempting to direct the student toward a solution of his problem, the counselor draws upon the information available to him through the student's records, his own knowledge of behavior patterns, and his own experience. Though the method is termed the "direc-

tive approach," its objectives remain "student-centered." Like other counseling methods, it requires that the counselor be fully accepted by the student if the session is to be successful. As the specialist, the counselor saves time by providing pertinent data and analysis. The counselor may advise the counselee; he may try to persuade the counselee to take a certain action; or he may explain the situation, offering neither advice nor persuasion.

A basic doctrine of directive counseling is that an individual needs aid from an outside source to develop his full potential. Williamson argues for "open and frank efforts to influence the student to become one kind of individual rather than another." Each individual needs external information to understand himself in terms of other persons around him. Directive counseling helps him to do this.

NONDIRECTIVE APPROACH. In this approach, the student is encouraged to talk, to purge himself of troubles, to clear his mind. Carl Rogers, the spokesman for the nondirective or client-centered counseling approach, defines counseling as a process by which an individual attempts to deal with some of his own problems while in relationship with another person who is trying to help. The goal of student-centered counseling is to help the student become more mature and more self-actuated. The student has to move forward in a positive and constructive way by using his own resources and potential. This is accomplished by removing emotional blocks and releasing positive forces for growth.

As Rogers states, "I don't think you help a student because you have a folder of information on him; I think you help him because of a relationship." Information collection has a place in student-centered counseling when it is for specific research purposes. The counselor does not work from external data or from an external framework. He seeks to enter and experience the private and subjective world of the counselee. Empathy is the key which unlocks the counselor's understanding of the student and the student's understanding of himself.

In the nondirective approach process, diagnosis by the counselor is avoided because diagnosis places the counselor in the role of an expert, an evaluator, and an authority. A diagnosis which has value for the counselee is a diagnosis performed by the counselee himself, on the basis of a more accurate perception of himself. Therefore, the nondirective approach stresses the importance of the counseling relationships, acceptance of the counselee, and counselor listening more than performing counselor direction. The main disadvantage of this approach is that it frequently demands more time than is available.

COANALYSIS APPROACH. This midway approach has the advantages of the other two, and in addition, it offers the counselor greater flexibility. It provides an opportunity for joint diagnosis. The student and the counselor work as a team to diagnose and solve the student's problem. This approach can succeed if the student accepts the counselor and is eager to help solve his own problems.

Counseling Techniques

Before beginning a counseling interview, the instructor should gather and study all data available on the student. If possible, he should memorize the significant information so that during the interview he will have no need to refer to notes and records. A display of written records can have an inhibiting effect on the student.

The setting for the counseling session should be satisfactory to the student as well as to the counselor. It is essential to have a place that discourages interruptions and removes the student from general view so that he does not feel conspicuous. Privacy is a great help in overcoming the student's inhibitions.

The seating arrangement, lighting, and physical surroundings should make the student feel comfortable and at ease. Extremely bright lighting can annoy the student, and very dim lighting can make him feel insecure. Placing a timid, withdrawn student on a level that is higher than that of the counselor sometimes has the psychological effect of making the student feel important. Conversely, in disciplinary cases, it is sometimes just as important for the counselee to be on a lower level, to achieve the opposite effect.

ESTABLISHING RAPPORT. One of the most important elements of counseling is the initial phase of the meeting. Time spent in establishing the student's confidence, giving him a feeling of well-being, and showing interest in him as an individual is not wasted. In fact, the time devoted to establishing and maintaining rapport actually saves time in the long run. Topics of common interest; the student's achievements, strengths, and hobbies;

current events; personal likes and dislikes; and family matters can be explored in the opening phase of a counseling session.

The counselor should not reveal his own attitudes and opinions before the student knows and trusts him. To do so might influence the student to say what he believes the counselor wants to hear, rather than what he himself thinks. Such responses from the counselee can obscure the real problem which is the reason for the counseling session.

GATHERING INFORMATION. The early part of the interview should be devoted to seeking facts. The counselor can get more information of the type he needs if he asks questions that require more than yes or no answers. In giving extended responses, the student has a chance to talk, to participate actively, to feel that he is helping himself. These responses give the counselor insights into the student's personality, attitudes, and reactions. The responses also provide clues to possible ways of leading the student to his own solutions.

The counselor should not interrupt the student to check minute facts. He should allow the student to express his thoughts in his own words with as few interruptions as possible. The counselor should talk only when the student is unable to proceed, when he is confused or lost in detail. An interim summary or a helpful question is sometimes all that is needed to redirect the student so he can continue.

CLOSING THE INTERVIEW. The counselor must be sure that the student leaves the interview with a feeling of accomplishment and confidence that he is welcome to return.

Students are often troubled by problems that are not academic. Since these problems can affect a student's learning, their solution is important. The instructor must recognize his own limitations and turn to other agencies when they are needed. Psychiatric, family, financial, religious, and other special problems frequently are highly specialized. For that reason, the instructor must direct the student to experts who can help him. Turning to highly specialized individuals or referral agencies for additional aid is an acceptable and profitable procedure. It frees the instructor to perform his normal counseling duties on educational problems, it keeps him from becoming involved in problems beyond his scope and capabilities, and it usually results in more satisfactory student adjustments.

When a student receives assistance from some outside source, the instructor is still responsible for following up to determine how well the student is adjusting. The instructor needs to stay in close contact with the student to be sure that the problem no longer makes learning unduly difficult or impossible. A tactful display of interest assures the student that the instructor has his welfare, morale, and well-being at heart.

KEEPING RECORDS. Counseling records should be compiled and retained for reference and continued use in the guidance program. It is unwise to record data throughout a counseling interview, since this practice tends to inhibit the student. The wise counselor makes his notes afterwards. A brief resumé including the date, major problems, suggested course of action, and student decisions is generally sufficient. It is essential, of course, that the counselor honor all of the student's confidences.

SUMMARY

The guidance programs of the schools of the Air Force are implemented by the assigned staff and faculty. These educators advise students on educational and some personal problems. When a student has a complex problem in an area beyond the training and experience of the educator-counselor, he is referred to individuals or agencies with special qualifications in that problem area.

The objectives of the Air Force guidance program are to identify the student's problems, to find solutions for these problems, and to assure the student of continuing helpful guidance as he progresses in his career. By meeting these goals, the program removes personal hindrances to individual academic achievement. This result, in turn, helps insure a highly trained and capable Air Force.

To help students handle their emotional, financial, legal, and other personal problems, the Air Force guidance program offers services of many types. The services most commonly offered are orientation to the new school environment, personal evaluation, career information, referral, followup, and counseling.

Counseling services are the heart of every good guidance program. The instructor-counselor in the Air Force guidance program is responsible for knowing his students and recognizing evidences of personal problems that hamper learning. As the person who initiates counseling activity, the instructor must be a trustworthy individual with

a genuine interest in the welfare of his students. He must have patience, objectivity, and above-average ability as a communicator.

The counselor may use three approaches to counseling sessions: the directive, the nondirective, and the coanalysis. Since each of these approaches is appropriate in certain situations, the counselor must use good judgment in choosing his approach to each session. A competent counselor can establish good rapport with the student, ask questions that elicit useful information, and close the interview on the right note. His records of the significant findings and results of counseling interviews are valuable references. The instructor uses them in following the progress of his students to make sure they are sufficiently in control of their personal problems to give their best efforts to learning.

CHAPTER 4

Instructor as a Critic

Among the many skills an instructor possesses, none is more important than his ability to analyze, appraise, and judge the performance of his students. The student quite naturally sees his instructor as a critic and looks to him for guidance, analysis, appraisal, suggestions for improvement, and encouragement. Criticism in the classroom is recurring and constant, but sometimes it is formalized, put into a structure, scheduled as part of a class period, and dignified with the title, *critique*. It is with criticism in such form that this chapter is concerned.

A classroom critique may be either oral or written. It should come immediately after a student's individual or group performance, while the details of the performance are easy to recall. An instructor may critique a speech, a problem-solving exercise, a demonstration, a written report, a practice teaching lesson, a physical maneuver, a mechanical assemblage, a repair operation, a driving test, or any other activity which a student performs or practices to improve his skill, proficiency, and learning. A critique may be conducted in private or before the entire class. A critique presented before the entire class can be beneficial to every student in the classroom as well as to the student who performed the exercise or assignment.

Two common misconceptions about the critique should be corrected at the outset. First, a critique is not a step in the grading process, and should be considered apart from it. It is a step in the learning process before formal measurement takes place. Second, a critique is not necessarily negative in content. It considers the good along with the bad, the whole in terms of its parts, or the parts in relation to the whole, or to each other. A critique can be as many sided and varied in content as the performance.

PURPOSE OF A CRITIQUE

A critique should improve the student's performance and should give him something constructive with which he can work and on which he can build, some direction and guidance to raise his level of performance. The student must understand the purpose of the critique. Otherwise, he cannot accept the criticism offered, and little improvement can be expected.

A critique can be used as a re-teaching device. Not all critiques lend themselves to re-teaching, but the instructor should be alert to the possibilities and take advantage of such an opportunity when it arises. If, for example, several students falter when they reach the same step in a weapon assembly, the instructor might recognize a need for re-explaining, or re-demonstrating the step, or giving it special emphasis in the critiques of subsequent performances.

CHARACTERISTICS OF AN EFFECTIVE CRITIQUE

Objectivity

The effective critique is focused on the student and his performance, and should not reflect the personal opinions, likes, dislikes and biases of the instructor. For example, if a student demonstrates a complicated wiring sequence, it would hardly be fair to criticize his personality traits unless they interfered with the performance itself. If a student makes a speech and expresses views that are at odds with the instructor's beliefs, the speech can and should be criticized on its merits, and not according to the way in which the views pleased or displeased the instructor.

"Error of halo" is a danger in criticism just as it is in evaluation. Critiquers sometimes permit their judgments to be influenced by their general impressions of the student, favorable or unfavorable. Sympathy for, or over-identification with, a student can be a barrier to objectivity. A conflict of personalities can unwittingly color an opinion. If a critique is to be objective, it must be honest; it must be based on the performance as it was, not as it could have been or as the instructor and student wish that it had been.

Flexibility

Obviously, a critique cannot be made until the performance is finished. Sometimes a good student will turn in a poor performance, and a poor student will turn in a good one. A friendly student may suddenly become hostile, or a hostile student may suddenly become friendly and cooperative. The instructor must fit the tone, technique, and content of the critique to the occasion and the student. A critique should never be designed and executed so that the instructor cannot allow for variables. Again and again, the instructor is faced with the problem of what to say, what to omit, what to stress, what to minimize—and it is the peculiar challenge of the critique that causes him to determine what to say at the proper moment. An effective critique is one that is flexible enough to satisfy the requirements of the moment.

Acceptability

Before the student willingly accepts his instructor's criticism, he must first accept the instructor himself. He must have confidence in the latter's qualifications, teaching ability, sincerity, competence, and authority. Usually the instructor has the opportunity to establish himself with his students before the formal critiquing situation arises. If he does not, however, his manner, attitude and readily apparent familiarity with the subject at hand have to serve instead. Critiques do not have to be all sweetness and light, nor do they have to curry favor with students. If a critique is fair, is presented with authority, conviction, sincerity, and from a position of recognizable competence, the student probably accepts it as such. The wise instructor does not rely on his rank or his position on the faculty to make a critique acceptable to the student. While such factors usually operate to his advantage, acceptability depends on more active and demonstrable qualities.

Comprehensiveness

A comprehensive critique is not necessarily a long one, nor must it treat every aspect of the performance in detail. The instructor must decide whether the greater benefit will come from a discussion of a few major points or a number of minor points. His criteria may be what most needs improvement, or only what the student can reasonably be expected to improve.

An effective critique covers strengths as well as weaknesses. How to balance the two is a decision that only the instructor can make. To dwell on the excellence of a performance to the neglect of that portion that should be improved is a disservice to the student.

Constructiveness

A critique is pointless unless the student profits from it. Praise for praise's sake is of no value if the student is not taught how to capitalize on the things he does well and use them to compensate for his lesser accomplishments. By the same token, it is not enough to identify a fault or weakness. The instructor should give positive guidance for correcting the fault and strengthening the weakness. Negative criticism that does not point toward improvement or a higher level of performance could be omitted from a critique altogether.

Organization

Unless a critique follows some pattern of organization, a series of otherwise valid comments may lose their impact. Almost any pattern is acceptable so long as it is logical and makes sense to the student as well as to the instructor. An effective organizational pattern might be the sequence of the performance itself. Sometimes a critique can profitably begin with the point where a demonstration failed and work backwards through the steps that led to the failure. A success can be analyzed in similar fashion.

Sometimes a defect is so glaring or a strength so great that it overshadows the rest of the performance and can serve as the core of a critique. Breaking the whole into parts or building the parts into a whole has strong possibilities. Whatever the organization of the critique, the instructor should be flexible enough to change it if the student himself cannot follow and understand it.

Thoughtfulness

An effective critique reflects the instructor's thoughtfulness toward the student's need for self-esteem, recognition, confidence in himself, and approval from others. The critiquer should never minimize the inherent dignity and importance of the individual. Ridicule, anger, or fun at the expense of the student have no place in a critique. On occasion, an instructor should give his comments to the student in private. In some cases, discretion may rule out any criticism at all. For example, criticism does not help a student whose performance is impaired by a physiological defect. While being straightforward and honest, the instructor should always respect the student's personal feelings. It is worth repeating, however, that a critique need not be all sweetness and light. When criticism is "namby-pamby" in nature, its usefulness is destroyed.

Specificity

The instructor's comments and recommendations should be specific; not so general that the student can find nothing to hold on to. A statement such as, "Your second phase wasn't as good as the third," has little constructive value to the student until he learns specifically wherein it was not as good. If the instructor has a clear, well-founded and supportable idea in his mind, he should express it with firmness and authority in terms that cannot be misunderstood. The student cannot act upon a recommendation unless he knows specifically what the recommendation is. At the conclusion of a critique the student should have no doubt about what he did well and what he did poorly, and most important, specifically how he can improve himself.

METHODS OF CRITIQUE

The critique of a student's performance is always the instructor's responsibility, and he can never delegate it in its entirety. He can add interest and variety to his criticism, however, if he exercises his imagination and draws on the talents, ideas, and opinions of others. Following are useful methods of conducting a critique.

Instructor-Student Critique

The instructor leads a group discussion in which members of the class are invited to offer criticism of a performance. This method should be controlled carefully and directed with firm purpose. It should be organized and not allowed to degenerate into a random, free-for-all. Chapter 17 (Guided Discussion) contains information that may be helpful in conducting this method of critique.

Student-Led Critique

The instructor asks a student to lead the critique. He can specify the pattern of organization and the techniques, or he can leave it to the discretion of the student leader. Because of the inexperience of the participants, student-led critiques may not be efficient, but they can generate student interest and learning and, on the whole, be effective.

Small-Group Critiques

The class is divided into small groups, and each group is assigned a specific area to criticize. These groups must present their findings to the class. Frequently, it is desirable for the instructor to furnish the criteria and guide lines. The combined reports from the groups can make for a comprehensive critique.

Individual Student Critique

The instructor requires a student to present the entire critique. A variation is for the instructor to put questions to a number of students (socialized recitation) about the manner and quality of performance.

Written Critique

Written critiques have three advantages. If the instructor writes the critique, he can devote more time and thought to it than he could to an oral critique in the classroom. A second advantage is that the student can keep a written critique and refer to it when he wishes, or as often as he needs to. A third advantage occurs when the instructor requires all the students to write a critique of a performance. The student-performer has the permanent record of the suggestions, recommendations, and opinions of all his classmates, which are certain to be varied. A disadvantage is that the other members of the class do not benefit from the criticism.

Self-Critique

A student is required to criticize his own performance. Where television facilities are available, and the performance recorded on TV tape, this can be one of the most effective of all

critiquing methods. Interestingly enough, the average student is inclined to be less lenient with himself than with others. Like all other methods, a self-critique must be controlled and supervised by the instructor.

Whatever the methods employed, the instructor must not leave controversial issues unresolved nor erroneous impressions uncorrected. If the students participate in the critique, the instructor must make allowances for their relative inexperience. Normally, he should reserve time for himself at the end of a student critique to cover those areas that might have been omitted or not emphasized sufficiently, or areas that he considers worth repeating.

GROUND RULES FOR CRITIQUING

- Except in rare and unusual instances, do not extend the critique beyond its scheduled time and into the time allotted for other activities.
- Avoid trying to cover too much. A few well made points may be more beneficial than a large number of points that are not developed adequately.
- Do not try to stretch a critique beyond its normal boundaries merely to fill out a class period. A point of diminishing returns can be reached quickly.
- Allow time for a summary of the critique itself to reemphasize the most important things a student should remember.
- Avoid dogmatic or absolute statements, remembering that most rules have exceptions. A critiquer can be wrong.
- Avoid controversies with the class, and do not get into the delicate position of taking sides with group factions.
- Never allow yourself to be maneuvered into the unpleasant position of defending criticism. If the criticism is honest, objective, constructive, and comprehensive, no defense should be necessary.
- If part of the critique is written, make certain that it is consistent with the oral portion.

SUMMARY

By the nature of his job, the instructor is a critic and should have the ability to conduct classroom critiques. A critique is not part of the grading process but a step in the learning process, and it is not necessarily negative in nature. The purpose of the critique is to improve future performances of the student and, when possible, as a re-teaching device. An effective critique is objective, flexible, acceptable, comprehensive, constructive, organized, thoughtful, and specific. Classroom critiques may be varied for interest, and may be written as well as oral. Student participation in critiques should be carefully supervised, and the instructor should reserve time for himself to insure adequate coverage.

part two

COMMUNICATIVE SKILLS

The ability to communicate effectively is essential for a successful instructor. In this part of the text, the four commonly accepted communicative skills—speaking, writing, listening, and reading—are described. Logical and creative thinking, support materials, instructional aids, and human relations are also discussed. The effective Air Force instructor must be an effective communicator.

CHAPTER 5

Communicative Process

Communicating effectively, in common with most human endeavors, is complex, variable and, at times, uncertain. Communicating as instructors is even more difficult because of the variations and complexities in the teaching-learning process. Nevertheless, to examine the process of communication, by analyzing its cardinal elements and the significant relationships between them, is useful to gain a more precise and a deeper understanding of the process. Improvement in communication rests, in large measure, on an understanding of the process.

BASIC ELEMENTS

Communication takes place when one person transmits ideas or feelings to another person or to a group of people. Its effectiveness is measured by the similarity between the idea transmitted and the idea received.

The process of communication is composed of

three elements: the source (a sender, speaker, writer, instructor, transmitter, or encoder); the symbols used in composing and transmitting the message (words, signs, music); and the receiver (a listener, reader, student, or decoder). These elements are dynamically interrelated, and that which affects one influences the others. If a listener has difficulty in understanding the symbols a speaker is using and indicates his confusion, the speaker may become puzzled and uncertain, losing selective control of his own ideas. Thus, communication effectiveness is diminished. On the other hand, when a listener reacts favorably, a speaker is encouraged, and force is added to communication. The relationship between the communicative elements is not only dynamic but also reciprocal. Communication is a complicated, two-way process.

Source

The communicator's effectiveness is related to at least three basic factors. First, his facility in selecting and using language influences his ability to select symbols that are meaningful to his listeners or readers. Second, the communicator consciously or unconsciously reveals attitudes towards himself as a communicator, towards the ideas he is trying to transmit, and towards his receivers. These attitudes must be positive if he is to communicate effectively. He must be confident. He must indicate that he believes his message is important. He must make it clear that he believes his listeners or readers have a need to know his ideas. Third, a successful communicator speaks or writes from a broad background of accurate, up-to-date, stimulating material. He must exercise great care to make certain that he communicates with ideas and feelings that are meaningful to his receivers. Far too often, a speaker or a writer may depend on a highly technical or professional background, with its associated vocabulary, which is meaningful only to others with a like background. Reliance on technical language to express ideas to any receiver often impedes effective communication.

Symbols

At its basic level, communication is achieved through the use of simple oral and visual codes. The letters of our alphabet when translated into words constitute a basic code. Common gestures and facial expressions form another. But words and gestures are seldom projected in isolation. Ideas are communicated only when symbols are combined in meaningful wholes, in ideas, sentences, paragraphs, speeches, or chapters. Each part of the whole then becomes important for effective communication.

Total ideas must be selected carefully if they are to convey messages which receivers can react to and understand. They must be analyzed to determine which are most suited to starting and concluding the communication, and which ideas can clarify, emphasize, define, limit, and explain —all of which form the basis for effective transmission of ideas from source to receiver. Finally, the development of ideas from simple symbols culminates in the determination of the medium best suited for their transmission. Many channels are available for transmission. Most frequently, communicators select the channels of hearing and seeing. Occasionally, the channel of feeling—of actually touching or manipulating objects—can be used effectively. The most successful communicator, however, uses a variety of channels through which to communicate his carefully selected ideas.

Receiver

The effective communicator always remembers a basic rule of thumb: communication succeeds only in relation to the reaction of the receiver or receptor. When the receiver reacts with understanding, and changes his behavior accordingly, then, and only then, has communication taken place.

To understand the process of communication, at least three characteristics of receptors must be understood: their abilities, attitudes, and experiences. First, they exercise their ability to question and comprehend the ideas that have been transmitted. The communicator can capitalize on this ability by providing an atmosphere which encourages questioning. Questions may be direct or silent. Readers do read; listeners do listen. Understanding the receiver's abilities is necessary if one is to understand the process of communication. Second, the receiver's attitude may be one of resistance, of willingness, or of passive neutrality. Whatever the attitude, the source must first gain the receiver's attention and then retain it. Probably the more he varies his communicative approach, the more successful he will be in this respect. Third, the receiver's background, expe-

rience, and education frame the target at which the communicator must aim. The latter assumes an obligation to assess his receptor's knowledge and to use it as his fundamental guide for the selection and transmittal of ideas. To get the receptor's reaction, he must first reach the receptor. The major barriers to effective communication are usually found in this particular area.

BARRIERS TO EFFECTIVE COMMUNICATION

The nature of language and the ways it is used often lead to misunderstandings. These misunderstandings stem primarily from three barriers to effective communication: the lack of a common core of experience, a confusion between the symbol and the thing symbolized, and the overuse of abstractions.

Lack of Common Core of Experience

Probably the greatest single barrier to effective communication is the lack of a common core of experience between communicator and receptor. Communication can be effective only to the extent that the experiences—physical, mental, or emotional—of the people concerned are similar.

Many people believe that words transport meanings from speaker to listener in the same way that a truck carries bricks from one location to another. But words never carry precisely the same meaning from the mind of the communicator to that of the receptor. In fact, words do not transfer meanings at all. Words, both spoken and written, are merely stimuli that the communicator sets forth to arouse a response of some kind in the receptor. The nature of this response is determined by the receptor's past experiences with the words and the things to which they refer. These experiences give the words their meaning, meaning that is in the mind of the receptor, not in the words themselves. Since a common core of experience is basic to effective communication, a communicator's words cannot communicate meaning to listeners or readers unless they have had some experience with the objects or concepts to which these words refer.

Confusion Between the Symbol and the Thing Symbolized

Words are simply representations. They represent, or correspond to, anything that exists, that is experienced, or that people talk about. At best, language serves as a map. Just as a useful map accurately represents some specified territory, language should correspond to the objects or concepts that it represents. Like a map that contains errors, a statement that contains inaccuracies implies a relationship that does not exist. For example, while Hitler's armies were mobilizing for invasion in 1938, he said, "I desire no more land in Europe." Nothing in the nature of language prevents words from being used in any way the speaker wishes.

Although it is obvious that words and reality can be different, people sometimes fail to make the distinction. A man may, for example, lose his job merely because someone calls him a thief. If people act as though being called a thief and being a thief are the same, they are confusing a word with a thing it represents. On the assumption that many people will "buy a label," or accept a word for a thing, manufacturers invest much money in naming their products.

Communicators must realize the danger in confusing symbols with the things they symbolize. Effective speakers and writers carefully differentiate between symbols and the things they represent, keeping both in true perspective.

Overuse of Abstractions

Concrete words refer to objects that human beings can experience directly. Abstract words, on the other hand, stand for ideas that cannot be directly experienced, for things that do not call forth mental images in the minds of the receivers. Suppose that a certain Gemini capsule is named "The Unsinkable Molly Brown." The Molly Brown is concrete. It can be touched, seen, and heard. Since it is concrete its name represents a concrete reality. If, however, a communicator who has seen the Molly Brown says, "I saw a Gemini capsule," his listeners do not form a mental image of the Molly Brown because there are capsules of many different names. If the communicator says, "I saw a capsule," he is speaking on an even higher level of abstraction. If he says, "I saw a space vehicle," he is using a phrase so abstract that his listeners are likely to form mental images that do not resemble the Molly Brown in any way.

Abstract words are necessary and useful. Their purpose is not to bring forth specific items of experience in the minds of receptors, but to serve as shorthand symbols that sum up vast areas of experience. The abstraction "Air Force manage-

ment," for example, cannot be directly experienced, but the term causes the receptor to think of certain individual Air Force activities among which he discovers a relationship. For the sake of convenience, the catchall label "Air Force management" is applied to these related experiences. If communicators were forced to use only concrete words, they would soon bog down in details.

Although abstractions are convenient and useful, they can lead to misunderstanding. The danger in using them is that they will not evoke in a listener's mind the specific items of experience that communicators intend. The receiver has no way of knowing what experiences the speaker or writer intends an abstraction to include. It is common practice in the Air Force to use such abstract terms as "proper measures" and "corrective action." These terms alone fail to convey the communicator's intent. When abstractions are used in communication, they should be linked with specific experiences through examples and illustrations. Even better, the level of abstraction should be reduced by using concrete and specific words as much as possible. By using concrete words, the communicator narrows and gains better control of the image produced in the minds of listeners and readers.

SUMMARY

To understand the communicative process is essential if a person wishes to become a more effective communicator. Being aware of the three basic elements of the process—the source, the symbols, and the receiver—is the beginning of understanding. Recognizing the various characteristics of each element and using this recognition as a basis for increased understanding can help a communicator to overcome inherent barriers in transmitting ideas and feelings. Air Force instructors need to be as effective communicators as possible, if they truly teach and their students truly learn.

CHAPTER 6

Speaking

Speaking is one of the four basic communication skills. Because everyone takes the ability to talk for granted, the study of speaking is too often considered unnecessary. Disciplined study of the principles and concepts of speaking, however, adds immeasurably to speaking effectiveness. The most significant of these concepts for military personnel are suggested by the following questions: What does a speaker talk about? How does a speaker get ready to talk? What happens when a speaker speaks? Principles of subject selection, speech preparation, and delivery are particularly meaningful for the instructor who is a communicator always, and a speaker most of the time.

WHAT TO TALK ABOUT

The success of any communicative effort depends on whether the receiver responds in the way the sender had planned. Therefore, a speaker must analyze his audience before he selects a subject. He must select a subject to which the audience can respond. Consequently, he needs to know many things about his audience. For instance, he needs to know the educational and social background of his listeners. The level and scope of their knowledge have a direct bearing on what he will talk about. A clear picture of his audience permits the speaker to predict their reaction to a subject. Audience analysis helps the speaker to decide not only what to talk about, but also how to talk about it.

HOW TO PREPARE

The first task any speaker faces in getting ready to talk is to determine and to limit the purpose of his speech. The other steps of speech preparation—gathering materials, planning organizational patterns, and completing a speech outline—stem directly from his purpose.

Purpose

Traditionally, all speeches are classified according to one of three purposes. When a speaker hopes to impart new knowledge to his receptors or to increase what they already know, the speech is informative. If a speaker wishes to change or reinforce his receivers' opinions, attitudes, and perhaps their behavior, he gives a persuasive speech. If the speaker wishes his receivers to relax and to enjoy themselves, the purpose of his speech is to entertain. The general purposes of speeches, as determined from receptor reaction, are to inform, to persuade, and to entertain.

But because of limiting factors, such as time, audience background and experience, speaker ability, and occasion for speaking, the general purposes must be limited. For example, "to inform the audience about the Federal Communications Commission" is such a general purpose that it would be almost impossible to achieve in a realistic setting. If it were limited to a specific purpose, such as "to inform this audience about the Federal Communications Commission's policies of issuing and revoking licenses," it would more likely assure speaking success. The well prepared speaker writes his specific purposes and keeps the written statement before him as a guide when he proceeds with the preparation of his speech.

Research

With his purpose in mind, the speaker now proceeds to the second step—gathering material on his subject. Three sources of information are

especially helpful: his own knowledge and experience, the knowledge and experience of others, and research.

The speaker should start his preparations by assessing his own knowledge and experience. What does he already know about this subject? What does he not know about the subject? From this survey he can develop a checklist of areas in which he needs further research and study.

He next turns to those people who know something about his subject. These people can help him clarify his own thinking. They can also provide him with new facts and suggest sources for further research.

The speaker is now ready to do primary research. He knows what aspects of his subject he needs to study. He may look for research material in a library. If he has narrowed his subject properly, he will have to do research on only a relatively small part of the total subject.

As he converses, reads, and observes, the speaker is evaluating ideas. He then tentatively screens all of his material to see if it is relevant to his purpose. This preliminary screening allows him to list ideas.

What should the receptor know about the subject? What ideas must the speaker get across if he is to achieve this purpose? From the material he has gathered, the speaker makes a list of all ideas that might be important, without attempting to evaluate or to expand them at this point. He need write only a word or a phrase about each idea. Now he is ready to evaluate his ideas. He discards some as irrelevant or unimportant; he combines others. Usually, he finds that the ideas he keeps fall into two or three categories. These are his main ideas.

The speaker must remember that he can adequately support only two or three main points in a period of about twenty minutes. Even in an hour, he should not try to cover more than four or five main points. The receiver should not be asked to follow and to remember too many points at a single sitting.

Determining Pattern

By analyzing the list of ideas he has developed, the speaker can determine their interrelationship. Once he finds this relationship, he is able to establish the pattern he will follow in presenting his ideas. Possible patterns are numerous but five are ordinarily used.

- The time pattern is probably the one most commonly used. This pattern is quite effective in a report, permitting events to be narrated in chronological order.
- The topical pattern can be used when the main points must be listed, for example, in presenting reasons in support of a proposal or a contention.
- The cause-and-effect pattern is useful for explaining forces or circumstances that have produced a particular result.
- The space pattern, which is often called the "geography book" pattern, can be effective in describing things.
- The problem-solution pattern permits several possibilities to be considered and all but one of them to be eliminated by showing how the others fail to solve the problem.

If the speaker's subject is too broad to be handled with ease, he may be able to find the source of his difficulty by using one of the above patterns. (AFM 10-4, *Guide for Air Force Writing*, offers detailed explanations of the same patterns as those used in writing.)

The best pattern is usually the one that most readily accomplishes the speaker's overall purpose. He should select the pattern that promises to clarify the material for the receptor, and he should follow that pattern in presenting all his main points. He may, however, adopt other patterns to develop supporting points.

Outlining

The final step in planning for speaking is to outline the ideas. The speaker's outline gives him structure to follow, and it also helps him to check the purposefulness, logic, and completeness of his presentation. The outline should never be viewed as a crutch, but as the ultimate tool in the process of preparation. Many successful speakers consider their speeches to be only as strong as the outlines developed as a final step in organizing and planning to speak. The value of this tool cannot be overemphasized.

The speaker should give special attention to the inherent parts of a speech: the introduction, the body, and the conclusion. The body of the speech covers the speaker's main ideas, the things he wishes to communicate to his listeners. The introduction and the conclusions of a speech serve special purposes.

The introduction should catch the receptors'

attention. To do this, the speaker might use a vivid example, a joke, or a surprising statement, making certain that whatever he uses is related to the subject of his speech. Ideally, this step focuses the attention of the receptors on both the subject and the speaker. The speaker must then hold the receptors' attention by showing why they need the information to be offered, why it is to their advantage to continue to listen. After the receptor is motivated to listen, he should be told briefly what is to be covered in the speech. This overview simply alerts him to look for main points.

The basic function of the conclusion is to summarize main points and to reemphasize the objective of the speech. It should do more than merely itemize points; it should tie the main ideas together. If possible, the speaker should remotivate his listeners so they will remember and apply what he has said. He should close his speech forcefully, yet gracefully, and lend a tone of finality to his presentation.

SPEECH DELIVERY

No matter how well a speaker has planned, organized, and supported his ideas for a lecture, he faces the real test when he presents his material to his receivers. His delivery can give his ideas dignity, force, and effectiveness. Through skillful use of his voice and body, he can project his ideas and accomplish his purpose.

The test of good delivery is whether the speaker holds the attention of his listeners and therefore furthers his purpose in speaking. Anything in his delivery that draws attention away from his main ideas is detrimental to his purpose. Delivery can be improved through practice. Some suggestions for improving delivery follow.

Directness

Some speakers seem to be addressing the ceiling, a knot in the floor, or someone outside the room rather than the people in their audience. This failure to develop a sense of communication with the audience is a common fault of beginning speakers. They seem to avoid the purpose of speaking: to communicate ideas that are calculated to win a desired response. The lack of a communicative attitude seriously weakens any presentation.

In its broadest sense, directness means talking to and with an audience, not simply at or in front of them. If a speaker feels an inner urgency to communicate ideas and is aware of what he is saying while he is saying it, his manner is direct. No effort to achieve directness is necessary for the speaker who is sold on what he has to say and who has a lively, intimate, and friendly feeling toward his listeners.

In a specific sense, directness means eye-contact. The failure to look listeners in the eye usually indicates fear or timidity. These reactions to the speaking situation can be overcome by forgetting oneself and seeking opportunities to speak before others.

If a speaker does not look at his audience, he misses some valuable guidance from his listeners: their signs of doubt, misunderstanding, or disagreement. He should capitalize on the opportunity to adjust at once to the reactions of his listeners. This opportunity, which is peculiar to oral communication, should be welcomed as a means of insuring understanding.

Sincerity

Sincerity results from a deep and abiding belief in the importance of the subject and in the correctness of information. This quality reveals itself through voice, action, and facial expression. A speaker cannot continue to maintain an appearance of sincerity if he is actually not sincere. Sooner or later, listeners "get the speaker's number." If they feel that he believes what he says, they are inclined to believe also.

Sincerity and enthusiasm are contagious qualities, and both go far toward winning a favorable response. On the other hand, an indifferent delivery carries no conviction. If a speaker does not build confidence in his subject matter, in himself, and in his relationship to his listeners—if he is arrogant, patronizing, hostile, or fearful—his listeners are likely to reject his ideas no matter how worthwhile they may be.

Voice

Rightly or wrongly, voice is used as an index to human characteristics—to attitudes, personality traits, and physical condition. And usually it is a surprisingly accurate index. The weak and apologetic voice connotes timidity, fear, superficiality, or other undesirable qualities in the speaker. The loud and boisterous voice indicates a bully or a bluff. A voice should be free from distracting, unpleasant characteristics. To hold

attention, a voice should be easily heard, pleasant, and characterized by variety in pitch, force, and rate. Since all points in a talk are not equally important, the speaker should vary his speed, tone, pitch, and loudness to hold interest and to lend emphasis to ideas that he wishes to stress.

Bodily Action

Bodily action includes gestures, facial expressions, movement from one place to another, posture, and the muscle tone of the body as a whole. Exhibitory action—contrived gestures and movements used for their own sake—can detract from what a speaker has to say. Bodily action should arise from inner impulses, from the genuine desire to communicate with others. The good speaker does not rely on rules for moving and gesturing. He does, however, follow two basic principles: he coordinates his bodily action and he uses his body to express animation.

COORDINATION. All parts of the body should be so well disciplined that they work together as a unit. The effective speaker has something to say, he wants to say it, and he uses his entire body to get his message across. Gestures should arise from a genuine impulse to clarify or to emphasize ideas. Above all, they should be unobtrusive, never drawing attention to themselves. In fact, any technique of speech that diverts attention from the central idea defeats the purpose of speaking.

ANIMATION. This quality indicates that the speaker has an enthusiastic interest in his topic. Listeners are quick to sense the lack of thought or feeling beneath a listless delivery. A speaker's action is of two types: overt and covert. Overt actions are the obvious, easily seen movements, such as clenching the fist or waving the arm. Although covert actions are less obvious, they are more important because they tell the audience a great deal about the speaker and his attitude. Covert actions, which indicate the muscle tone of the body as a whole, reflect the speaker's attitudes and feelings.

It is possible to use a studied overt movement, but impossible to contrive and assume deceptive covert actions. A speaker who strikes the lectern as he says, "If you believe in freedom, you will fight for it now!" may be quite convincing. His listeners may, however, detect a false note in his overall bearing. The speaker may not be half so energetic as he pretends. Even a strong, seemingly appropriate gesture, cannot contradict a placid muscular tone. To be truly effective, overt and covert action must complement and reinforce one another. Gestures that are used deliberately for their own sake usually do not convince an audience, since listeners are quick to detect inconsistencies between overt and covert actions. Such inconsistencies betray the speaker's real feelings. No action that a speaker may plan and practice can keep his covert actions from revealing his emotional state and his attitude toward himself and others.

Use of Notes

A speaker who is thoroughly prepared usually can speak effectively without notes. If he has carefully prepared his speech and his outline and is completely familiar with both, he should experience no real difficulty. The speaker whose preparation has been superficial may find it necessary to use his notes as a crutch.

Notes used wisely can, however, have certain advantages. They insure accuracy, jog the memory, and dispel the fear of forgetting. They are essential for reporting complicated information. For a discursive, rambling speaker they are a must, because they help keep him on the track. The speaker who requires notes should use them sparingly and unobtrusively. At the same time he should make no effort to hide them from his audience. Notes should be written legibly or typed, and they should be placed on the lectern where they can be consulted easily or held if the speaker walks about the platform.

Notes are personal possessions. Any system of note taking that serves a speaker well is satisfactory.

SUMMARY

The effective speaker, or instructor, selects an important subject only after careful study of his audience. He prepares his speech carefully by giving due consideration to a general and a specific purpose, by evaluating ideas resulting from extensive research, by analyzing the relationships of these ideas, and, finally, by carefully outlining them. He delivers his speech directly, and sincerely, using his voice and body to reinforce his ideas and purpose. He uses notes only as needed.

CHAPTER 7

Listening

Listening is one of the most neglected of the communicative skills. The listener usually neglects to assume his share of responsibility in the communicative process. Many poor listeners try to place the entire burden of the "speaker-listener" process on the speaker. The listener who sleeps through a lecture, for example, is apt to make the excuse that the speaker was dull. The listener who fails to recognize and grasp the speaker's main thoughts is likely to say that the presentation was poor. Such reactions from a listener are usually rationalizations for his own inattentiveness.

Certainly the speaker does initiate the communication process and he has a certain responsibility for controlling it. Yet he should not be held entirely accountable for the failure of members in the audience to listen. Successful communication depends upon cooperation between the communicator and the receptor.

An adult spends considerably more time listening each day than in any one of the other communicative skills of speaking, reading, or writing. Air Force personnel spend about 45 percent of a normal working day in situations offering opportunities to listen; in school situations, this percentage is much higher. Results of research by civilian educational institutions give a similar figure. This alone emphasizes the importance of effective listening habits.

WHAT IS LISTENING?

Hearing is not listening. A person hears, often without listening, whenever sound waves strike his eardrums. Frequently, one does not remember what he hears, because he did not listen. Almost everyone has been embarrassed by not knowing the name of a new acquaintance because of failure to listen when he was introduced. Even if one remembers, he does not necessarily get the most from his listening. A donkey is not rich simply because he carries gold on his back, nor is a person wise simply because he carries a mass of memorized facts in his head. Facts, memorized without an understanding of their significance, are as worthless to a man as gold to the donkey. In a broad sense, then, listening means hearing, comprehending, and remembering. To do this, a person must concentrate on what he hears. He must be willing to put keen effort into the listening process.

Students frequently complain that they cannot retain as much of what they hear as they should. Their problem is usually caused by failure to concentrate.

By definition, concentration is "close mental application, exclusive attention." From time to time, stories circulate about some "genius" who can simultaneously read a book, listen to his wife talk, hear the President speak by radio, and abstract the important ideas of each. Few people match this performance; in fact, most people have to work at focusing attention on even *one* subject for any length of time.

The behavior of the mind can be compared to the flow of a river. A river meanders, finding and following the course of least resistance from the mountain to the sea. Every navigable river, however, has a safe channel. The captain who wants to take his ship up and down the river and into the ports on his itinerary, keeps the ship in that channel. Like a river, the human mind tends to wander, but the objective listener keeps his attention in a mental channel, the channel of concentration. Whenever a listener allows his mind to stray, to slip into a whirlpool, to drift into shallow water, or to run aground, he

lets the current of the spoken ideas in the channel pass him by. His attention may get back into the current, but it can rarely catch up with the speaker's ideas. What can a person do to channel his attention? The secret lies in forming good listening habits.

FORMING GOOD LISTENING HABITS

Listening effectively is not a gift; it is acquired through practice and hard work. Any one who wants to become a better listener can do so by practicing the following seven rules at every opportunity.

Get Ready to Listen

Listening requires physical and mental preparation. The physical preparation for listening can be compared with that for catching a plane. If a man expects to be a passenger on a plane departing at 2000 hours, he must check his baggage, find his seat, fasten his safety belt, and be awaiting takeoff before that time. The same is true of the listening situation. First, the listener must check his baggage, that is, put away newspapers, books, and other extraneous material. Then he must seat himself comfortably before the speaker begins. He should, insofar as possible, prepare to listen to the speaker by mentally "tuning out" distractors such as noise or minor physical discomforts. He should be physically relaxed but mentally alert, with pencil and paper at hand for taking notes. Only then is he ready to travel along with the speaker.

If the listener and the speaker are in the same room, they cannot travel far from each other. Yet, despite their physical proximity, the listener and the speaker do not necessarily travel in the same channels of thoughts and ideas. By failing to listen to the speaker's opening remarks, members of an audience miss the basic structure upon which he will later build his ideas.

Physical preparation is not enough; mental preparation is also essential to good listening. The listener should be ready to "tune in" on the speaker's mental wave length. How does he prepare himself to do this? He starts by reviewing his own knowledge of the subject to be covered and then trying to imagine what the speaker will say. Just as he would study a map before starting on a trip into an unfamiliar area, he studies a mental map of the area through which a speaker is likely to take him. The alert listener will review schedules or other program data which might give him preliminary information about a speaker's topic or lesson. He finds material on the subject of the lecture and reads it. If he already knows something about the topic, he should *think* about it and consider what he would say if he were the speaker. This part of the preparation helps the listener recognize the core of experience he has in common with the speaker. By taking to the lecture as much knowledge of the subject as possible, he increases the probability of valuable two-way communication.

Take Responsibility for Comprehending

Frequently, an instructor will have a student in his class whose attitude speaks for him: "Here I am; teach me—if you can!" He believes knowledge can be poured into him as water is poured into a jug. He will not get the full benefit of any lecture or lesson until he learns that the successful listening-learning situation demands something of the listener as well as the speaker. Speakers frequently use examples to support points they wish to stress. The listener who feels responsible for comprehending looks for similar examples within his own experience and applies the point to himself or to his job.

Another way to increase comprehension is to rephrase ideas. In describing poor reading habits, a speaker might say, "The reader in this example has too many fixations per line." A listener might rephrase the statement: "This reader allows his eyes to stop too many times on one line of type." Rephrasing in this way helps him understand and retain the speaker's ideas. Basically, the listener is putting the speaker's words into a vocabulary with which he is more familiar.

Listen to Understand Rather Than to Refute

Critical listening is a good practice, but it is not achieved by critizing the speaker's thoughts before he has finished. Silent argument with a speaker while he is speaking can be a waste of time. In a learning environment, the thoughtful listener will analyze but not mentally argue with the teacher or lecturer during the lecture. Unless he honestly attempts to get the speaker's message, the listener cannot be well enough informed to evaluate the ideas intelligently. The listener should listen and wait; he should try to understand first and evaluate second. Some or all ideas

may deserve to be questioned and tested, but the testing should be done after a speech or lesson is finished. On the other hand, the responsible listener may find that no disagreement exists.

Control the Emotions

In the learning situation, the listener should not permit emotional blocks to develop between himself and the speaker. How can a listener be unbiased? If, for example, he is annoyed by a speaker's manner, how can he remain objective about the speaker's ideas? By isolating the source of his annoyance—the speaker's vocabulary, dress, or personal mannerisms—and by analyzing the reasons for his negative emotional responses to them, he can often minimize their effects on him. The intelligent listener does not permit emotional blocks to prevent his understanding of a speaker's ideas. Actually, the responsive listener tries to help the speaker—rather than to react unfavorably to him. The listener can assist the speaker merely by displaying an overt interest.

Sometimes, certain words trigger certain emotions. Many terms, such as "Red," "Socialist," "automation," and "collector of internal revenue" are emotionally loaded. Everyone has experienced emotional blocks upon hearing certain words. The person who wants to profit from his listening experiences should make a list of the words that stir him emotionally. By identifying and understanding them as blocks to communication, he can gradually force himself to react to speaker's ideas rather than to their vocabularies.

Listen for Main Ideas

It is possible to become too involved in details. The man who boasts, "I listen for the facts," may actually be a poor listener. By concentrating exclusively on individual supporting points he may miss the main ideas. Fact A, Fact B, and Fact C may be interesting for their own sakes, but the speaker's reasons for offering these facts may be to derive an important generalization from them. Realizing this, the alert listener trains himself to distinguish between main thoughts and the less important supporting ideas. Dr. Ralph G. Nichols states in *Readings in Management*: "We asked the 100 best listeners (in a research project) what they concentrated on in a listening situation and a bit timidly they testified, 'when we listen, we try to get the gist of it—the main idea!' "

How has the speaker organized his main points? What organizational pattern has he used? Does he present a main point and then support it, or does he use the opposite approach? Both approaches are effective, and both are commonly used in oral communication. The listeners must look for the relationship of examples, comparisons, and testimony to the ideas they support. If a listener has previewed the subject matter in advance, his listening task becomes easier.

By listening for the main ideas of speakers, anyone can increase his own store of knowledge and understanding. Most people want to know more about many subjects than they have time to learn through personal research. By listening intelligently, the listener can benefit from the research, experience, and thinking of speakers who are knowledgeable in a wide variety of fields.

Be Mentally Agile

Concentrating throughout a speech is a challenge, because people do not think and speak at the same rates. The normal person thinks much faster than the normal speaker can possibly talk. This rate differential gives the listener's mind the time and opportunity to stray from the speaker's subject. But the listener who has disciplined his mind can use this spare time to review what the speaker has said and to predict what he will say. In doing this, he profits from two practices essential to learning: mental activity and repetition. The mentally agile listener has ample time, mentally, to repeat, forecast, summarize, and paraphrase the speaker's remarks. This practice increases comprehension and aids retention.

Take Notes

In an unpublished research paper, Doctor Charles V. Irvin, Michigan State University, concludes that the comprehension and retention records of students who take notes are consistently better than those of students who do not. Students should always take notes at teaching lectures. Every student should establish and use a note-taking system that works for him. If he follows his system and establishes the habit of reviewing his notes on the same time every day, his comprehension and memory will improve.

The suggestions for getting ready to listen also apply to taking notes. The student should go to the lecture hall or classroom in time to have his materials ready before the lecture starts. If he uses a separate sheet of paper or note card for

each lecture, his notes will be easier to use later on. By using only one side of the paper and leaving enough marginal space, the student can easily make any clarifying notes he may wish to add later from other sources. One efficient system is to use a loose-leaf folder with separate sections for each subject or area covered in a course or lecture series.

Notes should include the speaker's main ideas and enough supporting details to make the main ideas clear. Yet, the listener cannot afford to let the notetaking process interfere with his understanding of what the speaker is saying. The main function of notes is to aid the listener-observer in reconstructing the oral communication upon its conclusion. Often it is helpful to use abbreviations or to jot down key or cue words, rather than complete sentences. When listeners try to take down the speaker's exact words, they risk losing the continuity of his thoughts and, therefore, the purpose of the lecture. In only one instance is it wise to take verbatim notes: for purposes of clarity, definitions of key words should be taken down just as the speaker expresses them.

The listener should watch for "road signs" indicating that the speaker is moving from one main idea to another: such transitions as "another point is" and "in contrast to what I've just said." Notes should be as brief as possible, yet readily understandable. Each note should help the listener recall one of the speaker's ideas. Good notes actually outline the speech.

The student should review and expand his notes as soon after a lecture as possible. This review permits the student to "relive the experience," thereby strengthening his memory of the most important ideas.

SUMMARY

The art of listening warrants the best efforts of those who wish to understand and use ideas verbally expressed by others. The listener cannot listen passively and expect to retain much. Although alert listening requires effort, it is still one of the best ways to gain knowledge and understanding. Our opportunities to listen are numerous. We shall be better listeners if we give the speaker our careful *attention*. We can improve our *comprehension* if we try to understand his point of view. Most forgetting occurs immediately after learning. To *retain* the most important ideas, we must diligently seek and catch the main ideas. Reasonably brief notes—taken during a speech and expanded later—help to retain the most important ideas for later use.

CHAPTER 8

Writing

Instructors sometimes ask, "Why should I be concerned with writing? My job is to teach, not to write. Why do I need to worry about improving my writing ability?" The answer may be found by analyzing the skills involved in instructing. These skills are many and varied and place heavy demands on the instructor's ability. One skill, however, stands out in importance: communicating.

The primary task of the instructor is to create a clear channel of communication. But the channel alone is not enough. More is required than a communication line with the instructor at one end and the student at the other. A flow and exchange of *ideas* must occur to make effective use of the line.

So what is an *idea?* Ideas are intangible; they cannot be seen, smelled, or touched. The instructor cannot dole them out as if they were peanut butter sandwiches. If he could, instructing and learning would be simple. The instructor faces the problem of giving form and substance to his ideas. He usually solves it by putting his ideas into words.

EFFECTIVE WRITING

Words are the primary means by which the instructor breathes life into his ideas. Words can describe, illuminate or limit ideas, and give them meaning. Words can give an idea the capability of moving from the mind of the instructor to the mind of the pupil. Words can give an idea the "communicability" that is vital to the learning process.

Since the instructor must work with ideas built of words, he needs to become a skilled user of words to be an effective teacher. After he skillfully constructs the idea and gives it "communicability," he must complete the process by deciding upon the best means of communicating it.

Usually he decides to verbalize, or speak, the idea. This is often the ideal means. The voice is an excellent teaching tool. It can emphasize and dramatize by inflection. It can bring tonal variety and interest into the classroom. It can be flexible and dynamic.

Sometimes, however, the instructor selects another means of transmitting ideas. Some ideas can be grasped more easily, and retained longer, if written where the student can "see" them. Ofter he needs time to consider an idea. The spoken word does not always present such an opportunity. The idea is voiced and if not grasped quickly, glances off into space. It does not register. But, if the idea is written, the student can read and learn at his own pace, not the instructor's. This is why the instructor must be concerned with writing and strive to write well.

The kinds of writing the instructor must do will vary. The purpose for which he writes usually determines the form his writing takes. In some cases, he might be called upon to write an entire textbook or workbook. More frequently, however, the requirements will be less ambitious and the style of writing less formal.

Writing can take many forms: a basic lesson plan, a handout containing a problem for the class to study and discuss, or material for an outside reading assignment to add depth and scope to the classroom presentation. Some writing efforts are only indirectly related to the classroom. For example, the instructor may write a report for an educational journal or submit recommendations to the curriculum committee. Writing tasks occur in many forms, but whatever the form they are a necessary part of instruction.

If the instructor has developed the ability to write well, two worthwhile results occur. First, his writing produces a favorable learning environment. Through his choice of words, his ideas spring to life and become indelibly impressed upon the minds of his students. Writing accomplishes the purpose for which he did it, namely, the student learns. This is the primary effect.

The other result of good writing is that no matter what subject an instructor teaches, if he uses the English language, he is inevitably teaching English. The way he uses the language becomes a model for the student. If the model is a good one, the student profits; if the model has flaws, the student suffers. In either case, the effects are long-lasting. A former teacher, President Lyndon B. Johnson, stressed this thought in 1964 when he sent this message to the President of the National Council of Teachers of English:

> ...Those who teach our national language inevitably exert an enormous influence on the course of our national affairs. When badly taught, our language becomes an imprecise and ineffective means of communication. It blurs our view of the past, our understanding of the present, and our vision of the future. When taught well, or better still, when taught superlatively, our language becomes a positive force in the advancement of both the cultural and economic life of our land.

Effective writing, then, can pay a dividend in addition to transmitting a message. If the student is exposed to an instructor who expresses his thoughts lucidly, he gains an appreciation of the power of language. This appreciation often materializes in the student's desire to become more literate, to express his own ideas clearly and competently. He pays the instructor a great compliment when he patterns his language after the instructor's example.

But what of the instructor who possesses no talent for writing, yet must write? Time spent complaining or worrying about it is wasted. If the instructor must write, he should try to improve his writing skills. How? Where does he find the time?

There can be no quick and easy answer to such questions, because there is no quick and easy way to acquire a skill. Facility in any skill grows through conscientious, purposeful practice. It is achieved slowly but surely as the individual devotes time and effort to it. So it is with writing. Developing writing facility takes time and effort, but any instructor who has worked hard to acquire it will agree that the dividends are worth the investment.

The starting point for improving writing skills is obvious: find the areas that need improvement. Many people struggle for years knowing that they do not write well, yet never know why. They recognize writing as a problem, but they never try to analyze the problem; they never attempt to pinpoint the reasons why they do not write effectively.

Any writing improvement program must begin with an honest appraisal. When the program is based on known deficiencies, the battle is half-won. Now the individual himself can set a goal and conduct a systematic campaign.

One method of analysis is self-appraisal. This approach can identify many writing faults. Too often, the instructor writes under the pressure of a crowded schedule, rushing through the writing task and not taking time to read what he has written. Even a cursory glance would probably reveal careless mistakes, made because of haste or inattention.

A quick backward glance is not enough, however, if the instructor wants to perform a thorough self-appraisal of his writing. He should look critically at four important aspects: clarity, appropriateness, directness, and correctness. A checklist (Figure 2) is offered to help conduct a systematic writing analysis. Although limited to these four aspects, other criteria could be used on such a checklist, but if the writing is clear, appropriate, direct, and correct, it will probably be good when measured by any other yardstick.

This checklist is like any other measuring tool. The writer must understanding what it measures and how to use it, but before he uses it, he needs to consider the meaning of each criterion. The next few paragraphs establish these guidelines.

Although each of the four aspects is treated as a separate entity, they are inseparable. They have been isolated for purposes of analysis, but each depends upon the other and all combine to produce effective writing. By studying the checklist carefully, the writer should have a clearer understanding of what and how it measures; he should also be able to use it more efficiently.

CLARITY (Did you communicate clearly?)

- Does your *main* message come through easily?

- Are your ideas logically *organized*?
- Have you *supported and developed* your ideas?
- Have you weeded out *unnecessary details*?

Clarity has been placed intentionally at the beginning of the checklist. It is the first quality the writer must strive for and the first to look for when he appraises his efforts. The reason is simple: if the meaning is not clear, he has wasted both his time and the reader's. If the idea does not stand out as clearly on the written page as it did in the writer's mind, he has failed to move that idea, whole and intact, from the transmitter to the receiver. At best, his communication is only partially successful. At worst, he may not only fail to communicate the intended idea, but he may implant one that is false, distorted, or misleading, instead.

It is not always easy for the writer to determine whether or not he has expressed his ideas with clarity. If the reader is required to perform an act as a result of the writing and if he functions accordingly, the communication must have been clear. The determination, then, is simple, as for example, when an instructor gives written instructions for certain student activity. But when the writing does not call for an overt response, measuring the degree of clarity is more difficult. The writer must judge his effectiveness by looking at the writing itself, not at the result of the writing.

In judging the clarity of his writing he should look for three essential characteristics: *unity, coherence, and emphasis*. If the writing possesses all three, he can feel reasonably sure that it is clear.

Unity means that a strong, central theme is established in the first few sentences and adhered to throughout. It means that the writer selects a single road to travel and stays upon it, avoiding side-trips which delay his arrival at his intended destination. He makes it easy for the reader to travel without confusion, by marking the message unmistakably and keeping it in plain sight throughout the course of the writing.

Coherence means that the separate parts read in a natural, easy flow from one idea to another. The reader never has to retrace his tracks to find where he wandered away from the thought-path. Writing that is coherent in total effect is achieved when each part is coherent. The sentence structure follows one of the customary patterns; if it varies, the meaning remains unmistakably clear. Each paragraph is built according to a logical arrangement and is essential to the plan devised by the writer. Each sentence in the paragraph contributes something to the idea and advances the meaning. The overall effect, therefore, is a steady progression of thought along a predetermined route.

Emphasis requires the writer to sort and weigh his ideas before he writes. Some are major ideas; some are minor. Others are in neither category and he discards these quickly. In his writing, he emphasizes the relative importance of his ideas, which he can do in many ways. He can do it boldly and directly by introducing a major idea with a phrase that says, "This is important." He can take advantage of mechanical means, by underlining his main ideas or placing them in italics, or using headings and subheadings. All of these devices are helpful and are used in this text.

Emphasis can also be gained by more subtle methods. One of these is proportion. If the writer wishes to present two ideas of unequal importance, common sense indicates that more attention should be given to the more important one. He therefore gives the major idea emphasis by devoting more space to it, developing it more fully, and by supporting it in greater depth and detail. Repetition also aids in emphasis. This does not mean merely repeating the idea in the same way. Rather, it means focusing attention on the same idea from more than one angle. Finally, the skilled writer knows that a major idea should never be buried in the middle of a paragraph or a chapter. The reader unconsciously looks for key ideas at the beginning of a selection and retains them if they are re-emphasized in the concluding sentences.

The essentials of clarity—unity, coherence, emphasis—make it possible for the writer to answer all of the first four questions on the checklist with a positive, confident, "Yes."

APPROPRIATENESS (Does the writing fit its environment?)

- Does the general tone suit the *subject matter*?
- Have you considered who your *reader* will be?
- Have you considered his *knowledge level*?
- Does your writing style seem to fit *you*?

Writing, to be appropriate, must fit its environment. This consists of several factors, all of which influence tone and style.

The nature of the subject is the first factor. If the subject is a serious one, the general tone of the writing should match. This does not mean that the writing must be dull; it can still be interesting, although serious. Treating a serious subject in a light and humorous vein could entertain the reader but cause him to miss the importance of the subject matter.

Another factor to be considered under "Appropriateness" is the reader. The reader is a key factor in deciding the style, level, and tone of the writing. In this respect, the instructor is more fortunate than most professional writers. He has a clear picture of his reader, because he usually writes for his students. He knows how much knowledge the student has and how much he wants and needs. Knowing this, the instructor can tailor his writing to fit the reader's requirements.

Although the primary purpose of writing is to express ideas, the manner in which they are expressed creates an impression of the writer in the reader's mind. This is why the third factor in writing environment—the writer himself—should be considered.

Writing mirrors the writer. If it reflects the way he sincerely feels about the subject, the message "rings true." The reader senses this sincerity and respects the ideas presented. He may not accept them, but he gives them honest consideration because he has unconsciously formed a favorable image of the writer as a person.

An unfavorable impression can also be formed. The reader can sense ideas that are presented artificially or insincerely. He quickly spots superficial understanding, even when the writer uses a veneer of flowery language to disguise his lack of knowledge. A glib vocabulary will not cover up the writer's inadequacies.

Recognizing these facts, the effective writer tries to convey an image of the kind of person he really is. He seeks to project a thorough understanding of himself by placing his thoughts on paper as simply and honestly as he can. As a result, he creates a favorable impression for both his ideas and himself.

If the writer can answer the four questions under "Appropriateness" in the affirmative, his writing will fit its environment.

DIRECTNESS (Do your ideas come into focus quickly?)

- Have you avoided *long, involved sentences*?
- Have you chosen *simple words,* rather than flowery or unusual ones?
- Will the reader understand all *technical terms*?
- Did you use *active verbs* whenever possible?
- Did you use *personal pronouns* where appropriate?

The next criteria on the checklist, "Directness," means writing that can be easily read and quickly comprehended.

The writer can best achieve directness with simple, uncomplicated sentences. He must seek and use words that his readers can grasp effortlessly. One might think that such writing would tend to be cramped and monotonous, but this is not necessarily true. Sentences can be varied in both word arrangement and length for good readability. Word choice need not be limited to a small vocabularly. On the contrary, a large vocabulary enables the writer to choose exact words to convey exact meanings.

To achieve directness, write as you talk; in other words, write conversationally. When speaking, the average adult presents his ideas simply and directly; his listener understands him. Unfortunately, when he writes, he sometimes fails to express himself quite as effectively. If he writes his ideas as naturally as he speaks them, his writing would improve, and his reader's comprehension would increase in direct ratio.

For example, an instructor usually speaks in active terms. If he announces, "Please finish your homework by tomorrow," his students have no difficulty getting the message. It gets to the point, it is personal, and it is exact. No room is left for misunderstanding. But consider how the same instructor might write the same message: "It is requested that students complete their prescribed assigned homework as soon as practicable." The message has become indirect, impersonal, and indefinite. The response from the written instructions will probably be less satisfactory than that from the spoken version.

One might deduce that the most effective solution to this problem is to give only verbal instructions, but of course, this is not the answer. Written instructions are often best, and can be as effective as oral, if they are written naturally and directly. The writer will then be able to

answer all the questions under the criterion, "Directness," with a direct and positive "Yes."

CORRECTNESS (Have you met the standards of accepted usage?)

- Are you sure about your *spelling*?
- Do your *subjects and verbs agree*?
- Have you *punctuated* correctly and where necessary?
- Are your *pronouns* in the right case?
- Have you *capitalized* correctly?

The final item on the checklist, labeled "Correctness," is probably the one used most often by the reader to form an opinion of a writer. The use of the English language is the standard by which the reader forms his opinions of the writer, and ascertains if his ideas are worth considering. This is why "Correctness" is so important. The writer may word his message clearly but if the reader decides that it stems from an uneducated source and cannot therefore be important, he might ignore it.

For the instructor, correctness is extremely important. If his writing contains many errors in usage, his students might unconsciously transfer this weakness to his ability to instruct. They may lose respect for the instructor's ideas, even though these ideas are sound and are based on a complete knowledge of the subject matter.

What is "correct usage"? Most grammarians say that correctness is determined by the way educated persons use the language. Consequently, the rules are not hardfast and unchanging. However, there are some generally recognized standards that determine correct and incorrect usage. If the skilled writer develops a knowledge of these standards, he increases his confidence in language usage and insures respect for his ideas by students.

Rules of language usage are similar to traffic rules. When one is learning to drive, the rules are new and he must consciously think what he must do to comply with them. For example, when he sees a stop sign, he must think about stepping on the brake, shifting gears and, if he intends to turn, giving the correct turn signal. Learning to abide by language rules is somewhat similar. The writer with little experience must think about the rules to comply with them. Experience, however, makes compliance almost automatic. Just as the driver gets a "feel for the road" and drives almost effortlessly, so the writer acquires a "feel for language" and writes easily without worrying about the rules.

The five areas covered by the questions under "Correctness" do not include all the rules of correct usage. However, they are the areas in which the most common and obvious errors occur. The writer who is reasonably confident about his spelling, verb agreement, punctuation, pronoun selection, and capitalization probably meets the other standards of correct usage as well. On the other hand, if he has doubts about any of them, he probably has other language-usage problems, also.

CHECKLIST

The checklist (Figure 2) contains a key question in parentheses after each criterion. The writer should first try to answer honestly, in his own mind, each key question. If he can answer all of them with a firm, confident "Yes," he may have little need of the other questions on the checklist.

However, if he cannot be positive about some of them, he should go through the checklist and try to answer the other questions. In some cases he may not be able to answer the questions with a definite "Yes" or "No." If not, he should check the "I don't know" column to indicate areas that might need improvement.

After the checklist has been used to identify areas that need improvement, the writer can proceed immediately to work on them. Many times he knows how to write better, and, if so, the appraisal will guide him as he edits and re-writes. Editing and re-writing cannot be overemphasized as a method of writing improvement. The world's finest writers often re-write their material many times before they are satisfied with it. The instructor can profit by their example if he makes it a habit to re-write all his own material at least once, and even more, if necessary.

Of course, if the instructor does not have the basic knowledge he needs to correct the weaknesses in his writing, he must find help from others. In many cases, he can get the help he needs from an authoritative reference book. Air Force Manual 10-4, *Guide for Air Force Writing,* provides much needed guidance. A good dictionary is also helpful, especially on questions of correctness and usage. In addition, the instructor should have access to a reputable guide or

CLARITY *(Did you communicate clearly?)*	YES	NO	I DON'T KNOW
Does your main message come through easily?			
Are your ideas logically organized?			
Have you supported and developed your ideas?			
Have you weeded out unnecessary details?			
APPROPRIATENESS *(Does the writing fit its environment?)*	YES	NO	I DON'T KNOW
Does the general tone suit the subject matter?			
Have you considered who your reader will be?			
Have you considered his knowledge level?			
Does your writing style seem to fit you?			
DIRECTNESS *(Do your ideas come into focus quickly?)*	YES	NO	I DON'T KNOW
Have you avoided long, involved sentences?			
Have you chosen simple words, rather than flowery or unusual ones?			
Will the reader understand all the technical terms?			
Did you use active verbs whenever possible?			
Did you use personal pronouns where appropriate?			
CORRECTNESS *(Have you met the standards of accepted usage?)*	YES	NO	I DON'T KNOW
Are you sure about your spelling?			
Do your subjects and verbs agree?			
Have you punctuated correctly and where necessary?			
Are your pronouns in the right case?			
Have you capitalized correctly?			
TOTALS			

Figure 2. Writing Analysis Checklist

handbook on writing. If he feels the need for a more complete review of basic fundamentals, he should either enroll in a writing course or undertake a self-study course. The base education office can provide information and guidance to assist him in this respect.

SUMMARY

The principal task in instruction is communicating. The instructor who communicates well can make the learning process a rewarding experience for both himself and his students. For him, the reward is the satisfaction of a worthwhile job well done. For the students, the reward is mental growth and the attainment of new skills and knowledge.

When communication takes the form of the written word, the instructor must write to impart meaning as clearly and concisely as possible. The checklist (Figure 2) gives him four main criteria to use in judging his efforts. If he can use the checklist and honestly say

I did communicate clearly
My writing does fit its environment
My ideas do come into focus quickly
I have met the standards of accepted usage

he can then feel confident that he has written effectively and that his students will learn from what he has written.

CHAPTER 9

Reading

A practical suggestion for reading improvement is a simple rule which World War II GIs applied to eating, drinking, and sleeping . . . never pass up a chance. The military man today cannot afford to pass up a chance to read, read, read. The following statistics compiled by William G. Perry, reading specialist, Harvard University, give some indication of the prodigious reading task faced by our military instructors.

> Over half of all the technical information printed in the United States since the American Revolution has been published in the last ten years. Currently the world's laboratories and research centers are producing technical papers at the rate of 60 million pages a year. If a fast reading omnilingual scientist reads 8 hours a day, no time off for lunch, it would take him to year 3363 to just finish this year's out pouring of facts.

A major problem for most instructors is their attempt to absorb this material by using limited reading techniques. A person learns to read during the early elementary grades and, unfortunately, most reading improvement programs stop at that level. In a 1960 article, "Reading in Relation to the Total Curriculum," Emmett A. Betts comments that only a few adults are either avid or discriminating readers. Surveys show that only 17 percent of the adults of the United States read books. About 70 percent of the adult population read or look at magazines, but, with few exceptions, magazines of high cultural level have a limited readership. Further, the quality of reading which is done by teachers is most disappointing since it appears to be only slightly better than average.

The military man must recognize that development in reading is a gradual process which should not be halted in the elementary grades. Today's complex military organization demands that each person develop effective reading habits as a means to skillful communication. To become an effective, more mature reader an individual must develop proper reading skills.

COMPREHENSION

Comprehension is the most important factor in reading. It is, however, relatively hard to measure. If comprehension is defined as the "ability to understand what is seen or heard," then the basis of comprehension becomes the sum total of all the experiences and training that an individual has had. Comprehension is usually classified as being either receptive or reflective.

Receptive comprehension of written material involves a literal understanding of an author's surface meaning. To understand accurately, a person must have an adequate vocabulary and must be capable of grasping the intended significance of an author's words and sentences. He must also be able to concentrate. Words convey only surface information to the reader.

Reflective comprehension of written material deals with a reader's ability to determine the author's full meaning and to draw desired inferences from what he reads, as well as applying significant ideas to new situations. A reader must first understand surface information before he determines purpose and meaning. Reflective comprehension involves comparing what the reader knows about a subject with the author's presentation and deciding which of the latter's points to accept or reject.

Comprehension is considerably sharpened by an increased awareness that receptiveness and reflection are important aids to mental growth and improved communication. Reading comprehension depends upon concentration and the ability to grasp ideas and store them in the mind.

The effective reader organizes his approach to ideas to grasp the full meaning of written material. A skilled reader opens a book and charts his way before he starts to read just as a writer does before he starts to write.

A 3-step method for charting reading to improve comprehension follows.

Identification

First condense the book's message into a single statement or a short paragraph. Publishers and authors provide signposts that highlight objectives of books in titles, forewords, book jackets, prefaces, preludes, etc. Then each part must be analyzed. The table of contents provides an outline of what is to be read. Last skim the material in the first chapter. Here the author establishes a pattern to be followed in subsequent chapters. Here the writer notes the importance of his subject, relates it to other areas, defines terms, establishes principles, and indicates his writing style. This identification step assists a reader in organizing the thoughts in the book to be read.

Interpretation

The second step is to search for meaning when reading. This involves recognizing an author's frame of reference, his propositions, and the supporting evidence which is used.

FRAME OF REFERENCE. Knowledge of the author's background helps to establish a book's viewpoint. A book on "NATO" written by a former chief marshal of the RAF, would obviously present a British viewpoint. The reader may go to the index and select a few topics of personal interest. Then by reading these passages and noting the author's treatment of them, and the completeness of this treatment, the point of view will become clear and assist in comprehension.

DETERMINE AUTHOR'S PROPOSITIONS. Whatever the book, the reader must find the propositions that support the book's thesis. For example, an analysis of Major de Seversky's book, *Air Power—Key to Survival,* provides several propositions in support of the book's theme. The author comments on the essence of speed and mobility in our armed forces and the destructive power of nuclear weapons.

FIND SUPPORTING EVIDENCE. A good writer supports his major propositions. Facts, statistics, and reasoning are the evidence that supports main ideas. Major de Seversky proves that the Army and Navy do not move fast enough to counteract all enemy military situations; therefore, he concludes that only a strong Air Force can act as a major deterrent factor. One aid in finding supporting facts is for a reader to recognize that the paragraph is a cluster of sentences around a central idea. Most writers follow such a pattern by placing the key proposition in the initial sentence and then using the complete paragraph for emphasis.

Evaluation

The final step in charting reading is to evaluate the written material, based on the reader's understanding of the complete book. When a reader understands a book, he then agrees or disagrees with the author. When there is complete agreement, the reading has been completed. However, if there is disagreement, the reader has an obligation to the author. Why doesn't he accept the main thesis? Did the author use illogical reasoning? Were the facts and statistics inaccurate and outdated? Were generalizations based on small samplings? When he answers these questions to his satisfaction, the reader may disagree with the book's message. Reaching a decision completes the 3-step method for effective, critical reading.

READING RATE

How fast should a person read? A few years ago, "speed reading" was a national fad and numerous courses dedicated to it came into being. This pace has now slackened and controversy has developed about speed reading practices. The major dispute in speed reading is the contention that it is possible to read at thousands of words per minute. A further division exists between those who favor the use of various mechanical devices to speed up reading and those who feel the machines are worthless. Reading experts do agree, however, that the average reader plods along at a slow rate and that improvement can be made. Some reading laboratories report that the average person has been able, after 20 hours of practice, to increase reading speed from 60 to 100 percent, and comprehension from 6 to 10 percent.

Each individual has the potential to read at a faster rate, but hard work and practice are necessary for improvement. Professor Paul Witty, reading specialist, Northwestern University, esti-

mates that the average college graduate uses only about 20 percent of his reading capacity. He suggests that merely by trying harder, the reader can double his customary reading speed without any loss of comprehension.

Gains in speed are generally easier to achieve with instruction, but substantial gains are possible without supervision or laboratory equipment. To increase his reading rate, the reader must faithfully work toward several goals: an increased span of recognition, shorter fixations, no regressions, no subvocalization, and a larger vocabulary.

Increasing Span of Recognition

The reading of a line of written material is not accomplished by a continuous sweep of the eyes across a page. The eyes move and then pause several times as they cross a line, and reading occurs during the stops between movements. The frequency of these stops, or "fixations," is determined by the eye span, or the "span of recognition."

When the span of recognition is increased, fewer fixations per line occur; the result is increased speed. For example, when a fast reader reads *Time* magazine with full comprehension, he generally makes only two fixations per line. A slower reader may make five fixations per line in reading the same material. A fast reader takes in three or four words per fixation, whereas the slow reader may stop on every word.

With practice, the span of recognition can be increased. A handy medium for practice is the daily paper. Since newspapers are printed in narrow columns, it is possible to increase the eye span sufficiently to read each line with a single fixation, that is, to read straight down the column. Daily practice of this kind increases span of recognition.

A slow reader not only makes more fixations than a fast reader, but also takes more time on each fixation. By forcing himself to read at a rate that is actually uncomfortable, a reader can cut down on his fixation time. The drop-shutter machines used in laboratories can be set to push readers to much faster rates. A person who does not have access to a drop-shutter machine can force himself to shorten his fixation time. Using a watch with a second hand, he should first time himself in minutes and seconds while reading a page. He should then attempt to read each succeeding page at faster and faster rates. Comprehension does not need to diminish as speed increases. In fact, increases in comprehension usually accompany increases in speed.

Eliminating Regressions

When a reader's eyes move back toward the left side of a page to fix again on a word, he is regressing. Regressions hold reading speed down. The good reader makes few regressions; the slow reader makes many. Of course, some regressions are necessary to reexamine an unfamiliar word or to study the structure of a confusing sentence.

If a reader lets his mind wander while reading, he has to regress to pick up what he has missed. Reading laboratories use pacing machines to prevent regressions. By concentrating intently on what he reads, the reader himself can control his habit of regressing. If the reader goes too slowly to keep his mind occupied he forgets what he has read. Then he has to regress to pick up the thread of the author's thought. The good reader keeps his eyes moving and his mind interested. He keeps himself too busy for woolgathering and consequently does not make unnecessary regressions.

Eliminating Subvocalizations

Subvocalizing is another serious reading fault. Most people are taught to read aloud before reading silently. Upon beginning to read silently, they continue to vocalize, but silently. As they pronounce silently each word, they read no faster than when they read aloud. Few adult readers actually form syllables with their lips, but many either form the syllables in their throats or pronounce the sound mentally. This habit limits a reader's speed in silent reading to the rate at which he can form or listen to spoken words. Since few people can read aloud more than 250 to 300 words per minute, the subvocalizer is tied to that speed.

Subvocalizing can be overcome. The reader who vocalizes uses his eyes, his lips, his throat, and his brain. The good silent reader uses only his eyes and his brain. If the reader's throat muscles vibrate as he reads, he is using those muscles to say words silently. Chewing gum, smoking, or humming while reading may help a reader overcome the habit of subvocalizing. When a reader works his rate up to about 400 words per minute, he subvocalizes less and less. Con-

tinued practice at high speed will eventually free a reader of this restraining habit.

Overcoming Vocabulary Difficulties

The final step in improving comprehension and speed is to increase the vocabulary. The reader with a poor vocabulary must constantly regress to fix his eyes on unfamiliar words and to guess at their meanings.

Vocabulary can be improved in many ways. Probably the best way is to read widely. New words often become clear in context, as do new meanings for old words. One aid in building up a vocabulary is to look up new words in a dictionary, list them, and use them often. The person who acquires new words and new meanings for old words can read steadily and swiftly if he makes these words an active part of his reading vocabulary. Words are functions of thought, and by handling complicated thoughts in reading, a person can develop and strengthen a useful vocabulary.

Adaptability

Adaptability, adjusting speed to the level of the reading material, is the key to effective reading. The reader should be able to gear his speed to the importance and the difficulty of his reading material. The habit of reading everything at the same speed is a certain sign of an immature reader. Every reader should frequently check to make sure that he is adapting his speed and comprehension to his reading material and his purpose in reading.

Adaptability and discrimination go hand in hand. The discriminating reader knows what to read to get the results he wants. He carefully chooses what he reads. It is important to decide in advance what is to be gained from reading and then to read in the most efficient manner to fill this need. There is little point in reading rapidly just to get through material, and little profit in reading so slowly that valuable time is wasted. Materials that must be thoroughly understood should be read with critical attention to detail. It is worthwhile to slow down, think about, and savor excellence in style, description, or narrative. When reading for general information, however, speed can save valuable time for the reader without robbing him of the information that he seeks.

SUMMARY

Most people can develop the ability to increase reading rate and comprehension. The key to efficient reading practices is the adaptability or flexibility in adjusting reading rate to the material and to the purpose in reading. The main causes of slow reading are a short span of recognition, regressing, subvocalizing, and an inadequate vocabulary. Everyone can increase his rate of reading without reducing comprehension.

The following suggestions will help each person improve his reading:

- Try to get something out of reading. Read with a purpose.
- Read at a forced pace to eliminate daydreaming.
- Vary reading rate to suit purpose. Types of material dictate reading speeds.
- Look for main ideas in reading to aid comprehension.
- Do not read words one at a time—read groups of words for key thoughts.
- Be word-conscious—a large vocabulary enables one to be a more efficient reader.
- Try to keep from regressing; the efficient reader concentrates on the material.
- Eliminate movement of lips and throat muscles when reading. Subvocalization restricts reading speed to rate of speech.
- Read more to develop broader interests, to become better readers.
- Be relaxed when reading.

CHAPTER 10

Support Material

The organization of ideas forms the background of any speech, but almost all ideas need some form of clarification, explanation, or proof if the listener is to respond in a particular way. Every speech, if it is to be understood by an audience or if the speaker is to achieve a purpose, must be supported. Support material is the basic tool for clarifying, proving, illustrating, emphasizing, and adding variety.

Probably the largest single barrier to communication is the lack of listener understanding of the words used by the speaker. The instructor should help his students by defining words which are unknown or which have a special meaning.

In personal conversation the listener can ask, "What do you mean by that?", but those listening to a speech generally cannot. Therefore, the instructor should define unusual or unknown terms. Words which are known only to a select group, such as military terms, academic language, etc., should be defined.

EXAMPLES

As with words that need defining for clarification, many ideas need some type of support material to clarify them. The outstanding instructor is the one who can clarify and simplify his ideas. One of the best ways is through the use of examples and illustrations. Examples should always be related to the background of the audience. There are two important categories of examples—the short and the long.

The short or specific example is used most effectively in clusters of three or more. A single illustration does not reach all persons in an audience because of their varying backgrounds. Additionally, a listener may think that the illustration which is used is the only one which applies. In the following, short examples are used to clarify the fact that age is not necessary for outstanding achievement:

> Lindbergh made his famous New York to Paris flight when he was only 25. William Pitt was Prime Minister of England at the age of 24. Alexander Graham Bell had invented the first telephone at the age of 28. Dr. Robert M. Hutchins was Dean of the Yale Law School at 28, and President of the University of Chicago at 30. Henry Ford had built his first automobile at the age of 29, and Lord Byron had published his first book of poems at the age of 19.

The long or extended example is a detailed, rather lengthy illustration which is used to support a speaker's point. An extended example can be either factual or imaginary. The following is a factual illustration used by General of the Army, Douglas MacArthur.

> In all my long service, both in war and in peace, it is in football men that I have found my greatest reliance.
>
> One such man was from that undefeated 1949 Army eleven, its quarterback, noted for his long-ball passing, Arnold Galiffa. He was given command of a key platoon in one of our attacks, but the enemy held in spite of all our firepower to dislodge him. Our whole line shivered to a halt some 30 yards from its objective. But, suddenly Galiffa rose up, seized a package of hand grenades, and began rapidly lobbing them into the enemy's machine gun nest, barking in his staccato signal voice, "Colonel Blaik always told me when we were stopped at the line to go through the air." The breach was blasted, his platoon went through the hole; the goal was reached and the victory was won.

Long examples may be about actual occurrences, places, or things, or they can be created by the speaker. Although the imaginary example usually does not carry the weight of the factual example, it does have the advantage of specifically fitting a particular occasion. Jesus used imaginary stories such as the parable of the Good Samaritan, which was especially tailored for His

audiences and which made a particular point. Aesop's Fables are fictitious stories in which a useful truth is being explained.

COMPARISONS

A comparison is a bridge, built by the speaker, between the known and the unknown. The new thing or idea can be clarified by pointing out its resemblance or similarity to a familiar subject, idea, or situation. Comparisons can be factual or imaginary.

A factual comparison deals with things or situations that are similar and belong in the same category. An instructor might compare the United States Air Force with the Russian Air Force, socialism with communism, or a Royal typewriter with a Remington typewriter. Factual comparisons are generally remembered longer than mere statements of fact. Comparisons which point out the differences between things or situations are called contrasts.

Imaginary comparisons are best used to add variety or to get attention. When the likeness between two things is expressed tersely, it is generally a simile or a metaphor. For example: "She was as light as a feather;" "He sped down the road like a bullet." In the metaphor a word or phrase is applied to something to which it is not literally applicable to suggest a similarity. A classic example of a metaphor was used by Winston Churchill when he called the barrier between East and West an "iron curtain."

An extended imaginary comparison is called an analogy. An analogy suggests a parallel between a story and the point being made. In speaking to critics of his conduct of the Civil War, Abraham Lincoln used the following analogy:

> Gentlemen, I want you to suppose a case for a moment. Suppose that all the property you were worth was in gold, and you put it in the hands of Blondin, the famous rope walker, to carry across the Niagara Falls on a tight rope. Would you shake the rope while he was passing over it, or keep shouting to him, "Blondin, stoop a little more! Go a little faster!" No, I am sure you would not. You would hold your breath as well as your tongue, and keep your hands off until he was safely over. Now the Government is in the same situation. It is carrying an immense weight across a stormy ocean. Untold treasures are in its hands. It is doing the best it can. Don't badger it! Just keep still, and it will get you safely over.

STATISTICS

Statistics are a systematic compilation of single things or occurrences. When properly collected and wisely used, statistics can help a speaker prove his ideas. Statistics are no better than the source from which they come. An audience should always be given the source of statistics. Often statistics must be interpreted and translated into terms which can be easily understood by a particular audience.

One of the best ways of helping students comprehend statistics is to visualize them. Such devices as charts, graphs, and models can help an audience visualize the significance of the statistics the speaker is using. Statistics can be dramatized orally as well as visually. Large numbers usually do not impress an average listener. For example, most people do not realize what a billion dollars can buy. World War II cost the United States over 200 billion dollars; however, this figure means little to most people. If the speaker were to show that this sum would provide a comfortable home and a medium priced car for every family in the country, the figure would be more meaningful to most audiences.

Statistics are often useful when comparing one thing to another. Comparative statistics help an audience visualize similarities and differences between two ideas or things. Like ideas or things can best be compared. Differences between objects, ideas, or occurrences, when compared, usually affect statistics.

Audiences tire of statistics easily. The good speaker limits his use of them to key points which require proof. Unless a good reason exists for giving exact statistical data, round figures should be used. Listeners are not likely to remember $69,473.98, but they can remember "almost 70 thousand dollars." When exact figures are important, showing them visually will help fix them in the minds of an audience.

QUOTATIONS

Quotations allow a speaker to borrow ideas from all of recorded mankind. Quotations can be used to add variety and unique word usage, as well as to give proof by using testimony of experts. Quotations from such people as Shakespeare, Lincoln, and Churchill can be used effectively to open or close speeches and to add spice and humor.

Most speakers are not expert in all areas and therefore such terms as "I believe," or "It seems to me," carry little weight; they are assertions. Assertions are relatively weak; authoritative quotations are relatively strong—for speech support. The person being quoted should be an authority in his field because of his training, education, or experience. If the authority is not well known to an audience, the speaker should make it clear why the person being quoted is considered to be an expert. Testimony will only help prove a speaker's ideas if the audience believes the authority is an expert. An expert, quoted out of his field, is not truly an expert.

Quotations should be short. Often a speaker quotes information which is not pertinent. Quotations may be shortened if the meaning of the whole is not changed. One way to reduce the length of a quotation or to simplify it is to paraphrase it; the speaker's own words often make it easier for an audience to understand.

RESTATEMENT AND REPETITION

Frequently, an instructor should repeat what he has said for emphasis. One way to do this is to restate it in a different way. More than one approach to an idea is often necessary for clarification.

Main ideas or key points stand out, if they are repeated. Some instructions and directions need to be repeated again and again without change. Moreover, skillful repetition has persuasive force. Winston Churchill realized this when he rallied Britain during World War II by saying:

> We shall defend our island, whatever the cost may be. We shall fight on the beaches. We shall fight on the landing grounds. We shall fight in the fields and in the streets, and we shall fight in the hills. We shall never surrender.

VISUAL AIDS

Instructional aids can be used to help clarify and illustrate ideas. Many things are difficult to explain with just words. The instructor may find the use of charts, graphs, pictures, slides, and models reinforcing. The instructor should consider the advantages instructional aids can give him in making the best use of his time. How to use and select instructional aids is explained in Chapter 11.

One of the difficult problems confronting every speaker is the way in which he starts and ends his speech. Although support material is generally thought of in conjunction with the body of a speech, the speaker should also consider it for openings and closures. Stories, statistics, quotations, and comparisons can often be used to open or close a speech.

SUMMARY

Support material helps an instructor clarify, illustrate, prove, emphasize, and add variety to his lessons. If student understanding is to take place, the instructor must define unknown words or terms for his audience. One of the best ways to clarify ideas is through the use of well chosen examples or comparisons. Often, an instructor needs to offer proof for his ideas; statistics or expert testimony can do this. Main ideas can be emphasized by restatement and repetition.

CHAPTER 11

Instructional Aids

The classroom teacher can use instructional aids to improve communication between himself and his students. Instructional aids are defined by the Department of Audiovisual Instruction of the National Education Association as "Devices which assist an instructor in the teaching-learning process by simply presenting supporting or supplementary material, usually intermittently. They are not self-supporting." They may be either sight or sound devices, or a combination of both. The key factor is that aids support, supplement, or reinforce.

While an instructor may become involved in actually preparing aids, his main function is to plan their use so that they help to achieve maximum learning. He must understand some of the theory behind aids, some reasons for using aids, and some guidelines for their use. He should also be familiar with different types of aids.

THEORY

For many years experts have been theorizing concerning the activity which takes place within the human brain during the communicative process. There is much difference of opinion and little positive agreement concerning this matter. However, there is general agreement about three items of theory that seem pertinent to an understanding of the use of aids.

During the communicative process the mind acts as a filter. As great numbers of verbal or visual bits of communication are received, the brain works to sort out the important items from the routine descriptive or supportive items. Therefore, learning can probably be furthered by helping to identify the important bits. One way to do this is by using aids to emphasize them.

The brain also tries to organize the communication bits into reasonable arrangements. Verbal bits require considerable effort in this direction. Charts, graphs, pictures, and other organized aids reduce the effort needed here.

After the bits have been sorted and arranged, the brain is faced with the problem of storing the bits needed for future use. Storage efficiency and speed of recalling information are gained whenever it is possible to store a single bit (usually a visual one) instead of multiple bits of description. This increased efficiency is especially noticeable in dealing with concepts, theories, philosophies, and other abstract ideas.

REASONS FOR USE

Getting and holding student attention is essential to learning. Visual aids which support the topic cause both the seeing and the hearing channels of the mind to work in the same field. Remember, the instructor is a salesman of ideas, and many of the world's sales techniques for getting the attention of clients are worth considering. One caution —get student attention on the subject, not just on a distracting gimmick.

An important goal of all instruction is for the student to retain as much of the instruction as possible, and certainly the key points. Many studies have been made to determine the effect of instructional aids on learning retention. While the specific results of the studies vary greatly—from modest results in which retention increases 10 or 15 percent to exciting (and perhaps overly optimistic) studies in which the retention percentage is multiplied by 4, resulting in retention up to 80 percent—all agree that a significant improvement in student retention occurs when instruction is supported with meaningful aids.

One problem which plagues instructors is to

use words which have the same meaning for the student as they do for the instructor. This problem is compounded by floods of new technical terms, the differing vocabularies of people involved and, in some cases, by the need to communicate across the barrier of different languages. Use of visual materials plants in the learner's mind the same mental picture that is visualized by the teacher. The good instructor makes learning easier and more accurate for his student by providing him with visual images.

It is often difficult for a student to understand the relationships between materials and concepts. If the relationships are presented visually, they are much easier to deal with. For example, the subsystems within a physical thing are relatively easy to relate to each other through the use of schematics or diagrams. Symbols, graphs, and diagrams can also show relationships of location, size, time, frequency, and value. By symbolizing the factors involved, it is even possible to visualize relationships between abstracts.

Instructors are frequently asked to teach more and more in less and less time. Instructional aids can help him do this. Instead of using many words to describe a sound, object, or function, the instructor plays a recording of the sound and shows a picture of the object or function. Consequently, the student learns faster and more accurately.

GUIDELINES FOR USE

The use of any instructional aid must be planned on its ability to support a specific point in a lesson. A simple four-step procedure can be used to determine if and where aids are necessary.

1. First, clearly establish the lesson objective. Be certain of what is to be communicated. This is the most important step.
2. Next, gather the necessary data by researching for support material.
3. Organize the material into an outline or a lesson plan. The plan should include all key points that are to be presented.
4. Finally, and only after completing the previous steps, determine what ideas should be supported with instructional aids. The aids should be concentrated on the key points. Aids are often appropriate when long segments of technical description are necessary, when a point is complex and difficult to put into words, when the instructor finds himself forming mental visual images, or when students are puzzled by an explanation or description.

Aids should be simple and compatible with the learning outcomes to be achieved. Obviously, an explanation of elaborate equipment may require detailed schematics, but less complex equipment may lend itself to only basic shapes or line figures. Since aids are normally used in conjunction with a verbal presentation, words on the aid should be kept to a minimum. The instructor should avoid the temptation to use the aids as a crutch for himself. In many cases, visual symbols and slogans can replace extended wordage. The tendency toward ornateness and unnecessary distracting artwork should be avoided.

Aids have no value in the learning process if they cannot be heard or seen. Recordings of sounds and speeches should be tested for correct volume and quality in the actual environment where they are to be used. Visual aids must be visible to the entire class. All lettering and illustrations must be large enough to be seen easily by the students farthest from the aids. Colors, when used, should be in clear contrast, and easily visible. Numerous rules of thumb can be applied to visibility. The surest and most successful rule is actually to test the aids in the environment in which they will be used.

The effectiveness of aids can be improved by proper sequencing. Frequently, good organization and natural patterns of logic dictate the sequence. Sequencing can be made relatively simple by using acetate overlays on transparencies, stripping techniques on charts and chalkboards, and by imaginative use of felt and magnetic boards. Sequencing can be emphasized and made clearer by the use of contrasting colors.

The effectiveness of aids and the ease of their preparation can be increased by initially planning them in rough draft form. Revisions and alterations are easier to make at that time than after their completion. The rough draft should be carefully checked for accuracy of information, grammar, spelling, basic balance, clarity, and simplicity.

SOURCES OF IDEAS

Almost every school or base has a graphics or aids section staffed by professional visualizers and artists who can suggest new techniques, and

who frequently visualize and produce aids to meet specific learning outcomes.

Other instructors are a valuable source of ideas for aids. Sometimes their own methods of teaching can spark an idea. Sometimes, their specific suggestions, when requested, can be fresh and interesting because they are detached.

Commercial displays in newspapers and magazines, on television, and in stores can suggest imaginative ways of depicting ideas.

Finally, the instructor's own imagination, if he gives it full rein, is an excellent source of ideas for aids.

TYPES

Some of the most common aids are chalkboards, projected materials, models, charts, and maps.

Chalkboard

The chalkboard is one of the most widely used tools of learning. Its versatility and effectiveness make it a valuable aid to most types of instruction. Two characteristics of the chalkboard are significant: (1) the material presented on it can be erased, allowing the surface to be used again and again; and (2) the chalkboard serves as an excellent medium for joint student-instructor activity in the classroom.

The following practices are fundamental in the use of the chalkboard:

- Keep the chalkboard clean.
- Erase all irrelevant material.
- Keep chalk, erasers, cleaning cloths, rulers, and other aids readily available to avoid interruption of the presentation.
- Organize and practice chalkboard presentation in advance.
- Write or draw large enough for everyone in the group to see.
- Do not overcrowd the chalkboard. Leave a margin around the material and sufficient space between lines of copy.
- Present material simply and briefly.
- If necessary, use the ruler, compass, or other devices in making drawings.
- Use colored chalk for emphasis.
- Underline statements for emphasis.
- Use a pointer when discussing chalkboard materials.
- Stand to the side of the material being presented so that the entire class will have an unobstructed view.

Projected Materials

This grouping includes motion pictures, filmstrips, slides of several sizes, transparencies for overhead projection, and materials used in the opaque projector. The essential factor governing their use is that the content must support the lesson.

Motion pictures can bring many realistic situations to the classroom. Usually, they emphasize key points with no unnecessary details. The combination of motion and sound appeals to students. The availability of packaged lessons or lesson segments is attractive to instructors. Care should be exercised to insure that the lesson is being supported, not supplanted. Films should be previewed and summarized before use.

Use of other projected materials can be flexible. The sequence of filmstrips is predetermined, but it is possible and sometimes wise to show only selected frames. Slides, transparencies, and opaque items can be placed in any sequence.

Use of projected materials requires careful planning and rehearsal by the instructor for equipment, lighting, and timing.

Models

A model is a realistic copy of an actual piece of equipment. Models are not necessarily the same size as the equipment they represent, nor are they necessarily workable.

Models can be used effectively in explaining operating principles of various types of equipment. They are especially adaptable to small group discussions in which students are encouraged to ask questions.

A model is even more effective if it works like the original, and if it can be taken apart and reassembled. With the display of an operating model, the students can observe how each part works in relation to the other parts. When the instructor points to each part of the model as he explains these relationships, the students can better understand the mechanical principles involved.

As instructional aids, models are usually more practical than originals because they are lightweight and easily moved.

Charts

Illustrations, graphs, statistics, diagrams, and other visual material can often be displayed in chart form. The most important factor is the chart's content. Charts may be a series of single stiff cardboards or a series of thin flexible flip charts. The material should be displayed in a clear, easily understood format. The location and handling of charts should be carefully planned and rehearsed.

Maps

Maps reduce geographic areas to workable dimensions and visualize topographical and political features, such as distribution of people, land and water areas, animal and vegetable life, climate, economic resources, and political units. Many varieties of maps are available to the instructor. He should select those that contain appropriate information and are on a scale suitable for his class.

FUTURE DEVELOPMENTS

Recent years have seen an explosion of new materials and techniques in the field of instructional aids. They present many new opportunities for the instructor, but they may also confuse him by their very abundance and variety. While he must keep in mind the teaching goals to be achieved, the instructor must also be selectively receptive to new possibilities. Recent developments include improved projectors, 8mm. film loops, new slide production cameras, simplified techniques and equipment for making transparencies, rear screen projection, improved adhesives, and many materials for models.

Effective instructors must keep abreast of both new materials and the potential uses for them. They should read extensively in professional journals about these new instructional materials. Above all, they should develop creative imaginations. There is always a better way to accomplish a learning outcome.

SUMMARY

Instructional aids are devices which present supporting or supplementary material to improve the teaching-learning process. The use of aids is based on widely accepted theories about mental processes. These theories suggest that the mind works as a filter in sorting out the important items of the verbal or visual information which is presented. Then it tries to organize these items into reasonable patterns. Finally, the brain finds it more efficient to store single visual bits of information, instead of large numbers of verbal bits.

There are many reasons for using instructional aids. Among the reasons most significant to military instructors are opening and keeping open the communication channel, increasing the retention of learned material, insuring that teacher and student have a common mental picture of meanings, understanding relationships, and teaching more in less time by the elimination of long verbal descriptions.

Aids come in a wide variety of types, such as chalkboards, projected materials, models, charts, and maps. Sensible guidelines should be used in planning and using any aid. These guidelines include planning each aid to support a specific idea, keeping aids as simple and uncluttered as is compatible with the learning outcomes, insuring visibility as to size and location, properly sequencing aids, and planning aids in rough draft form.

An effective instructor should always be aware of new ideas in the field of aids. An active imagination will reveal unlimited possibilities. The aids must support the ideas being developed.

CHAPTER 12

Logical Thinking

Man is able to judge, reflect, imagine, form opinions, and reason. In brief, he can think. All types of thinking directly affect success in teaching. Of the many types of thinking, one—logical thinking, or reasoning—is essential to educators. This chapter discusses logical thinking, including the types of data or evidence used in reasoning, the basic reasoning processes, and some common errors in thinking that can cause it to be illogical.

EVIDENCE

Reasoning, the process of drawing inferences, of applying judgments to arrive at conclusions, must be based on information of some type. The information or evidence which is used to support reasoning is of two main kinds: facts and opinions. Facts are observed events; opinions are the conclusions and judgments of authorities or specialists.

Unless a person intends to limit his sources of facts and opinions to his own realm of observation and his own field of authority, he must accept as evidence for his reasoning the reports of other observers and the opinions of authorities besides himself.

Observers and authorities must be reliable and relatively free of bias and prejudice. The reliability and objectivity of observers and authorities can be verified by the affirmative answers to certain questions such as: Was the observer in a position to learn the facts? Is the authority actually an expert? Is he expressing opinions in his own field? Is he being quoted fully and correctly?

TYPES OF REASONING

Before the ideas and conclusions of any authority are accepted as valid, the reasoning processes that led to the ideas and conclusions should be checked. Did the authority use valid evidence? What was the basis for his conclusion? Why did he reach this conclusion instead of others that seem to be equally sound? These questions are difficult to answer without some knowledge of the reasoning processes. These processes are of two general types: inductive and deductive.

Inductive Reasoning

In the inductive process of reasoning, conclusions are drawn from the study of evidence or specific instances. The reasoner gathers and studies data from which he draws inferences and later arrives at conclusions. If, for example, a person wanted to determine whether a large object would fall faster than a small one, he might seek out an elevation from which he could drop objects of different sizes. After making repeated drops and taking notes on each, he would study all his records to arrive at conclusions. Data gathered in this manner become the logical support for conclusions reached through inductive reasoning. Sound induction depends on complete and accurate data about enough individual cases to justify making a generalization, or stating a principle. The data may be studied in a number of ways: through generalizing, hypothesizing, seeking causes for effects, or through some combination of these three ways (Fig. 3).

GENERALIZATION. In generalizing, inferences are drawn and conclusions formulated about a class or group of things after studying only a part of that class or group. Public opinion pollsters, for example, gather and study the opinions of a relatively small number of citizens, and from this sample, they reach conclusions about the opinions of the entire population. Speakers and writers do

much the same thing. They frequently cite examples to prove or illustrate points. These examples are selected as typical, and they are used as support for certain conclusions, with the intention of showing that the conclusions are true and will, in all cases, be true.

If a conclusion is based on the study of too few samples or on samples that are not typical, it may be a "hasty generalization." In dealing with large groups or classes, such as the voting population of a country, the reasoner must use statistical methods to make sense out of the vast amount of information collected. The process of getting a typical cross section or sample of a large group is a science in itself, yet people are often asked to accept conclusions based on a few samples or on rigged samples. These conclusions are hasty generalizations. Examples can be used appropriately to illustrate or clarify points in discussion. But the isolated or unique example must be carefully studied, no matter how dramatically it seems to support a point. It may pave the way to a conclusion that is nothing but a hasty generalization.

HYPOTHESIS. Quite often a person who is studying data starts with a tentative goal in mind. He may form speculative theories to explain certain facts that he has gathered. These trial suppositions are called hypotheses. A hypothesis can help the investigator select evidence for study and can give direction to his work. When the necessary data has been gathered, it must be studied so thoroughly that it tests the thesis and leads to a conclusion. A careful and honest reasoner is as ready to disprove his hypothesis as to prove it. He does not discount evidence that fails to support a conclusion he favors. No matter how credible his hypothesis may seem to be, he must objectively test its validity.

CAUSE AND EFFECT. In this type of introduction, the investigator studies some occurrence or some form of human behavior in an effort to discover what phenomenon caused it. If he can show that a particular phenomenon actually produced the specific result that he is studying, he can then argue that the same cause will always produce that result. A person who investigates mechanical problems can usually demonstrate cause and effect with a fair degree of certainty. The skilled airplane mechanic, for example, can locate the cause of engine malfunction by using trouble-shooting procedures. If he finds that the cause is a defective part, he can say that under the same circumstances a similar defect will again produce the same engine malfunction.

The student of human behavior cannot, however, relate causes and effects with the same degree of certainty. Who can say precisely what makes people act as they do? It is very difficult to isolate the causes of human behavior. Even when the causes are successfully isolated, they do not necessarily reflect the truth, since it may lie in the interrelation of various causes. Furthermore, the circumstance that causes certain behavior in one individual or group may not produce the same behavior in individuals or groups with different backgrounds or experiences.

Inductive reasoning does not always lead to positive conclusions. Sound induction that is based on valid evidence can, however, lead to credible conclusions that are acceptable for most practical purposes. Negative evidence, evidence that tends to destroy a hypothesis, cannot be ignored. It is possible for a small amount of negative evidence to invalidate a considerable amount of data, hence disproving a conclusion. The possible invalidation does not mean that the processes of induction are faulty. It means that inductive methods must be used with care to insure acceptable conclusions. In addition, the conclusions must be reviewed continually, and if new evidence indicates the need, the conclusions must be modified accordingly.

Deductive Reasoning

In the deductive process conclusions are used as propositions, that is, as statements on which to base further discussion and references. The propositions are studied and arranged to establish relationships that permit new conclusions to be developed. The conclusions that are used as propositions are the result of reasoning, either inductive or deductive; it does not matter which (Fig. 4).

Formal logic is not concerned with the truth of propositions. Its sole concern is that the propositions be stated and arranged so as to lead logically to a conclusion. Acceptible deduction, however, is a different matter. To be valid, it must follow the formalities of logic and also deal

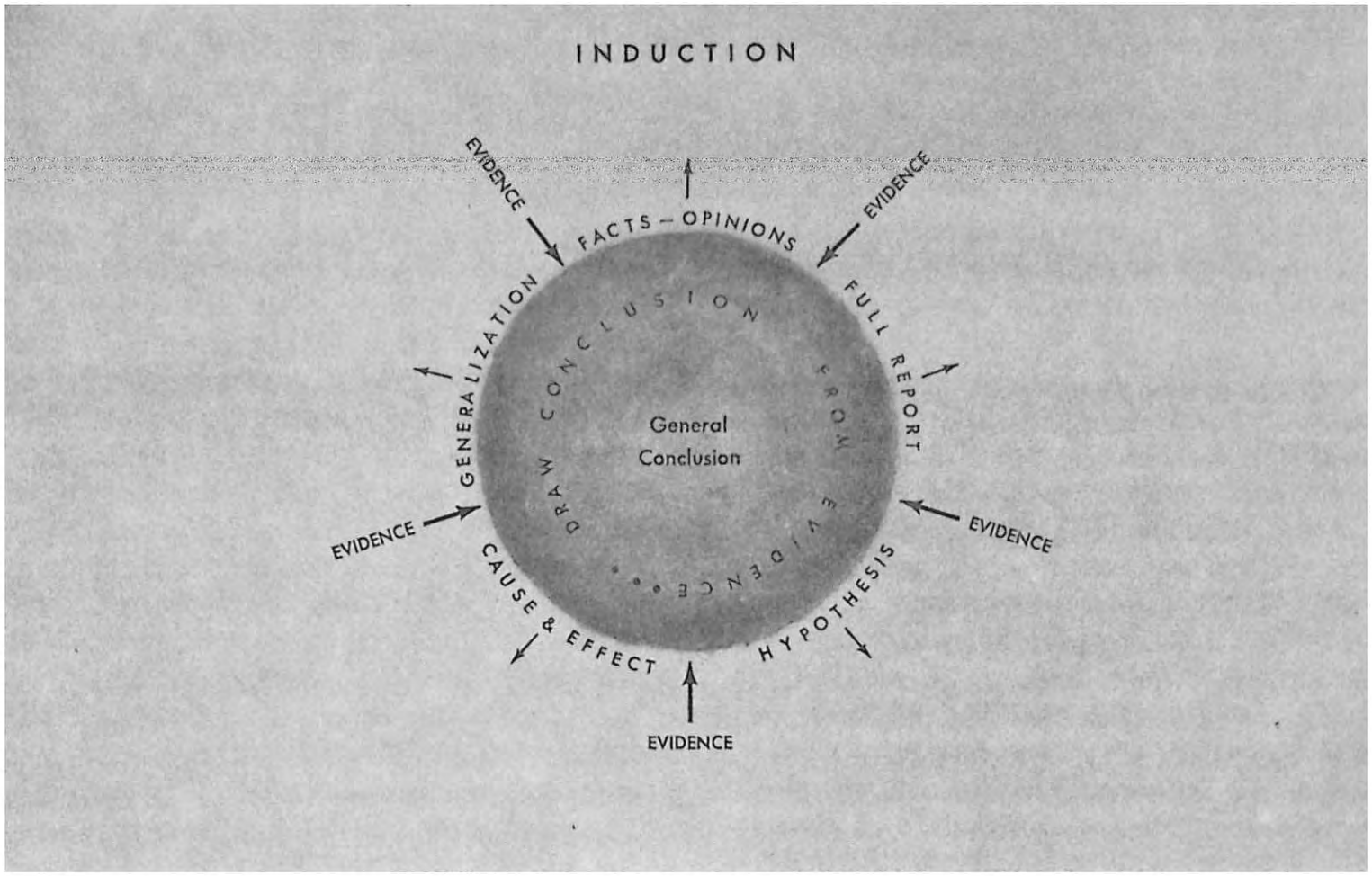


Figure 3. Induction

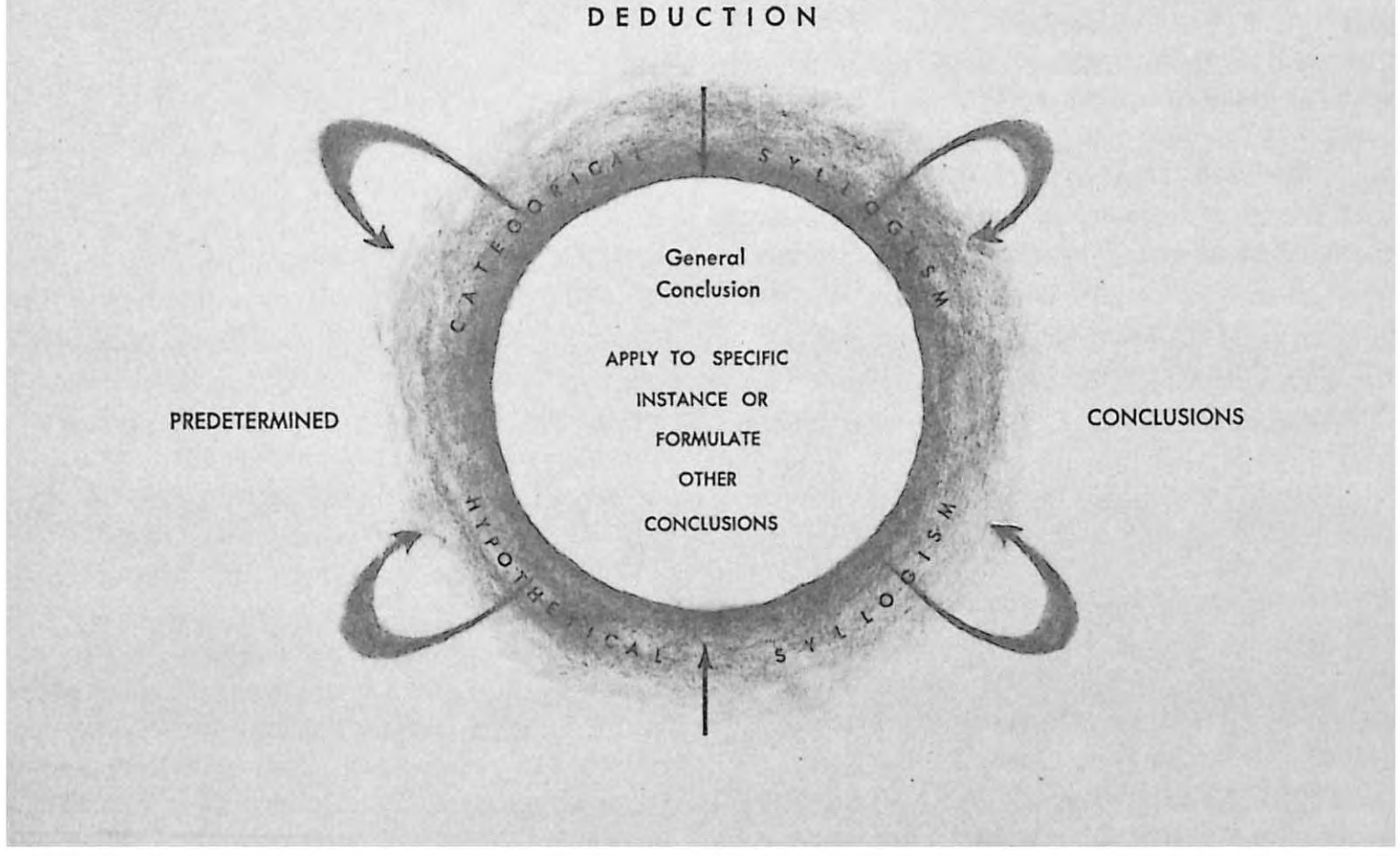


Figure 4. Deduction

in truths. To insure the validity of his conclusions, the deductive thinker must examine the evidence and the reasoning that underlie his propositions. He realizes that his conclusions can be no more valid than the propositions on which they are based.

For purposes of analysis and study, deductions can be expressed according to a prescribed pattern, called a syllogism. Although speakers and writers rarely express themselves in syllogistic terms, farmiliarity with the syllogistic pattern is a help in checking the validity of deductions.

Aristotle observed that a syllogism exists whenever two propositions, or premises, are formulated and expressed so that a conclusion necessarily follows. The most significant types of syllogisms are the categorical and the hypothetical.

CATEGORICAL SYLLOGISM. This type of syllogism has a major premise, a minor premise, and a conclusion, as follows:

Major Premise: All Regular Air Force officers are over 21.

Minor Premise: Jones is a Regular Air Force officer.

Conclusion: Therefore, Jones is over 21.

The categorical syllogism deals with a category. or class, of items. The major premise makes the statement that all the items in a certain class have a particular characteristic. Once the reasoner has established his major premise, he studies a specific item or instance to see if it falls into the class mentioned in the major premise. If so, the reasoner states that fact as his minor premise. The conclusion then follows as a matter of course: that the specific item or instance possesses the characteristic of its class.

To be valid and to result in a conclusion that is true, a categorical syllogism must meet certain criteria.

- The syllogism must follow the prescribed format.
- The premise must state actual facts.
- The major premise must concern all items in the category mentioned.
- The major premise must not offer alternative characteristics.

HYPOTHETICAL SYLLOGISM. As the name suggests, this type of syllogism poses a condition, or antecedent, which, if true, is followed by a consequence. The minor premise must either affirm that the condition exists or deny that the consequence has followed. Two examples follow.

(condition)

Major premise: /If Brown wrote the book,/

(consequence)

/it is a good book./

(condition affirmed)

Minor premise: /Brown did write the book./

Conclusion: It is a good book.

(condition)

Major premise: /If Brown wrote the book,/

(consequence)

/it is a good book./

(consequence denied)

Minor premise: /It is not a good book./

Conclusion: Brown did not write the book.

Reasoning and the Instructor

To be effective, an instructor must continually apply logical reasoning techniques and procedures in both planning and presenting a lesson. Consider the illustration in Figure 5. After selecting the topic, an instructor, in planning a teaching lecture, determines the lesson objective. This objective may be compared with the general conclusion identified in the preceding paragraphs. Through the deductive reasoning process, this objective is used to formulate sub-objectives or desired learning outcomes. Planning is completed after adequate support material or evidence is obtained for each of the desired learning outcomes. During the presentation of the lecture, the instructor uses the inductive reasoning process. The support material for each of the desired learning outcomes is presented primarily by oral communication, and through inductive reasoning, the students are led in the teaching process to an achievement of the over-all lesson objective.

By taking into account all the affirmative and the negative evidence that is available, the inductive reasoner can reach credible conclusions. As mentioned earlier, these conclusions can be followed safely for as long as the evidence remains the same.

When the deductive reasoner follows the prescribed syllogistic format and states truths in his propositions, his conclusions are logical and factual. If, however, his premises are inaccurate or vague, he may arrive at conclusions that are not

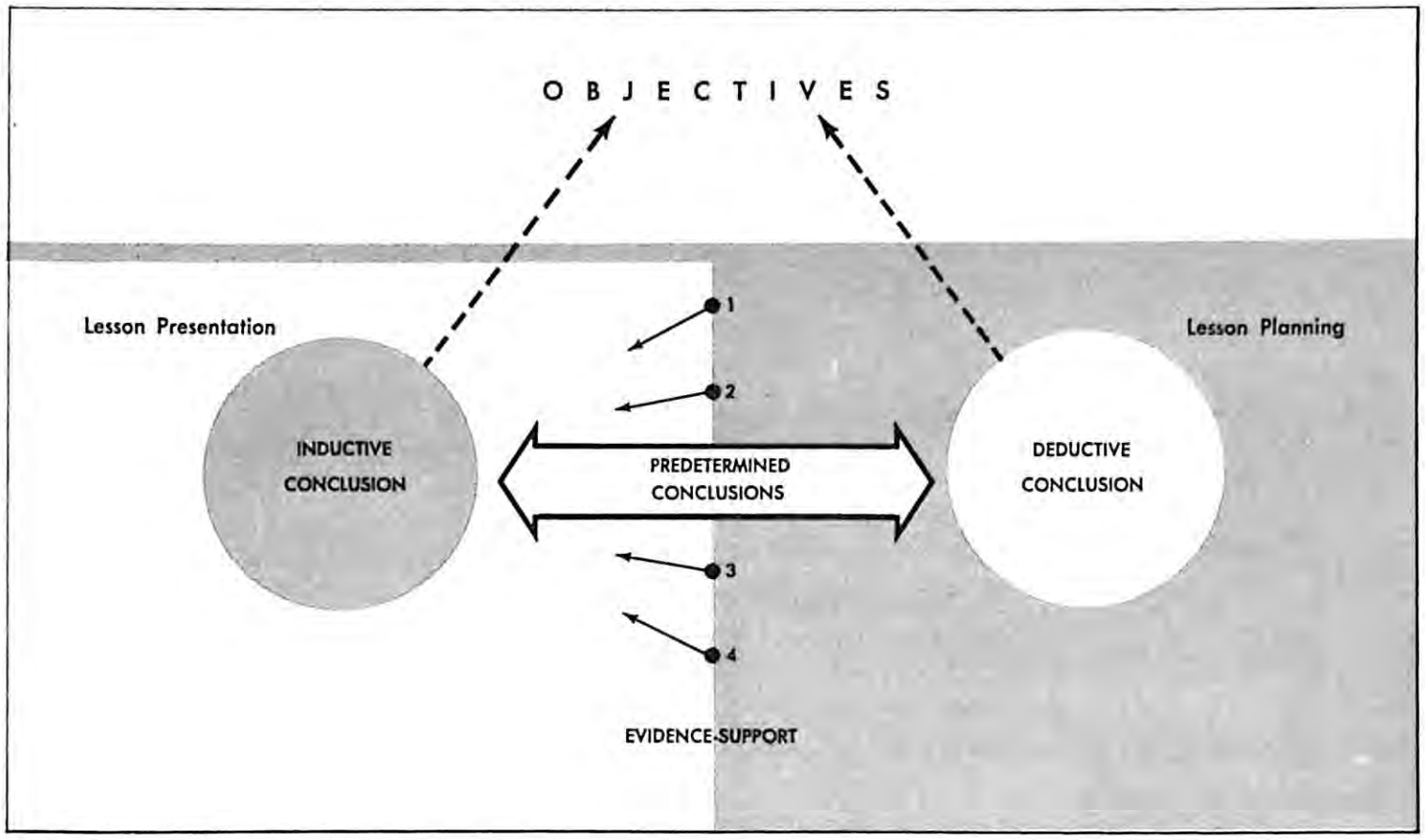


Figure 5. Reasoning and the Instructor

valid. For example, consider the following syllogism:

Major Premise: All red headed men have bad tempers.

Minor Premise: John is a red headed man.

Conclusion: John has a bad temper.

Although the logic is faultless, the conclusion is invalid because the major premise is inaccurate.

In both types of logical thinking, the reasoner assumes a heavy responsibility. The inductive reasoner must take care to examine, evaluate, and use all evidence pertinent to his conclusion. The deductive reasoner must use specific and reliable facts, and he must follow rigid guidelines in applying them.

The receptor should never assume that the reasoner has met the standards of reliability and logic. Instead he should maintain a critical attitude. By scrutinizing the evidence and the logic used to support a conclusion, he can test the quality of the conclusion by answering certain questions: Is the evidence for this induction accurate? Is it complete? Does it support the conclusion? Are the propositions in this deduction true? Are they arranged to show a relationship from which the conclusion must follow? Unless these questions can be answered affirmatively, the conclusion should be rejected by the reasoner himself, and if not by him, by the receptor.

An objective, questioning attitude can bring to light any fallacies that may exist in reasoning. Intelligent readers and listeners should examine the reasoning behind words, no matter how appealing the words themselves may be. It is not unusual for speakers and writers to present conclusions based on logic that is only superficially acceptable. Close scrutiny of their facts or their propositions reveals gaps or errors in their facts, or liberties taken in their use of reasoning patterns.

ILLOGICAL REASONING

It is not enough that instructors understand logical thinking. They must also understand how many people misuse logic or use what might be called illogical reasoning. A critical attitude plus the application of the rules of logic generally alert a receptor to this kind of reasoning. Two of the most common forms of illogical reasoning are the figurative analogy and the faulty dilemma.

Figurative Analogy

To be useful in supporting points made in oral or written discussion, an analogy may be literal or figurative. If it is literal, it must compare two similar cases in the same general class or category. A comparison of two schools, two cities, or even two automobiles may offer valid support for a point. Sometimes, however, people are asked to accept as valid a conclusion based on figurative analogy which compares cases in different classifications. The folly of changing horses in the middle of the stream, for example, is often cited as a reason for not changing office-holders at election time. This kind of analogy does not affect the validity of the conclusion one way or the other. To be valid, a conclusion must be based on truth. Facts and reliable opinions can prove points, but figurative analogies cannot. Figurative analogies, on the other hand, can help illustrate a point.

Faulty Dilemma

When a communicator offers his receptors two extreme propositions and implies that no other choices exist, he is using a faulty dilemma. The militant pro-Communist, for example, might brand all who do not join him as right-wing reactionaries. The usual procedure is to seek support for a certain proposition by offering, as the only alternative, a proposition that is almost certain to be rejected. When urged to choose between two alternatives, the alert receptor refuses to be blinded to other, perhaps more acceptable, courses that he might follow.

One of the common types of faulty dilemma is the loaded question. This familiar device employs the trick of including an assumption, perhaps the desired answer, in the question. An old cliche provides an example: "It is true that you have stopped beating your wife?" Propagandists sometimes use this type of fallacy to good advantage. The loaded question that is perhaps most difficult to recognize is one that is composed by welding two questions into one. For example, "Are you willing to reduce the flow of money into capitalist pockets by supporting increased taxes on dividends?"

EMOTIONAL APPEALS

Many speakers and writers base their reasoning on emotional appeals. These appeals discard logic and deliberately play on human feelings to bring about a transfer of feeling from one object or concept to another. The communicator hopes his readers or listeners will not realize that they have no reason to feel about the second object as they do about the first. Emotional appeals are of many types; three of the most common are the bandwagon, the plain folks, and the glittering generality.

Bandwagon Appeal

This appeal puts pressure on people to accept or reject an idea because it is "the thing to do." The communicator promotes the feeling that the individual would be presumptuous to judge for himself something that his group accepts. The success of advertisers in promoting changes in clothing fashions is due, at least in part, to the appeal of "getting on the bandwagon," of "being in style."

Plain Folks Appeal

This appeal is based on the implication that because plain people have more "horse sense" and greater ability to "think straight" than sophisticated people, the ideas of plain people are good ideas. The communicator who describes himself as "just a country boy like lots of you" is using this appeal. The idea that the best reasoning is done by people with "common sense" is also based on this appeal. "Snob appeal," which is equally fallacious, goes to the opposite extreme by implying that the thoughts or preferences of the wealthy or social prominent individual are better than those of the "common man."

Glittering Generality

This appeal is an attempt to win approval for an idea or a project by giving it an appealing title. A politician might use this appeal by describing his pet revenue measure as "typifying the American way." Some organizations that are listed on the Armed Forces Security Questionnaire as "having significance in connection with security" have such deceptive titles as "Council for Pan-American Democracy" and "Voice of Freedom." Glittering generalities can be highly persuasive in advertisements, propaganda, newspaper editorials, public speeches, and day-to-day conversations The challenge is to recognize not only the obvious but also the subtle examples.

SUMMARY

Evidence consists primarily of facts and opinions. To provide a sound basis for inductive and deductive reasoning, evidence must be complete, valid, and reliable. Sound evidence and sound reasoning result in logical thinking.

In induction, the reasoner studies specific instances and from them draws inferences on which he bases conclusions. This type of reasoning may be accomplished by generalization, hypothesis, cause and effect, or by a combination of any or all three. Complete and accurate data on an adequate number of cases must be used, however, to reach logical conclusions.

In deduction, conclusions serve as propositions on which to base further inferences that lead to new conclusions. Deductions can be expressed according to prescribed patterns called syllogisms. The main types of syllogisms are the categorical and the hypothetical. In both, two propositions are formulated and expressed in such a way that a conclusion must follow. When valid propositions, or premises, are expressed and related as prescribed, they can lead to positive conclusions that are reliable.

Logical thinking is vitally important in the field of education. Its application by the instructor in lesson planning and presentation directly affects the quality of instruction. Its application by the student, especially in the receptor skills of listening and reading, directly affects the quality and level of learning achieved.

The reasoner and the intelligent receptor both have a responsibility to reject illogical reasoning. By adopting a critical and objective attitude and by recognizing the fallacies that can invalidate conclusions, an individual can promote more valid reasoning. Although appeals to emotions have a place in teaching, an instructor must realize that the most permanent learning takes place when ideas are logically and accurately presented.

CHAPTER 13

Creative Thinking

Because of the scientific explosion since World War II, neither the instructor nor his students can be knowledgeable on all phases of Air Force operations. But they do have ideas and imagination. This country has always had individuals of vision who had the courage to dream and, what is more, to translate their dreams into usable ideas. Jet aircraft, missiles, space travel, lunar exploration, nuclear power, electronic computers, television—all of these modern marvels started out as ideas in the minds of ordinary men.

Alex F. Osborn, author of *Applied Imagination,* identifies four mental powers possessed by all human beings in varying degrees. He identifies these as the power (1) to absorb knowledge; (2) to memorize and recall knowledge; (3) to reason—the ability to analyze and to judge; and (4) to create—the ability to visualize, to foresee, and to generate ideas.

A student's education and past experience usually develop the first three powers but often neglect the fourth. New thinking and new patterns of experience are not always demanded or even encouraged in the classroom. The challenge facing instructors today is to teach creatively so that learning can become a living adventure.

To create is "to produce as a work of thought or imagination, especially as a work of art or of dramatic interpretation along new or unconventional lines." Many synonyms exist: make, build, produce, fashion, invent, originate. Creativity by definition, then, must incorporate something peculiarly individual. It cannot be a copy of that which already exists. An instructor who finds new and better ways to teach is creative. When he uses his imagination to recombine known elements into something new and fresh, he is creative.

CREATIVE PROCESS

The creative process consists of a series of experiences, each of which builds on previous experiences and leads directly to other experiences. There is a continuous merging until a final whole is realized. Norman F. Munn, author of *Psychology: The Fundamentals of Human Adjustment,* says that the process occurs in successive stages, which he divides into four periods: (1) preparation; (2) incubation; (3) insight, illumination or inspiration; and (4) verification.

Preparation

In reality, the period of preparation takes in all past experiences, but it is intensified and becomes specific when, for example, an instructor gets a feeling that something is not as good as it can be and he is motivated into improving it. He becomes sensitive to the problem, collects relevant information about it, and attempts to organize this information into usable data. The preparation period is a time of concentration, routine work, and trial and error.

Incubation

The period of incubation is one of unconscious activity during which solutions begin to take shape. Because he does not progress consciously the individual may experience frustration, restlessness, and feelings of inferiority and insecurity. A change in activity, or deliberately setting the problem aside for awhile, will allow the subsconscious to take over. If the process is successful, new ideas may occur within hours, perhaps in days or weeks, but they will occur.

Insight

The period of insight comes when past experience is reorganized. It may occur when least expected, in various places, times, and ways. Sometimes, it is a flash, a useful hunch, an "aha" experience, a sudden illumination. Success is sensed immediately and the creative thinker works rapidly to capture the idea and to develop it into a meaningful whole.

Verification

The period of verification takes place when the idea is tested and evaluated, and when its usefulness has been established. Not all ideas produced in this manner are useful or valuable. John E. Arnold, a psychologist and mechanical engineer, emphasizes the importance of this fourth period of the creative process:

> An idea by itself is not the sum total of the creative process. An idea is conceived, it is developed, it is communicated and sold to others before the process of innovation is complete.... Few ideas are in themselves practical. It is for the want of imagination in *applying* them, rather than in acquiring them, that they fail. The creative process doesn't end with an idea—it only starts with an idea.

Before they are implemented, many ideas must be approved by curriculum committees, school commandants, or by higher authorities. Unfortunately, some good ideas are never approved because of poor communication techniques in presenting them. This, of course, does not negate the value of the idea, necessarily, but it does emphasize the creative thinker's responsibility beyond the four basic stages of the inception of an idea.

BLOCKS TO CREATIVITY

To think creatively, the instructor must overcome certain obstacles which may be viewed as blocks or barriers to his creativity. Habit, fear, prejudice, and inertia are four common barriers having great influence on creativity. Recognizing and understanding these barriers are the first steps toward overcoming their influence or reducing their effect.

Habit

Habits exist in the routine of everyday life. Some habits work to our advantage; others tend to channel us into set ways of procedure and perception. Anything that creates an attitude of resistance to change is a barrier to creativity. Perceptual habits must be analyzed and trained to see dimensions. Another type of habitual thinking may be described as "functional fixedness." We assign certain functions or characteristics to people or things and then find it difficult to see any other functions or characteristics in these people or things. For example, if we think of a man as a mechanic, in our minds he remains a mechanic despite his qualifications in other fields. A paper clip has the obvious function of holding paper, but, if we go beyond this functional fixedness, we can find any number of uses for this paper clip.

Fear

Fear often hinders creative thinking. There are many kinds of fear, and it is easy to see how each kind might keep a man from trying something new. It all adds up, perhaps, to a desire to conform. The fear of ridicule, laughter, loss of prestige, or of being branded as an oddball may affect the frequency of new, original or unconventional ideas. Probably everyone has hesitated to ask a question even when he wanted or needed an answer because he was afraid of sounding silly. The same kind of fear affects staff meetings. The commander asks for suggestions for solving a problem, and almost everyone sits back afraid to voice his idea because it might make him look ridiculous. Those who say nothing may be afraid to propose something new because it might reflect on their judgment or ability to do a job. Fear can do more than silence us; it can cause panic and keep our minds from operating effectively.

Prejudice

By effectively preventing the consideration of certain methods, materials, or people, prejudice can constitute an almost insurmountable barrier to creative thinking. Prejudice can limit one's thinking in two ways: first, by automatic rejection of certain ideas against which a person is emotionally biased, and, second, by restricting his consideration to certain favorite methods, materials, or people. Anything that arbitrarily restricts thought may prevent us from seeing the best solution, and prejudices are strong forces for unreasoned rejection of certain ideas. Only rarely can prejudice be effectively attacked with logic. Probably the best attack is to learn to recognize prej-

udice in ourselves and others and to meet all situations with an open mind and a receptive attitude.

Inertia

There are two aspects of inertia—static and dynamic. Like habit, inertia has its positive values as well as its negative aspects. There is no denying that human and organizational inertia provide stability and continuity. However, inertia acts against creativity when we accept things as they are and do not look for new and better ways of doing things. Inertia can restrict the challenge to venture beyond the well-worn path of familiar routine and habit. It can cause a static condition where very little progress or achievement can be realized. The best attack on the inertia barrier is "action."

These four barriers represent some of the possible blocks to creative thinking. There are others that may apply on individual basis. The effective instructor must identify forces that inhibit thought processes and overcome them. An awareness of these barriers will open the door to a more creative atmosphere and to an attitude that will stimulate creativity.

CREATIVE ENVIRONMENT

Research at the University of Southern California under the direction of Dr. J. P. Guilford, a noted psychologist, concludes that creativity can be deliberately developed and that it is indispensable to leadership. Instructors should provide students with the kind of training that will develop their creative potential. The ideal creative environment is one in which students and teacher feel secure, are at ease with each other, and enjoy working together. Ideas are shared because communication channels are open between teacher and student.

Dr. E. Paul Torrance, noted psychologist at the University of Minnesota, says that children and adults learn and develop along whatever lines they find rewarding. He believes creative thinking can be rewarded in the following manner:

- Treat unusual *questions* with respect.
- Treat unusual *ideas* with respect.
- Show students that their ideas may have value.
- Provide opportunities for self-initiated learning and give credit for it.
- Provide periods of non-evaluated practice or learning.

On the basis of research dealing with the characteristics of the creative personality, Dr. Torrance found that "teachers are not able to free the creative capacities of their pupils if their own values do not support creativeness." Evidence showed that in some cases creative behavior had been punished rather than rewarded.

Gilbert Highet, in his book, *Man's Unconquerable Mind*, says that creative teachers "recognize the almost limitless treasure of ability and creativity that every pupil carries about in the locked safe of his mind, and he, the teacher, always hopes and strives to unlock it."

Ben S. Gilmer, President, American Telephone and Telegraph Company, says

Give us from the colleges and universities:

- Men who have been taught—even forced if necessary—to think for themselves;
- Men who doubt the methods of the past;
- Men who are able to conceptualize the future;
- Men who have the boldness and imaginativeness to pioneer in the development of new busines ssystems and new businesses;
- Men who have the ingenuity and drive to develop and re-improve new devices and techniques.

Many teachers often seek facts when they should be seeking ideas. "Traditionally the lecture method is the most widely used in college classes," says John Carr Duff of New York University. He continues to say that the lecture has serious limitations as a teaching device, unless it is supplemented by other methods—discussion, debate, argument, demonstration, experimentation, and a wide variety of methods that involve the students as active participants. Unfortunately, many teachers, to improve their teaching, have turned to motion pictures, television, or some other mechanical or electronic devices which do not always cultivate or develop creativity. Duff believes that every classroom is a laboratory in which the instructor must be aware of action and reaction, of cause and effect, in the educational process.

Too many of our military classrooms are teacher-dominated, teacher-centered, and teacher-evaluated. Authoritarian management tends to punish the free spirited student and to reward students who are made in the teacher image. Sometimes students are taught that they must be

responsive to control if they wish to get ahead; that pleasing the teacher is more important than personal perfection; that acceptance of drills from a textbook chosen by those who hold reward or punishment at their discretion is easier than self-initiated exploration of the mysteries of truth.

Dr. Torrance states that the creative instructor-pupil relationship is not a stimulus-response situation, but involves a living relationship, a co-experience. Without creative instructors, creative talent will go unrecognized, under-developed, and unrewarded. The greatest reward for learning is thinking—doing something with what has been learned.

Shy students will talk freely if they are given time to ask questions—time to think and to find words to express their ideas. Sometimes, over-attention is devoted to mechanics with excessive emphasis on success and exaggerated fear of mistakes. Emphasis is placed on one's knowledge rather than upon his attitude toward what he knows or how can he apply what he knows.

To stimulate the imagination of students in the classroom the creative teacher must establish and maintain completely open communication; that is, the flow of information from the teacher to the student, from the student to the teacher, and communication between students. In this environment both the instructor and the students learn together. The students bring to classrooms a wealth of experience and knowledge—a good instructor will capitalize on this.

Once communication channels are open, the instructor must convince students that learning is a joint responsibility. They should be assured of this through example and action, not by mere words. The students must be guaranteed psychological safety in the classroom. An atmosphere of academic freedom must be provided so that students will feel free to experiment, to disagree, to question, to try something new with the assurance that failure will not isolate them from their peers or teachers. Instructors should arouse the intellectual curiosity of each student so that he will discover things for himself. The classroom should foster mental excitement.

Group brainstorming can be used as a valuable teaching device in this creative environment. Brainstorming is a conference technique by which a group attempts to find a solution for a specific problem by amassing all the ideas spontaneously contributed by its members. According to Osborn, "no conference can be called a brainstorming session unless the deferment-of-judgment principle is strictly followed." He gives four basic rules:

1. Criticism is ruled out. Ideate here, evaluate later.
2. "Free-wheeling" is welcomed. The wilder the idea, the better.
3. Quantity is wanted. The greater the number of ideas, the more likelihood of useful ideas.
4. Combinations of ideas and improvement are sought.

He also suggests several reasons why group brainstorming is a useful teaching device:

- The power of association is a two-way current. One idea from a student almost automatically causes him to think of another idea or spurs the imagination of another student.
- The stimulative effect of rivalry. Competition increases idea generation.
- Brainstorming provides reinforcement by rewarding all ideas with receptiveness.
- An environment is created that provides the students with "psychological safety."
- Studies show "free associations" of ideas of adults are from 65 to 93 percent more numerous in group activity than working alone.

Brainstorming is only one technique of idea generation. Other techniques are:

Gordon technique—a variation of brainstorming. The problem is not revealed until the chairman feels the group is getting close to a satisfactory solution; the objective is usually to produce *one* best idea. The chairman starts the discussion with the basic concepts associated with the problem area.

Attribute listing—the selecting of some object to improve. List all the parts and qualities of an object; then systematically change or modify the attributes.

Catalog technique. Take a commercial catalog (Sears, Spiegel, etc.) or a telephone book (yellow pages) and simply refer to these for ideas. These, in turn, will suggest other ideas.

Checklist technique. Check items on a prepared list against the problem or subject under consideration.

For additional techniques and details, read Jack W. Taylor's book, *How to Create New Ideas.*

There have been outstanding examples of how the use of imagination in teaching has made some dull courses a new experience for the students.

One example involves Professor Edwin Peterson, University of Pittsburgh, who teaches courses in freshman English composition. Professor Peterson sits at the front of a class of approximately 350 students, uses an overhead projector to enlarge and transfer transparencies to a screen above him, and comments on the materials presented. He can face the student and write in normal handwriting on a sheet of clear plastic. The classroom is not darkened for use of the overhead projection. Professor Peterson flashes on the screen a passage from the work of a professional writer and, with overlays, colors all pronouns red, echo words blue, all relationship words yellow, all repetitious words green, etc. He also uses this technique to edit student themes while the students are still in class. At the end of their freshman year, the students are asked to pick their favorite courses. If past poll results hold true, 98 percent will name English composition.

Dr. Peterson's technique is now being used in 500 colleges and high schools throughout the nation. He developed this technique because he was dissatisfied with methods that failed to maintain student interest and to increase learning.

Dr. Jene Clark, associate professor of economics and business administration, University of Chattanooga, has established ambitious projects in the introductory economics course. In one project, Dr. Clark required his students to write a television scenario to dramatize to the American people the need for bolstering national defense by reducing unemployment. This urgent economic problem was linked to the present-day threat of attack by nuclear weapons. The project sought to show the functional similarities between the processes involved in our nation's preparation against attack by two different kinds of enemy action: (1) a nuclear attack by a military enemy; (2) an attack by an economic "enemy," unemployment. Students spent over 1,500 hours doing research work for the project. Teams "brainstormed" the problem and sought answers to basic questions. The students took time from their Christmas holidays to work on their papers. They considered the project one of the most rewarding of their college careers.

Dr. Clark believes teachers should stimulate students to develop their intellectual muscles: "Any method by which a teacher can put color and life into his subject and bring it down from the stratosphere of abstract discussion in a textbook to concrete application in real-life situations is helpful, in my view." Dr. Clark injects drama into his economics courses. A few years ago, he had his students attack a planet and formulate plans for organizing a new government and a new economic structure for the people who had been conquered in the space war.

In the field of nursing, the use of imagination is an important asset to the teacher. A course in advanced surgical nursing was conducted in the following manner during a part of the senior year in a nursing school program in Montgomery, Alabama. In lieu of lecturing, the alert instructor divided the 33 students into sub-groups. Each group was given an area to research and, later, the groups presented the results of their findings to the entire class, using any method of presentation they desired. Conservative measures versus radical surgical procedures, the use of artificial kidneys, emergency care of the burned patient, were examples of some of these assignments. Students were encouraged to interview faculty members, doctors, patients, and to use local library facilities.

Various methods were used by the students to present their findings. One group conducted a TV panel discussion. Students were cast "in role" as international physicians in the presentation of their material. Imaginative "commercials," subject-matter oriented, were sprinkled throughout the program. A second group used the patient-nurse technique to develop its findings. Still another group assumed the role of an element in the fluid system of the body. Students placed large signs around their necks for identification of their particular roles in this system. They then conversed among themselves in terms of their particular functions.

At the conclusion of the project the nursing students felt that the research was worthwhile. They said it had stimulated interest in independent and group work, it gave them a chance to use their imaginations, but most important of all, it created an interest in what they had always thought was a dull area of study.

With the introduction of computers another new avenue is available to the creative teacher

who wishes to improve his method of instruction. Ralph E. Grubb, IBM research scientist who teaches statistics at a small college, programmed a course to be taught by a computer. His normal course involved 24 hours of lectures, 25 hours of home work, and about 5 hours of review for the final test, making a total of 54 hours. The average time spent by students enrolled in the computerized course was only 5.8 hours. The students averaged 30 percentage points higher in the final examination grades.

At the Massachusetts Institute of Technology, civil engineering students are learning faster by substituting the computer for the chalkboard. The professors cite two reasons for using a computer in the classroom:

1. The nature of the decisions that an engineer and designer must make can be shown to students more forcefully with a computer than without one.
2. By the use of computers students are able to complete more challenging assignments within definite time limits.

The M.I.T. engineering staff also believes that the computer helps a student to see quickly the effects of his changes in design and materials. He can use various methods in solving a problem; this opportunity to experiment was not available to his predecessors.

Desk size computers are becoming less expensive and are being used throughout educational institutions. The Air Force Academy and AFIT instruct selected students in use of the computer to solve school problems. Some military instructors have available on base a computer that is used for processing management data. With a little imagination and initiative, perhaps it can also be used to make instruction more meaningful.

Socrates once said: "The best teacher is not one who crams the mind of the student with the greatest number of facts in the shortest possible time, but the one who is able to kindle a fire of spiritual and intellectual enthusiasm; who develops within the student a knowledge of what he can become; who strengthens his high moral, spiritual, and cultural aspirations."

SUMMARY

All normal human beings possess four types of mental powers: absorptive, retentive, reasoning, and creative. Society and schools seem to demand conformity to routine and to prevent individuals from using their creative mental power more effectively. Creativity is the ability to use one's imagination to recombine known elements into something new. The creative process may be divided into four periods: preparation; incubation; insight, illumination or inspiration; and verification. The last period is the most important, for ideas in themselves are useless; they must be developed, communicated, and applied before innovation is complete.

There are many possible blocks to creative thinking. The four most common are habit, fear, prejudice, and inertia. The first step in overcoming them is recognition of their existence. In the creative environment, the instructor establishes and maintains an atmosphere that is permissive, that insures psychological safety, and that provides ways for the students to work in groups or individually. To make this possible communication channels must be kept open.

In creative teaching the instructor can use the latest techniques and equipment known today. The use of imagination in the selection of teaching methods has aided creative teachers in making dull subjects living experiences for the students.

CHAPTER 14

Human Relations

The behavioral sciences are rich in knowledge of the management of people and the use of human resources. The Air Force instructor should draw upon this knowledge. He need not rely exclusively on his own personal experiences and observations. Indeed, he may do a disservice to his students should he try. Establishing good relations with his students means far more than "getting along" with them. It goes deeper into *how* he "gets along" with them, a direct outgrowth of how he organizes and controls their efforts; i.e., human management. One of the instructor's major tasks is to organize the efforts of his students, not only to direct their activities, but to promote a climate conducive to learning. He can do this successfully only if he has some ability to predict and control their behavior.

CONTROL OF HUMAN BEHAVIOR

The relationship between the instructor and the student has a profound impact on how much the student learns. To the student, the instructor is the symbol of authority during the time they share the classroom. The student expects the instructor to exercise certain controls, and he recognizes and submits to authority as a valid means of control. The instructor's challenge is to know what controls are best for what circumstances. The instructor should create a classroom environment that enables the student to help himself.

Every student works toward a goal of some kind. It may be success itself; it may be a grade or an honor. Whatever the goal, the instructor is obligated to help the student achieve it. The instructor directs and controls the behavior of the student as he guides him toward that goal. This is a process of directing the student's actions and modifying his behavior. Without the instructor's active intervention the student would be passive and perhaps resistant to learning. The controls the instructor exercises—how much, how far, to what degree—should be based on more than random selection or trial and error, or on his feelings of the moment.

Some interesting generalizations have been made about motivated human nature by the late Douglas McGregor, Massachusetts Institute of Technology. While Professor McGregor's assumptions are directed specifically toward industrial management, they have implications for the instructor as well. To state these generalizations in capsule form, as they are presented here, almost gives them the aspect of truisms, but their implications run deep and they should be considered carefully:

- The expenditure of physical and mental effort in work is as natural as play and rest. The average human being does not inherently dislike work. Depending on conditions, work may be a source of satisfaction, and if so, will be performed voluntarily. On the other hand, when work is a form of punishment, it may well be avoided, if possible.
- Man will exercise self-direction and self-control in the pursuit of goals to which he is committed.
- Commitment to goals relates directly to the reward associated with their achievement, the most significant of which is probably the satisfaction of ego.
- The average human learns, under proper conditions, not only to accept, but to seek responsibility. Shirking responsibility and lack of ambition are not inherent in human nature. They are usually the consequences of experience.
- The capacity to exercise a relatively high degree of imagination, ingenuity, and creativity in the

solution of common problems is widely, not narrowly, distributed in the population.

• Under the conditions of modern life, the intellectual potentialities of the average human being are only partially used.

If the instructor accepts McGregor's assumptions, he begins to see the student as a vast, untapped potentiality. The instructor's ingenuity must be used in discovering how to realize the potentialities of the student. The responsibility rests squarely on the instructor's shoulders. If the students are perceived as lazy, indifferent, unresponsive, uncreative, uncooperative, and antagonistic, McGregor's assumptions imply that the cause lies in the instructor's methods of control. The raw material is there, he holds, and the shaping and directing of it lie in the hands of those who have the responsibility to control it.

How to mold a solid, healthy, productive human relationship with his students depends, of course, on the instructor's knowledge of his students as human beings and of the needs, drives, and desires that they continually try to satisfy in one way or another. Some of their needs and drives are discussed in subsequent paragraphs.

STUDENTS AS PEOPLE

The superior instructor never loses his awareness of the fact that his students are human beings. The needs of students, and of all mankind, are given labels by psychologists and are generally organized in a series of levels—a hierarchy of importance. The hierarchy, or pyramid of needs, as suggested by Abraham Maslow of Brandeis University follows.

Physical Needs

At the broadest level are the physical needs (Fig. 6). Each man is first concerned with his need for food, rest, exercise, and protection from the elements. Until these needs are satisfied to a reasonable degree, he cannot concentrate on learning or self-expression. Of course, *once a need is satisfied it no longer provides motivation,* because a want that is satisfied is no longer a want. Each man therefore strives to satisfy the needs of the next higher level.

Safety Needs

The safety needs are protection against danger, threat, deprivation, and are labeled by some authors as the security needs. Regardless of the label, however, they are real, and student behavior is influenced by them.

Social Needs

If a man is physically comfortable and has no fear for his safety, his social needs then become the prime influence on his behavior. These needs are to belong, to associate, to give and to receive friendship and love. Many studies have demonstrated that a tightly knit, cohesive group, under proper conditions, will be more effective than an equal number of separate individuals. Inasmuch as students are usually separated from normal surroundings, their need for association and for belonging will be more pronounced.

Egoistic Needs

The egoistic needs will usually have a direct influence on the student-teacher relationship. Those needs are of two kinds: (1) Those that relate to one's self-esteem—needs for self-confidence, for independence, for achievement, for competence, for knowledge; and (2) those needs that relate to one's reputation—needs for status, for recognition, for appreciation, for the deserved respect of one's fellows.

Self-Fulfillment Needs

At the apex of the hierarchy of man's needs are those for self-fulfillment, or for realizing one's own potentialities, for continued development, for being creative in the broadest sense of that term. This need of a student should offer the greatest challenge to the instructor. Aiding another in

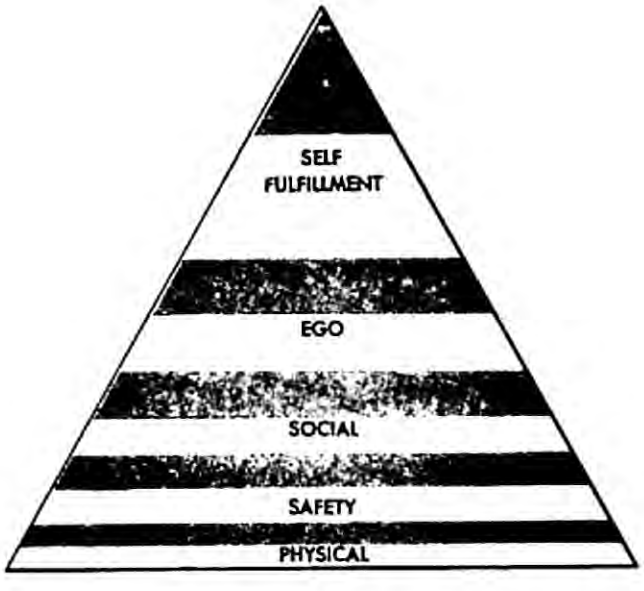


Figure 6. Pyramid of Needs

realizing self-fulfillment is perhaps the most worthwhile accomplishment an instructor can achieve.

An instructor should strive to help the student satisfy these needs in a manner that will insure a healthy environment for learning. When the instructor works for good human relations, his students experience fewer frustrations and can therefore devote more attention to their studies.

DEFENSE MECHANISM IN STUDENTS

When someone or something prevents a student from achieving his goals, he becomes frustrated. While this frustrated feeling exists, he cannot give his full attention to learning. People react to frustration in many different ways. By observing the reactions of his students, the instructor can recognize their behavior patterns and identify the students whose problems interfere with their work.

Certain behavior patterns are called "defense mechanisms," because they are subconscious defenses against the realities of unpleasant situations. People use these defenses to soften feelings of failure, to alleviate feelings of guilt, and to protect feelings of personal worth and adequacy.

Although defense mechanisms can serve a useful purpose, they can also be hindrances. Because they involve some self-deception and distortion of reality, defense mechanisms do not solve problems. As with aspirin, they alleviate symptoms, not causes. Moreover, since they operate on a relatively unconscious level, they are not subject to normal conscious checks and controls. Once a person actually realizes that he is relying on one of these devices, his behavior ceases to be a subconscious adjustment mechanism and becomes instead an ineffective way to satisfy a need. Common defense mechanisms are rationalization, flight, aggression, and resignation.

Rationalization

If a student cannot accept the real reason for his behavior, he may rationalize. This device permits him to substitute excuses for reasons; moreover, he can make those excuses plausible and acceptable to himself. Rationalization is a subconscious technique for justifying actions that otherwise are unacceptable. When true rationalization takes place the individual sincerely believes in his excuses. To him they are real and justifiable. A moderate amount of rationalization is normal. Danger is potential in the student who rationalizes excessively or as a means to excuse himself from performing at his top level of ability.

Flight

A student often escapes from a frustrating situation by taking flight, physical or mental. To take flight physically, the student may develop symptoms or ailments that give him a satisfactory excuse for removing himself from frustration. The symptoms in such cases are subconscious reactions, not a conscious effort to relieve the frustration. Although his ailment may be mental rather than actually physical, the results can be real to him and as such, be painful.

More frequent than physical flights are mental flights, or daydreaming. Mental flight provides a simple and satisfying escape from problems. If the student gets enough satisfaction from daydreaming, he may stop trying to achieve his goal altogether. When carried to extremes, the world of fantasy and the world of reality can become so confused that the dreamer cannot distinguish one from the other. His picture of what he wishes to be then cancels out his knowledge of what he is. Within reasonable bounds, daydreaming is normal, but the instructor must remember that a student who is daydreaming in a classroom is missing an opportunity to learn.

Aggression

Everyone gets angry occasionally. Anger is a normal, universal emotion. An angry person might shout, swear, slam a door, or give in to the heat of his emotions in a number of ways. He becomes aggressive against something or somebody. After a cooling-off period, he may see his actions as childish. In a classroom, such extreme behavior is relatively infrequent. Because of social strictures, a student's aggressiveness in the classroom is usually subtle. The student may ask irrelevant questions, refuse to participate in the activities of the class, or disrupt activities within his own group. If a student cannot deal directly with the cause of his frustration, he might vent his aggressiveness on a neutral object or person not related to his problem. The frustrated student with no outlet for his feelings may turn inward to an extent that blinds him to the activities around him. When this happens, of course he cannot learn.

Resignation

A student may become so frustrated that he loses interest and gives up; he no longer believes it profitable or even possible to work further. He accepts defeat. The most obvious and apparent cause for this form of resignation is the student's inability to master his material. Sometimes resignation takes place when, after completing the early phase of a course without grasping the fundamentals, the student becomes bewildered and lost in the advanced phase. From that point on, his learning is negligible, although he might continue to go through the motions of participating.

INSTRUCTOR'S ROLE

To minimize the frustrations of his students and to help achieve good human relations in his classroom are prime responsibilities of the instructor. He can follow several rules which, if adapted to the problem at hand, can help him.

Keep Students Motivated

Students gain more from wanting to learn than from being forced to learn. All too often students do not realize how a particular lesson or course can help them reach an important goal. When they can see the benefits or purpose of a lesson or course their enjoyment and their efforts will increase.

Keep Students Informed

Everyone feels insecure when he does not know what is expected of him and what is going to happen to him. The instructor can minimize such feelings of insecurity by telling his students what he expects from them and what they can expect from him. The instructor can keep his students informed in various ways: giving them an overview of the course; keeping them posted on their progress; and giving them adequate notice of examinations, assignments, and administrative requirements.

Approach Students as Individuals

When the instructor limits his thinking to the whole group without considering the individuals who make up the group, he directs his efforts at an average personality which really fits no one. Every group has its own personality, which stems from the characteristics and interactions of its members. However, each individual within the group has a personality which is unique and which should constantly be considered.

Give Credit When Due

When a student does something extremely well, he wishes his ability and his efforts to be noticed. Otherwise, he becomes frustrated. Praise or credit from the instructor is usually ample reward to the student, and provides him with an incentive to do even better. Praise given too freely, however, becomes valueless; but when deserved, it pays dividends in student effort and achievement.

Criticize Constructively

Although it is important to give praise and credit when deserved, it is equally important to identify mistakes and failures. To tell the student that he has made a mistake without explaining why or how does not help him. If a student has done his best but is told that the work was unsatisfactory, with no other explanation, he becomes frustrated. He cannot correct his errors if he does not know what they are, and in all likelihood he will perpetuate them with faulty practice. If, on the other hand, he knows what he did wrong and how to correct his errors, he can progress and enjoy a feeling of accomplishment.

Be Consistent

A student wants to please his instructor. This is the same desire that influences much of a subordinate's behavior toward his superior in industry and business. Naturally, students have a keen interest in knowing what is required to please the instructor. If the same thing is acceptable one day and unacceptable the next, the student gets confused. The instructor must therefore be consistent in his philosophy and actions.

Admit Personal Errors

No one, not even his students, expects an instructor to be perfect. The instructor can win the respect of students, sometimes, by honestly acknowledging his mistakes. If he tries to cover up or bluff, his students will be quick to sense it. Such behavior tends to destroy their confidence in him and in his subsequent actions. If in doubt, the instructor should admit it to his students; he should give them the correct information when possible.

These are but a few of the many attitudes and reactions that can help establish good human

relations in the classroom. An instructor should treat his students as he would wish to be treated if the relationship were reversed. Good human relations not only promote pleasure in classroom activities but also insure more effective learning.

SUMMARY

Every professional teacher is concerned with many areas of learning, in addition to the one which includes the subject he teaches. A particular area in which he should have extensive knowledge is that of the behavioral sciences. Teaching is more than merely describing ideas, illustrating concepts, and demonstrating procedures. It is directly involved with student learning and with an understanding of how to promote a climate conducive to learning. When the efforts of students to satisfy their needs are frustrated, learning suffers. The greater the students' frustration, the more difficult it is for them to learn. The teacher who understands the value of good human relations in the classroom can help students realize greater gains from their learning experiences.

part three

TEACHING METHODS

This part is concerned with tools of instruction that help the instructor do a better job. In lesson planning, the first tool discussed, the instructor lays the foundation upon which to build the lesson. Other tools include four common methods of instruction—demonstration-performance, guided discussion, case-situation, and lecture. The instructor can also use programmed instruction and educational television. By using the method best suited to each class session, the instructor can make his instruction more realistic, flexible, and interesting.

CHAPTER 15

Lesson Planning

Planning a lesson is "planning for learning." Every successful executive or professional man knows that the price of excellence is careful planning. The outstanding lawyer spends hours in preparing a case before presenting it in the courtroom. The forceful minister does not ad-lib his sermon; he plans for days or weeks in advance. In preparation for the big game, the competent coach spends hours in planning the plays and in watching his team execute them. The effective instructor devotes much time and energy to the preparation of each classroom session. He carefully selects and arranges activities that will bring about desired changes in the behavior of his students. Only through careful planning can the instructor be certain that he is including all necessary ideas and properly organizing the material to help the students achieve the lesson objective.

The complete cycle of lesson planning includes six steps: establishing the lesson objective, developing the desired learning outcomes, researching the topic, organizing the material, selecting the instructional method, and preparing the lesson plan.

ESTABLISHING LESSON OBJECTIVE

The first step in lesson planning is to establish the basic objective for a particular learning experience. The instructor must have his final goal—his ultimate destination—clearly in mind. In stating the objective, the instructor should plan for these requirements: focusing his attention on the needs of the student, limiting the subject, selecting the level of learning, and determining the purpose.

Attention to Student Needs

The lesson objective should be stated so as to express the activity of the student, not the teacher. The phrase, "To teach the principles of good management," is poor, because the word "teach" indicates that the instructor is concerned with performing an activity rather than with student performance. To make the objective center on the student, it might be stated: "The objective of this lesson is for each student to understand four principles of good management." This focuses the suggested activity where it rightfully belongs—on the student.

Limiting Subject

The lesson objective should be one that can be attained within the lesson limitations. To make sure that the objective can be accomplished, the instructor should consider four criteria: the physical facilities of the classroom, the students' backgrounds and abilities, the instructor's capability, and the time allowed for the lesson.

The instructor should avoid broad, vague objectives that do not limit the scope of the material to be learned. Obviously, such a broad objective as having each student "understand the development of communist doctrine . . ." could not be achieved in one class period. The objective should be limited to one phase of the development of communism. Time is a critical factor when planning for effective learning.

Selecting Level of Learning

This text discusses four basic levels of learning. As shown in Table 1, these are familiarity, knowledge, understanding, and application.

FAMILIARITY. To become "familiar with" information is to become acquainted with the verbal or symbolic material used. This level is used to introduce material that sets the stage for other more important material, sets the atmosphere of the lesson, or is motivational in nature. At this level the information does not represent material critical to subsequent parts of the lesson. An example is "to become familiar with several techniques of counseling," as preliminary to a thorough understanding of one or two techniques.

KNOWLEDGE. "To know" is to have factual information in one's mind ready for immediate use. Knowledge consists of facts which answer the basic questions: Who, what, when, or where? For example, Columbus discovered America in 1492.

Knowledge is often the foundation for more extensive learning. In many learning situations, the student must acquire knowledge before he can proceed to the more challenging aspects of learning. Frequently, this level of learning is used to explain the parts of a piece of equipment, the tools used to repair it, or more abstract information such as "to know that man's organic needs are for food, water, air, rest, and propagation of the species."

UNDERSTANDING. "To understand" is to comprehend a concept or idea, as opposed to memorization and recall of facts at the "know" level. To understand a concept or idea thoroughly, the student must recognize its relationship to other concepts and ideas. For each student to "understand that the effective counselor applies the principles of good human relations," involves recognition of the values of human relations to improve counseling procedures.

Through this "understanding" he is able to explain the "hows" and "whys" of the concept, as well as its implications. The instructor normally works toward this level of learning by showing cause and effect relationships, by considering advantages and disadvantages, or by showing the interrelationship of ideas to draw conclusions. He uses a variety of support material (definitions, examples, testimony, comparisons, quotations, and statistics) so that the student learns the material thoroughly.

APPLICATION. This level of learning can be viewed as either physical or mental use of previous learning. Physical use is achieved when the student is able to perform a certain physical act. Examples are "to be able to draw simple

Table 1. Relationship of Levels of Learning to Teaching Situation

Levels of learning	*Definition of learning*	*Teacher-supplied support material*	*Mental functions employed to achieve this learning*
APPLICATION	For mental application: Use of facts, principles, ideas, or concepts for interpreting situations and solving problems.	For mental application: Opportunity for generalizations or transfer of learning (case histories, problem situations, etc.).	Generalizations, transfer of learning, creativity, rational perception, analysis and synthesis, structuring of new relationships to apply principles, gain insights, solve problems. Structuring of thought systems.
	For physical application: Physical ability to perform an integrated sequence of related actions.	For physical application: Clear-cut explanation-demonstration of the skill. Supervision of student performance to insure that he uses the same sequence of actions as taught in the explanation-demonstration.	
UNDERSTANDING	Comprehension of concepts and ideas — learn the basis for, and the background of, the concept or idea.	Support in terms of the "hows" and "whys" of the concept or idea and its implications.	Comparison and contrast, development of a concept, comprehension of implications of concepts, insight.
KNOWLEDGE	Acquisition of factual information — simple recall of verbal or symbolic material.	Support in terms of the "who," "what," "when," and "where" of the factual or symbolic material.	Simple recall, association of material with previously learned facts.
FAMILIARITY	Initial acquaintance with verbal or symbolic material.	Basic, "who," "what," "when," and "where" of material.	Awareness of, or initial link with, material.

stick figures" and "to be able to fold the American flag properly for storage." Mental use is achieved when the student applies ideas or concepts to develop other ideas, or applies principles to solve problems, either real or hypothetical. Examples are "to apply the principles of human relations" and "to be able to solve the manpower shortage problem of the 123rd Fighter Squadron."

By using these terms and definitions consistently, the instructor can avoid confusion while planning for the learning he wants his students to achieve. Using special vocabulary to denote different learning levels the instructor can plan for a specific level of learning in preparing each lesson plan.

Determining Basic Purpose

The term "purpose," as used in the lesson plan objective, means the reason for the lesson; why the student needs to learn the material contained in the particular lesson.

Once the lesson planner has his purpose firmly in mind, his organization will become clearer, the nature of support material will be more obvious, and the motivation for the lesson will become self-evident. For example, if the student is learning the principles of electrical circuits, the reason why he must learn it (the purpose) becomes important. Is he learning about electricity so that he can wire a house? Or is it to prepare for subsequent material involving the electrical circuitry of an amplifier? Or is it simply as an application of the use of electricity so that he can better understand the theory of electricity? The lesson planner must have a clear purpose for the lesson.

In some cases the purpose is obvious. For example, in the objective "to understand four additional methods of teaching" the implied purpose is "to become a more effective teacher." In the objective "to understand the effect of environment on learning in order to make teaching more student centered," the purpose is specifically stated

and would help the lesson planner by way of guidance for organization, selection of support material, and motivation.

Having considered the separate elements of an objective, the instructor should now be in a position to combine them, as follows:

- The objective of this lesson is for each student *(student centered)* to be able to *(level of learning)* fit properly the life vest *(subject)* so that he can survive an aircraft ditching (*purpose*).
- The objective of this lesson is for each student *(student centered)* to understand *(level of learning)* the principles of war *(subject)* so that he can plan campaigns *(purpose).*
- The objective of this lesson is for each student *(student centered)* to be able to *(level of learning)* compute drift angle corrections *(subject)* to help him pass his flight check for a civilian pilot's certificate *(purpose).*

DEVELOPING DESIRED LEARNING OUTCOMES

After the instructor has established the lesson objective, he should analyze it to determine the specific learning experiences necessary to achieve it. These are changes in behavior, or desired learning outcomes (DLOs). The DLOs are the student's specific learning experiences that represent a step-by-step development of the lesson toward its objective. The DLOs are the criteria or standards for planning, conducting, and evaluating a lesson. Each one should be stated as a complete thought, relating to a single, specific idea; each should be on a single level of learning and, like the lesson objective itself, stated to express the activity of the student. Each DLO should be formulated carefully and specifically; the instructor can then organize his lesson to help his students achieve these outcomes.

Every statement of a desired learning outcome should meet certain minimum standards. These are discussed below.

Use of Straightforward and Descriptive Language

Preparing definite and precise statements of desired learning outcomes is seldom an easy task. When indicating the level of learning the instructor should avoid such vague wording as "to gain an understanding of," "to understand about," "to understand how," or "to understand why." The word understand includes both the "hows" and "whys."

Poor

Each student should —
1. gain an understanding of lesson planning.
2. understand about the nature of learning.
3. understand how background experience affects learning.
4. understand why we should increase foreign aid.

These vague indefinite statements do not identify the precise ideas to be understood. If these desired learning outcomes are to serve as guides in planning a lesson, they should be stated as clear, specific ideas. If the word "that" is used immediately after the level of learning, the DLO will be forced into specific ideas.

Better

Each student should —
1. understand that lessons must be well planned if the lesson objective is to be achieved.
2. understand that learning is a change in behavior through experience.
3. understand that background experience lays the foundation for future learning.
4. understand that continued support through foreign aid would increase our prestige abroad.

Relationship of DLOs to Lesson Objective

The instructor can frequently develop meaningful DLOs by putting himself in the place of the student and asking questions that would guide the latter's thinking toward the lesson objective. The specific ideas that answer these questions usually constitute the desired learning outcomes. To be adequate, a DLO must stem directly from, and lend support to, the objective. The following example contains an error that inexperienced instructors frequently make.

Objective: The objective of this lesson is for each student to understand three principles of organization to assist him with planning staff responsibilities.

Desired Learning Outcomes: Each student should —
1. understand that unity of command will . . .
2. understand that homogeneous assignment will . . .
3. understand that delegation of authority will . . .
4. understand that good supervision can increase group effectiveness.

The fourth DLO is interesting, and informative, but it does not relate directly to the lesson objective.

Clarity of Meaning of DLO

The phrase "to know the flag," for example, does not convey an unmistakable meaning. It might mean to recognize one's national flag when

displayed with other flags, or to describe every feature of a certain flag, or something entirely different from either of these interpretations. Such ambiguous combinations of words are meaningless DLOs. A DLO worded, "to know that there are 50 stars in our nation's flag," leaves no doubt what the student is expected to know.

Clearly expressed DLOs are especially important for a lesson in which the objective is for the student "to be able to" perform a motor skill. Clarity can be achieved in such DLOs by specifying each subskill that is a part of the overall action or performance. Since the DLOs represent a step-by-step approach to the final objective, it would be incorrect to state the lesson objective as the final DLO.

Poor

Objective: The objective of this lesson is for each student to be able to wire a male plug correctly.

Desired Learning Outcomes: Each student should —

1. know what equipment is needed.
2. be able to wire the plug.

Better

Objective: The same.

Desired Learning Outcomes: Each student should —

1. know the tools and materials needed to wire the plug.
2. be able to prepare the ends of the wire cord.
3. be able to tie the Underwriter's knot.
4. be able to fasten the wires to the plug correctly.

Every effort should be made to express the *idea* contained in the DLO clearly, without undue concern about exact wording.

Once the instructor has established the desired learning outcomes, he has the foundation for his lesson. He knows what he wants the students to gain from the lesson, and he has broken down his lesson objective into separate goals. A good test of the desired learning outcomes is to determine whether each one will contribute directly to the student's achievement of the overall lesson objective.

RESEARCHING THE TOPIC

After the instructor has established the lesson objective and the desired learning outcomes, he is ready to do research on the lesson topic. Each bit of material that he gathers should directly support one or more of the learning outcomes. To do research on a mass of material and then to develop a DLO to match the findings is the incorrect approach; the DLO should always dictate the support material needed.

Selecting Support Material

The level of learning influences not only the type and amount of support material but also the time required to achieve each desired learning outcome.

Two important criteria for selecting support material are usefulness and appropriateness. If an instructor selects material on the basis of interest alone, he may prepare a lesson that is full of interesting information but of little value to the student. Conversely, unenlivened, dry facts may defeat the instructor's purpose. When factual material is enriched with interesting information, however, the student is likely to grasp and remember it.

The instructor should weigh every new point he considers. A good test for accepting or rejecting a finding is the question: Will it help the student achieve the desired learning outcome? This simple test enables him to reject extraneous material that he finds during his research.

While doing research, the instructor is likely to find some material that the students should read in preparing for the classroom period. If the instructor keeps this requirement in mind when he begins his research, he can prepare a suggested reading list for the students while he is doing his own research, and this will save him much work later on. For the students' list, he should select interesting, informative background material that deals with fundamentals only.

ORGANIZING THE MATERIAL

After gathering the necessary data, the instructor should organize his material to develop and support the desired learning outcomes. Each main point must relate to the other main points, and together they must support the lesson objective. Each subpoint must add meaning to the main point that it supports.

One of the most effective ways to organize a lesson is to divide it into parts. A frequently recommended division breaks the lesson into an introduction, a development, and a conclusion.

Introduction

The introduction should serve several purposes: to establish common ground between the instructor and his students, to capture and hold the attention of the group, to indicate what is to be covered during the presentation and relate this coverage

to the entire course, to point out specific benefits the student can expect from the learning, and to establish a receptive attitude toward the subject and lead into the lesson development. In brief, the introduction sets the stage for learning.

ATTENTION. The instructor might begin by telling a story that relates to the subject and establishes a background for developing the learning outcomes. He might gain the students' attention by making an unexpected or surprising statement or by asking a question that helps him relate the lesson topic to the welfare of the group. No matter how the instructor introduces the lesson, his main concern should be to gain the attention of his students and to focus it on the subject.

MOTIVATION. The introduction should offer the students specific reasons for needing to be familiar with, to know, to understand, to apply or to be able to perform whatever they are about to learn. This motivation should appeal to each student personally and accentuate his desire to learn. The appeal may relate the learning to career advancement, financial gain, service to community groups, use at home, or some other attraction, but in every instance a specific application should be cited.

OVERVIEW. Every lesson introduction should contain an overview that tells the group what is to be covered during the period. A clear, concise presentation of the objective and the key ideas gives the students a road map of the route to be followed. A good visual aid can help the instructor show the students the route that they are to travel. The introduction should be free of stories, jokes, or incidents that do not help the students focus their attention on the lesson objective. Also, the instructor should avoid a long or apologetic introduction, because it will dampen the students' interest in the lesson.

Development

This is the main part of the lesson. Here the instructor develops the subject matter in a manner that helps his students achieve the desired outcomes.

The instructor must logically organize his material to show the relationships of the main points. He usually shows these primary relationships by developing his main points in one of the following ways: from the past to present, from the simple to the complex, from the known to the unknown, and from the most frequently used to the least frequently used.

FROM PAST TO PRESENT. In this pattern of development, the subject matter is arranged chronologically, from the present to the past or from the past to the present. Such time relationships are most suitable when history is an important consideration, as in tracing the development of tactical air power or nuclear weapons.

FROM SIMPLE TO COMPLEX. This pattern helps the instructor lead the student from simple facts or ideas to an understanding of involved phenomena or concepts. In biology, for example, the student studies the simplest forms of life, then the intermediate forms, and finally the more complex organisms. In studying jet propulsion, the student might begin by considering the action involved in releasing air from a balloon and finish by taking part in a discussion of a complex gas turbine.

FROM KNOWN TO UNKNOWN. By using something the student already knows as the point of departure, the instructor can lead into new ideas and concepts. For example, in developing the theory of flight, the instructor could explain flight in the atmosphere before proceeding to flight in outer space.

FROM MOST FREQUENTLY USED TO LEAST FREQUENTLY USED. In some subjects, certain information or concepts are common to all who use the material. This fourth organizational pattern starts with common usages before progressing to the rarer ones. In a course on navigational proficiency, pilots start by learning dead reckoning procedures, which become the basis for their study of other forms of navigation, such as radio, loran, shoran, and consol.

Under each main point in a lesson plan, the subordinate points should lead naturally from one to the other. With this arrangement, each point leads logically into, and serves as a reminder of, the next. Meaningful transitions from one main point to another keep the students oriented, aware of where they have been and where they are going.

Organizing a lesson so that the students will grasp the logical relationships of ideas is not an easy task. But this type of organization is necessary if the students are to learn. Poorly organized information is of little or no value to the student.

Conclusion

The conclusion should include three basic elements: summary, remotivation, and closure. The effective summary retraces the important elements of the lesson and relates them to the objective. This review and wrap-up of ideas reinforces the student's learning and helps him retain what he has learned. No new ideas should be introduced in the conclusion, because at this point they are likely to confuse the students. The purpose of the remotivation is to instill in the students a desire to make use of what they have just learned. The closure may consist of a quotation, some concise statement, or any other device that will serve as a conclusion without reducing the students' motivation.

SELECTING INSTRUCTIONAL METHODS

In planning a lesson, a good starting point is with what the students already know. The instructor must be familiar with the background and experience of his students to carry them from where they are in his subject matter area to where he wants them to go. If he ignores their background knowledge, they will find him a condescending bore. On the other hand, if he assumes that his students know more than they actually do, they will be lost from the beginning of the lesson. The students' actual knowledge of the subject should dictate the complexity of the material to be covered and the approach to be followed.

Since each lesson is usually only one element in a course covering many subjects, the instructor should develop each lesson objective so that it supports the objectives of related lessons in the curriculum. One way for him to insure this integration is to discuss his lesson plans with fellow instructors: show them a tentative lesson outline, ask for their reactions, and if possible arrange for them to attend and critique a practice session. Their comments are likely to contain many useful suggestions for making the lesson more effective.

After deciding exactly what to teach in a lesson, the instructor determines how best to teach it or what instructional method to use. This selection of method is an integral part of lesson planning.

When related to instruction, the word "method" refers to a planned sequence of procedures used to help students reach a desired learning outcome. An instructional method may include the use of any devices, techniques, or procedures that will help students acquire additional learning. To put it another way, an instructional method is a combination of techniques that a teacher uses to enable students to participate in activities offering meaningful experiences. A method is a broad approach to instruction; for example, the lecture method or the discussion method. A technique, on the other hand, is a specific concrete act or procedure used in implementing a method; for example, the technique of using the chalkboard or of telling a story.

Philosophy Underlying Selection

Knowledge does not exist in and of itself—it has to be discovered. Knowledge is continually being recorded from the observations and experiences of people. Knowledge, then, comes from experience. Since people acquire knowledge through their own experiences or those of other people, the most effective learning results from vivid experiences. It follows that the best teaching method is the method that provides the most vivid experiences for the learner.

A teacher should think not in terms of his activities as a teacher, but in terms of the student's activities as a learner. After the teacher has established a lesson objective, he must decide how he will direct student activities toward the attainment of the desired learning outcomes. In making this decision, the instructor considers the ways that people learn: by doing, by discussing, by listening, by observing, and by participating. He selects the instructional method that will most effectively guide the students toward the desired learning outcomes. In other words, the learning outcomes dictate the method that will provide the learning experiences needed by the students. The teacher's role, therefore, is to provide the activities that will result in meaningful experiences for his students.

Selection Process

No one method is suitable for all teaching situations because no single method is flexible enough to meet all the needs of students in every learning situation. If, for example, the students are to gain skill in performing a certain task, their activity should be practice in performing the task. If the desired outcome is knowledge, the student probably should listen and relate what he hears to his

own experience. If the desired outcome is for the student to be able to apply a principle, his activity might be to solve a problem or perform some task requiring an application of the principle.

To proceed with the lesson-planning process, the nature of the student activity should indicate to the instructor the method that he should use to stimulate and guide his students. The instructor can, for example, guide a student discussion by asking questions. Similarly, if the students are to learn to apply a certain principle in solving problems, the instructor must provide problems requiring the application of that principle.

The instructional approach that the teacher chooses for one learning outcome may be different from the approaches he chooses for other outcomes in the same lesson. In fact, he may select a different instructional method for every desired learning outcome in his lesson plan by planning and selecting the approach he believes to be most appropriate for helping his students achieve each learning outcome.

Factors Limiting Selection

Certain limiting factors may prevent an instructor from using the instructional activities that he prefers. In addition to the desired outcome, the instructor must consider the background and ability of the students, the number of students, his own personality, the time allotted to the lesson, and the available facilities.

These and similar factors are limiting, but not determining, factors. For example, the instructor might see that a problem approach would be most effective for a certain desired outcome, yet recognize his students' lack of background and experience for solving the complex type of problem that would be required. For that reason, he might substitute an adaptation of the case-situation method to approximate the desired outcome. Some possible ways of doing this would be to (1) have a panel of experts discuss and solve the problem, (2) present the problem and its solution in a handout for the students to read and study, or (3) describe the problem and its solution as a means of stimulating student discussion of the principles involved.

The number of students and the facilities available need to be considered during lesson planning. For example, a certain desired outcome might suggest discussion as the most appropriate method, but the class might be too large for an across-the-board discussion to be effective. When the facilities are inadequate for dividing a large class into small discussion groups, the guided-discussion method is usually ineffective. A dialogue, a panel, or a symposium might, however, quite effectively achieve the desired outcome. The socialized recitation-method of asking questions and getting responses from some or all of the students is also effective for a large group that cannot be divided.

The instructor might use any of these methods to encourage the students to volunteer explanatory and supporting matter from their personal experiences, opinions, and beliefs. From these contributions, he could then develop the same principles or ideas that he could teach to a smaller group through discussion. When these and similar techniques are combined with a lecture, the students are usually stimulated to do more thinking than when only the lecture method is used.

The next four chapters explain four basic methods of instruction. Some additional instructional methods are discussed in Chapter 20. The instructor who masters all these methods can combine, adapt, and modify them to meet his own needs and those of his students.

PREPARING THE LESSON PLAN

The written lesson plan has been carefully designed to serve several purposes. It is a check list to insure that the very best planning has gone into the lesson. It is a teaching guide during the lesson, and it can serve as a reference for another instructor who may have to conduct the lesson in an emergency. It is a handy record of how the lesson was planned and is to be accomplished. One of the most practical functions of the lesson plan is to serve as a step-by-step guide for the instructor while he is planning the lesson.

Part I of the lesson plan is an overview of the lesson objective, desired learning outcomes, references, and related general information. Part II contains a complete outline of the lesson development. The ideas discussed earlier in this chapter relate to collecting and organizing material for the lesson but the medium used to fuse these ideas together, to give structure to these ideas, is the lesson plan itself. Each step in the process depends upon the step that precedes it. First, the instructor clearly establishes the Lesson

Objective. Next, this Lesson Objective is broken down into its component parts called Desired Learning Outcomes. Finally, each of these DLOs is developed in a step-by-step process starting with student outcomes, student activity, and finally instructor activity. If the instructor follows this logical sequence, the lesson plan serves as a format which lays out each succeeding step in accordance with sound teaching psychology. To insure the best learning situation for the student and to assist the instructor in outlining his lesson for easy presentation, these steps should be followed.

The format of the lesson plan shown in succeeding chapters was developed to insure student-centered thinking during the planning process. The concept of active student participation as a basic principle of effective learning is a significant part of the planning sequence.

SUMMARY

The first step in planning a lesson is to define and state the lesson objective and the desired learning outcomes. The objective should be limited to a feasible outcome, and the objective and outcome should both be stated in terms of student activity. The desired learning outcomes should be stated clearly and concisely to reflect what the student is to retain from the learning experience.

In planning a lesson, the instructor usually needs to do considerable research. The lesson objective and the desired learning outcomes guide him in this research, the extent of which depends largely on the available time, the instructor's past experience with the subject matter, and the complexity of the subject.

As the instructor gathers his research material in support of the desired learning outcomes, he organizes it to some extent. The primary emphasis in the final organization of the material should be on the clear and logical arrangement of ideas and procedures. Main points should overshadow subordinate points, and the material should be closely related and arranged so that one idea or procedure leads naturally to the next. This type of organization helps the student remember important points, because each key fact serves as a reminder of related facts.

The final selection of an instructional method may very well be a compromise between the method that is most suitable to the outcome (an ideal approach) and the method that is possible under the circumstances (a realistic approach). Many variations, combinations, and adaptations can be made of any method or methods of teaching; in fact, the number of possibilities is limited only by the instructor's imagination. For this reason, the instructor should recognize the many available opportunities to help his students accomplish desired outcomes.

The primary purpose of the lesson plan is to insure that the instructor considers every factor that might influence the effectiveness of a lesson as he plans that lesson. The lesson plan also helps him keep a constant check on the activities he plans for himself as well as those he plans for the students. This careful preparation helps him guide his students toward the desired learning outcomes when he presents the lesson he has planned.

CHAPTER 16

Demonstration-Performance Method

The demonstration-performance method of teaching is based on the simple, yet sound, principle that we learn by doing. Students learn physical or mental skills by actually performing these skills under supervision. An individual learns to write by writing, to swim by swimming, and to drive by driving. Students also learn mental skills, such as speed reading, by this method. Skills requiring the use of tools, machines, and equipment are particularly well suited to this instructional method.

Every instructor should recognize the importance of student performance in the learning process. The instructor should identify the most important learning outcomes for the students early in a lesson that is to include demonstration and performance. Next, he should explain and demonstrate the steps involved in performing the skill he is teaching. Then he should allow the students time to practice each step and thus increase their ability to perform the skill. The students will be able to perform the skill more proficiently if they actually practice as they learn.

The demonstration-performance method of teaching is widely used. The scientist uses it in directing student laboratory periods. The shop foreman teaches manual arts almost entirely by this method. The master craftsman shows the apprentice how a particular operation should be performed and then acts as an overseer while the apprentice attempts to perform the skills as demonstrated. During this practice, the master craftsman helps his assistant by pointing out any errors and by helping him eliminate rough spots in his performance. At Air University, Allied officers from more than forty nations receive four or five hours of instruction in English from a professional linguist each day. Two or three of these hours are spent in instruction in small seminar groups. The students spend the remaining time in the laboratory where they learn good language habits by practicing with tape recorders.

Students learn better if they understand how the lesson will benefit them. For that reason, the instructor who is using the demonstration-performance method should include in his introduction some references to the personal or professional benefits the student may expect to derive from the lesson.

ESSENTIALS OF DEMONSTRATION-PERFORMANCE METHOD

Much of the learning of Air Force personnel involves doing. From simple administrative procedures to more complex mechanical tasks, the duties of individuals and groups usually require skills to be performed. The demonstration-performance method of teaching, which can help insure proficient performance of these skills, has five essential phases: explanation, demonstration, student performance, instructor supervision, and evaluation.

Explanation

In teaching a skill, the instructor must convey to the students the precise actions that they are to perform. In addition to the necessary steps, the instructor may want to describe the end result of these efforts. Before leaving this phase of the method, the instructor should encourage the students to ask questions about any step of the procedure that they do not understand. Instructional aids, discussed in Chapter 11, are helpful to instructors in explaining and demonstrating a skill.

Demonstration

The instructor must show the students the actions necessary to perform the skill. He demonstrates the exact procedures that they must perform to achieve the desired learning outcomes. This phase and the explanation phase are often combined and presented simultaneously (Fig. 7). Sometimes the instructor can explain a skill while someone else demonstrates it. For example, the instructor might explain the techniques for firing a ground-to-air missile, while another person actually does the firing in full view of the students. Then shortly after the explanation and demonstration phases, the students are required to perform the identical procedures.

Student Performance and Instructor Supervision

Because these two phases, which involve separate actions, are performed concurrently, they are discussed under a single heading here. The first of these phases is the student's performance of the physical or mental skills that have been explained and demonstrated (Fig. 8). The second activity is the instructor's supervision.

Student performance requires the students to act, to do. To learn skills, students must practice. The instructor must therefore allot enough time for meaningful student activity. Through doing, the students learn to follow correct procedures, meet a reasonable time schedule, and to reach established standards. If the students are required to perform the skill in unison (by the numbers) prior to terminating the performance phase, they should be allowed to complete the task at least once independently with supervision on an "as needed" basis.

While students are practicing, they need supervision to help them improve and perfect their



Figure 7. Explanation-Demonstration Phase



Figure 8. Performance Phase

performance. Supervision can be done by the instructor alone or with the help of faculty members or advanced students. Sometimes, a checklist, a step-by-step chart, or a sample of the finished product can be helpful to the instructor as he supervises student performance.

Evaluation

In this final phase, the instructor judges student performance. Here, the student shows his ability to perform on his own. Through evaluation, the instructor discovers just how well the students have learned. To test each student's ability to perform, the instructor requires the students to work independently throughout this phase and makes some comment as to how each performed the skill relative to the way it was taught. From this measurement of student achievement, the instructor determines the validity of his own instruction.

TYPES OF PERFORMANCE

To accomplish the Air Force mission, each airman, officer, and civilian employee must perform his duties effectively. Sometimes these people perform as individuals and sometimes as members of groups. Since Air Force instructors must teach both types of performance, both are examined here.

Individual Performance

Basic and technical training courses in the Air Force emphasize individual student performance. In some cases, the individual is allowed to progress at his own speed in learning a skill. Normally, an instructor is available to help the student who needs assistance. Sometimes, the instructor uses the coach-pupil, or buddy, system,

in which he pairs students for alternately assuming the roles of coach and pupil.

The instructor acts as a supervisor during class sessions devoted to individual student performance. By moving through the group, he can observe, assist, and question students to make certain that each one knows what to do and how to do it. This allows the instructor to identify those who apparently are having difficulty and to give them special attention. He should not assume that students will follow through automatically, but should check to see that they are performing correctly. In supervising a large class, the instructor may need the help of qualified assistants.

In supervising individual performance, the instructor must detect wrong practices as they appear; otherwise, they will quickly develop into habits. Constant supervision of student practice is necessary to eliminate errors in individual performance.

Team Performance

Team, or group, performance receives special emphasis in tactical and logistics training. Since modern warfare requires efficient teamwork, military units must be given effective training in cooperative action. Teamwork is not a matter of chance. Only through intensive practice will groups know exactly what to do and how to do it. Through practice, a group learns not only how to work smoothly as a unit but also how its mission relates to those of other units.

Successful team practice demands an instructor who brings resourcefulness, ingenuity, and thorough preparation to his instructional task. For a field exercise, preliminary instructions must be crystal clear. Any instructions that can be misunderstood are likely to be misunderstood, at least by some. Instructions should include statements of the objective and the importance of student cooperation and coordination. Groups work harder when they understand why their efforts are necessary.

Demonstration-Performance Lesson Plan

Every lesson should be based on a carefully prepared plan. The example shows how the plan for a demonstration-performance lesson might be recorded. This sample plan and those in later chapters all follow the recommended format.

SUMMARY

The demonstration-performance method puts theory into practice. It is only through practice, actual performance, that individuals are able to learn certain skills and techniques. Because performance puts the student in contact with the acts that make up the motor or mental skills he is learning, he is likely to learn more rapidly by this method.

Supervision by the instructor or by his assistants helps the student acquire *correct* procedures, as presented in the instructional demonstration. Effective supervision also insures that the student will correct his mistakes as he makes them, before they become habits. The demonstration-performance method permits the instructor to check on student progress and also to judge the success of his own efforts.

The team-performance method promotes cooperation and group spirit among individuals who are to perform as a unit. Through working together in well-planned field operations, a group of individuals can be welded into a smoothly functioning team. This team can, in turn, be taught to function efficiently in relation to other teams that are contributing to the same mission.

SAMPLE LESSON PLAN

(Demonstration-Performance Method)

LESSON TITLE: Proper Folding of the U. S. Flag

COURSE: Academic Instructor Course

INSTRUCTOR: Capt John B. Newton

ADVISOR: Maj Holcombe

PART I

LESSON OBJECTIVE: The objective of this lesson is for each student to be able to fold correctly the flag of the United States.

DESIRED LEARNING OUTCOMES: Each student should

1. know that the flag consists of a union, a ground, a hoist, and a fly.
2. be able to make the two necessary horizontal folds.
3. be able to make a series of triangular folds.
4. be able to tuck the fly end into place.

INSTRUCTOR REFERENCES:

1. *The Airman's Guide*, The Stackpole Co., 12th Edition, Jan 64.
2. *Air Force Manuals* 50–14 and 900–2.
3. *The Encyclopedia Americana.*

INSTRUCTIONAL AIDS:

1. Seven flip charts.
2. Chalkboard and chalk.
3. Flags (one large all-purpose; five smaller organizational).

STUDENT PREPARATION: None.

HANDOUT MATERIALS: None

TIME REQUIRED: 35 minutes

PLAN OF PRESENTATION: After the introduction, the instructor will explain the parts of the flag, as he develops a flag on chalkboard. He will then explain and demonstrate the 5-step folding procedure, using a student to hold one end of flag. One organizational flag will then be handed to each "pair" of students. Students will practice in each of the two positions. The instructor will supervise and help. Each student's proficiency will then be assessed in a final folding. The instructor will review the parts and the folding procedure. He will then remotivate and close.

PART II

Student Outcomes	*Student Activity*	*Instructor Activity*
	A. INTRODUCTION (5 minutes)	
1. Become attentive and focus on subject.	1. Listens and observes flag changes.	1. Shows pictures (mounted on flip charts) of the various flag designs since 1776.
2. Realize professional need for learning correct folding technique.	2. Listens and visualizes self in a number of roles where flag folding skill will be helpful.	2. Emphasizes student need: a. In appreciation of an American tradition. b. As a citizen — teaching youth, such as scout group. c. As a member of military forces (retreat ceremony; funeral tribute).
3. Realize that he will learn the skill by the end of the period.	3. Listens and visualizes the instructor's plan for the period.	3. States objective and briefly outlines procedures: a. Become familiar with terminology. b. Hear a running commentary during demonstration. c. Practice. d. Receive final check by instructor.
	B. DEVELOPMENT (27 minutes)	
	EXPLANATION-DEMONSTRATION (8 minutes)	
1. Know that the flag consists of a union (white stars in a blue field), a ground (red and white stripes), a hoist end, and a fly end.	1. Listens, observes, and associates terms with derivation.	1. Explains significance of each part as the flag is developed on the chalkboard. Cites fly and hoist dimensions of various flags. a. Quote Henry Ward Beecher on symbolic nature.
2. Understand the procedure for making the two necessary horizontal folds.	2. Observes and comprehends method for making folds.	2. Using one student to assist, demonstrates folding procedure. Position

Student Outcomes	*Student Activity*	*Instructor Activity*
		and role of the two participants are clarified verbally: (1) starting positions. (2) relative waist high position of flag. (3) lower striped section is folded over blue field; then folded edge is folded over to meet open edge.
3. Understand the procedure for making a series of triangular folds.	3. Observes and forms a mental checklist.	3. Continues to explain and demonstrate this second step. Mentions that person assisting stands fast — folder at fly end moves toward him. Folder brings striped corner of folded edge to open edge. Then outer point is turned inward to form a second triangle. Continue.
4. Understand the procedure for tucking the fly end into place.	4. Watches procedure for folding ends into final fold.	4. Explains that it may, or may not, be necessary to tuck ends. Notes that triangular or "cocked hat" design is the objective. Demonstrates procedure. Shows that only blue field is visible. Unfolds flag, switches position with assistant, and asks him to demonstrate. Comments and corrects any errors.
	PERFORMANCE-SUPERVISION (14 minutes)	
5. Be able to make the horizontal folds, the triangular folds, and to complete the cocked hat design.	5. Practices folding procedures. Changes position and repeats.	5. Divides class into teams of two. Hands each team an organizational flag. Directs "pairs" into proper position and asks each team to fold flag. Instructor checks folds for neatness and correctness. Have team members exchange positions and repeat procedure. Instructor helps, and answers questions. Reaccomplished if time permits.
	EVALUATION (5 minutes)	
6. Be able to fold correctly, without supervision, the flag of the U. S.	6. Refold flag in the correct sequence, independently.	6. Asks students to refold, without assistance from instructor. After each person has completed his folding, instructor checks for neatness and correctness. a. Comments on quality of folds. b. Collects flags.
	C. CONCLUSION (3 minutes)	
1. Recall parts of the flag.	1. Listens and visualizes parts.	1. Reviews the parts of the flag.
2. Remember each step of folding procedure.	2. Listens and mentally checks self for correctness of fold and sequence.	2. Verbally reviews the folding procedure, clarifying any points of difficulty noted during the lesson.
3. Recognize or recall the personal and professional value of being able to fold flag.	3. Listens and visualizes ways skill can and will help him.	3. Remotivates students by emphasizing: a. Parental responsibility. b. Legal aspect. c. Professional responsibility.
4. Recognize that lesson is complete.	4. Realizes that lesson is concluded.	4. Establish closure by reading a short excerpt from President Wilson's 1917 Flag Day address.

CHAPTER 17

Guided Discussion Method

Discussion is a part of everyday life. People gather in groups to talk over their common interests, problems, worries, and joys. Members of families discuss world events and local news at mealtime and in the evenings. Members of organizations and communities compare ideas and take definite stands on problems. During most of these discussions people are shaping their own thoughts and the thoughts of others. They are drawing conclusions based on available information. Since discussion is a familiar way to exchange ideas and reach conclusions, it is ideally suited for classroom use.

DISCUSSION APPROACH TO TEACHING

Because discussion is particularly adapted to student participation, instructors should use it whenever possible, especially in dealing with small groups. In a group discussion, the student can fulfill his personal-social needs by working with other students. The high morale and group consciousness resulting from cooperative effort stimulate the student to display initiative and to think creatively.

The instructor can use discussion to promote reflective thinking, to generate and improve creative expression, to develop sound social attitudes, and to develop and increase abilities to cooperate in group thinking and in group efforts.

KINDS OF QUESTIONS

In the guided discussion, learning is produced through the skillful use of questions. Questions can be categorized by function and by characteristic. Understanding these distinctions helps the instructor become a more skilled user of questions.

The instructor often uses a question to open up an area for discussion. This is the lead-off question and its function is indicated by its name. Its purpose is to get discussion started. After the discussion develops, the instructor may ask a follow-up question to guide the discussion. His reasons for using a follow-up question may vary. He may want a student to consider an idea more deeply or to explain something more thoroughly. He may need to bring the discussion back to a point from which it has strayed. Often, he may use a follow-up question to include a reticent student in the discussion.

In terms of their characteristics, questions can be identified as overhead, rhetorical, direct, reverse, and relay. The overhead question is directed to the entire group to stimulate the thought and response from each group member. The instructor uses an overhead question to pose his lead-off question. The rhetorical question is similar in nature because it also spurs group thought. However, the instructor answers the rhetorical question himself. Consequently, it is more commonly used in lecturing than in guided discussion.

When the instructor wants to phrase a question for follow-up purposes, he may choose the overhead type. If, however, he wants a response from a specific individual, he may ask a direct question of that student. The instructor may use a reverse question in response to a student's question. Rather than give a direct answer to the student's query, the instructor can redirect the question for the student to provide his own answer. A relay question is redirected to the group instead of the individual.

PLANNING A GUIDED DISCUSSION

Planning for a guided discussion is basically the same as planning for a lecture. The instructor will find the following suggestions helpful in planning a discussion lesson.

- Select a topic the students can profitably discuss. Unless the students have some knowledge to exchange with each other, they cannot reach the desired learning outcomes by the discussion method. If necessary, make assignments that will give the students an adequate background for discussing the lesson topic.
- Establish a specific lesson objective and desired learning outcomes, as discussed in Chapter 15. Through discussion, the students develop an understanding of the subject by sharing knowledge, experiences, and backgrounds. Consequently, the objective normally is stated at the "understand" level of learning. The desired learning outcomes should stem from, and be related to, the objective.
- Conduct adequate research to become familiar with the topic. While researching, the instructor should always be alert for ideas on the best way to tailor a lesson for a particular group of students. Similarly, the instructor can prepare the pre-discussion assignment more effectively while he is conducting research for the classroom period. During the research process, he should also earmark reading material that appears to be especially appropriate as student background material. Such material should be well organized and based on fundamentals.
- Organize the main and subordinate points of the lesson in a logical sequence, as presented in Chapter 15. The guided discussion has three main parts—introduction, discussion, and conclusion. The introduction consists of the attention step, motivation, and overview; the conclusion consists of the summary, remotivation, and closure. In the discussion, the instructor should be certain that the main points discussed and the sequence in which they are discussed build logically to the objective. By organizing in this manner, the instructor phrases his questions to help the students obtain a firm grasp of the subject matter and to minimize the possibility of a rambling discussion.
- Plan at least one lead-off question for each desired learning outcome. In preparing questions, the instructor should remember that his purpose is to bring about discussion, not merely to get answers. The instructor should avoid questions that require only short categorical answers, such as "yes," "no," "green," "white," "one," or "four." Lead-off questions should usually begin with "how" or "why." It is much better, for example, to ask, "How can we use training aids most effectively in teaching?" than to ask, "What kinds of training aids are available to an instructor?" Students can answer the second question by merely reciting the types of training aids, but the first question is likely to spark a genuine discussion. Therefore, proper phrasing of lead-off questions is very important.

Since the instructor employs the lead-off question to open the discussion of each main point of the lesson, it is worthwhile to consider a proven three-step procedure for phrasing effective questions. First, in terms of desired outcomes, the instructor poses ideas that lead to discussion and understanding of main points in the lesson. Second, these ideas become the anticipated responses and are listed in the middle column of the lesson plan. The instructor should bear in mind that the students may not only discuss the ideas represented by the anticipated responses, but also develop other worthwhile ideas that appropriately support the desired outcome. In the third and final step, the instructor carefully plans and phrases the lead-off question so that the replies will result in a discussion of the ideas listed as anticipated responses.

An Air Force instructor's skill in conducting a discussion lesson depends to a great extent on his ability to use the questioning technique. William H. Burton, in *The Guidance of Learning Activities,* comments on the difficulty of mastering this technique:

> The actual technique of questioning is one of the most difficult and, oddly enough, one of the most neglected problems in teaching. It remains a constant problem for many good teachers. Good questioning requires the ability, native or acquired, to think quickly and easily while facing a class, to shift and change as thought progresses, and to phrase questions in clear and unambiguous terms.

- Complete the lesson plan by putting it in written form, using the sample lesson plan in this chapter as a model if one is needed.

Written Plan for Classroom Discussion

The sample plan was designed for a lesson to be taught by the discussion method. It exemplifies the principles covered in this chapter.

Student Preparation

It is the instructor's responsibility to help the students prepare themselves for the discussion before coming to class. He must encourage each student to accept responsibility for contributing to, and profiting from, the discussion.

Throughout the time that the instructor prepares the students for their discussion, he makes certain that they are aware of the lesson objective. In certain instances, particularly in practice teaching, the instructor has no opportunity to assign preliminary work and therefore must face the students "cold" for the first time. In such cases, it is practical and advisable for the instructor to give the students a brief general survey of the topic in his introduction. Under no circumstances should students without some background in a subject be asked to discuss that subject.

GUIDING A DISCUSSION

Introduction

A guided discussion lesson is introduced in the same manner as the lecture. The introduction should include an attention step, a motivation step, and an overview of key points. To encourage enthusiasm and stimulate discussion, the instructor should create a permissive atmosphere. Each student should be given the opportunity to discuss the various aspects of the subject, and he should be made to feel free to do so. Moreover, he should feel that he has a personal responsibility to contribute. The instructor can make his students feel that their ideas and active participation are wanted and needed. A permissive atmosphere encourages students to relax and to give their best.

Discussion

The instructor opens the discussion by asking one of his prepared lead-off questions. After asking a question, the instructor should be patient. The students should be given a chance to react. The instructor has the answer in mind before he asks the question, but the student has to think about the question before he can answer. Thinking takes time. Sometimes an instructor finds it difficult to be patient while students figure out answers. He must remember that it takes time to recall data, word an answer, or think of an example.

The more difficult the question, the more time the student will need to produce an answer. Sometimes students do not understand the question. Whenever the instructor sees puzzled expressions, he should state the question again in a slightly different form. The nature of the questions should be determined by the lesson objective and desired learning outcomes.

Assume, for example, that the objective of a lesson is for students to understand the importance of attitudes in the learning process and that the desired outcomes state specific ideas that the students must develop to achieve the lesson objective. One of the instructor's first problems is to get the students interested enough to discuss attitudes. He might arouse their interest by asking them to explain what the word "attitude" means to them. When the instructor phrased the question, he anticipated student answers such as "learned responses," "reactions to environment," or "feelings." Differences of opinion will stimulate the students to discuss and expand their concept of attitude.

After the students have discussed what attitude means to them, the instructor might ask them to explain how attitudes are formed. Their anticipated responses might include the following: "You learn attitudes from parents, teachers, and elders." "Attitudes result from favorable and unfavorable experiences." "Political and religious affiliations underlie many of our attitudes."

Once the discussion is under way, the instructor should listen attentively to the ideas, experiences, and examples contributed by the students during the discussion. Remember that during his preparation, the instructor listed some of the anticipated responses that would, if discussed by the students, indicate that they had a firm grasp of the concept of the subject being discussed. As the discussion proceeds, the instructor may find it necessary to guide the direction, to stimulate the students to explore the subject in greater depth, or to encourage them to discuss the topic in more detail. By using "how" and "why" follow-up questions, the instructor should be able to guide the discussion toward the objective of the students to understand the subject.

When it appears the students have discussed the ideas that support this particular part of the lesson, the instructor should summarize what the students have accomplished. In a discussion

lesson, the interim summary is one of the most effective tools available to the instructor. To bring ideas together and help in transition, he can make an interim summary immediately after the discussion of each learning outcome. This will summarize the ideas developed by the group and show how they relate to, and support, the idea discussed. The interim summary may be omitted after discussing the last learning outcome when it is more expedient for the instructor to present the first part of the conclusion. An interim summary reinforces learning in relation to a specific learning outcome. In addition to its uses as a summary and transitional device, the interim summary may also be used to keep the group on the subject or to divert the discussion to another member.

Keeping on the Subject

If students are to achieve the objective of a lesson, their discussion must not deviate from the subject matter that supports the desired learning outcomes. When this happens, the instructor should take over, summarize the group's ideas, and ask a follow-up question that brings the discussion back to the subject. Sometimes it is difficult to decide when the student's discussion has deviated too far from matters pertinent to the desired learning outcomes. A good rule is to let the group proceed on a topic as long as it seems to be profiting from the exchange of information and progressing toward the lesson objective.

Sometimes the instructor has to "play dumb" in a discussion group. For example, a student may use terms that are familiar to him but new to other members of the class. When this happens, the instructor should ask for further explanation. The questioning technique helps the instructor insure that every member of the group understands. This technique also discourages bluffing. Students may think they know all about the discussion topic, but, when faced with explaining it to the class, they may realize they are not so sure. The instructor should keep them explaining until they have expressed their ideas clearly and the entire group understands (Fig. 9).

Throughout the discussion, the instructor repeats the pattern of using lead-off questions, guiding when necessary, and summarizing until all the main points on desired learning outcomes have been covered.

GROUP DYNAMICS

Like conversations with relatives and friends, discussion in the classroom involves personal feelings as well as subject matter. These feelings, which spring from the personal relationships among the members of the class, are the dynamic forces that work within the group. If, for example, one student responds to the opinion of another student by saying, "You're wrong, I can't agree with that," a force is created that may stop the learning process. Although the interrelationships of the members of a group can impede the learning process, they can also work as constructive forces. For that reason, the instructor who intends to use the discussion method in teaching must know how to help his students handle personal relationships constructively.

As explained in Chapter 14, certain personal-social needs are common to all people. To help his students concentrate on a lesson, the instructor must do everything feasible to see that their personal-social needs are satisfied. All members of the group should be encouraged to treat each other with consideration and respect, to recognize the good qualities of each member of the class and try to understand his weaknesses. In developing such attitudes in his students, the example set by the instructor is the single most important element. If he demonstrates that he recognizes the worth of every person in the class, his students will follow his example. The instructor inadvertently demonstrates his real attitudes through his tone of voice, facial expressions, and general manner, no matter what he says. For example, the instructor who genuinely respects other people does not make fun of a student who makes a mistake. By recognizing and praising



Figure 9. Guided Discussion

worthwhile ideas, the instructor can bolster the self-confidence of his students and encourage them to be relaxed and natural. By varying his approach, he can stimulate the interest of his students and satisfy their need for new experience. Many specific ways to satisfy the personal-social needs of his students will occur to the instructor who gives the matter serious thought.

To increase the effectiveness of his teaching, the instructor should strive to make each student feel that he is a member of the group. Some useful devices are using the word "we," referring to the common problems of the group, and combining the contributions of individual students to show how the group can work together to solve these common problems. Here again, the instructor can bring his own experience and careful thought to the devising of further techniques for developing a sound, relaxed atmosphere for learning.

The type of leadership that the instructor displays in group discussions influences his effectiveness as a teacher. Because the competent leader always respects the thoughts, opinions, and feelings of the members of his group, he creates a permissive atmosphere for work. The leader who exercises rigid control improperly focuses attention on himself rather than on the job to be done. Conversely, the leader who exercises too little control fails to provide guidance to the group. If the instructor prepares for his leadership role thoroughly in advance, he leaves himself free during the discussion to exercise judgment and discretion in handling any unusual problems that may develop.

DISCUSSING TECHNICAL MATERIAL

Although the discussion is most often used to develop abstract concepts in such areas as ethics, morale, and supervision, it can also be used effectively in teaching technical material. However, the instructor should make sure that the students have enough background in the subject to make the discussion worthwhile. Unless everyone in the class understands the fundamentals of the subject, a few students are likely to dominate the discussion, or worse, the class may find that it cannot discuss the topic at all. For example, students lacking a background in electronics could not intelligently discuss problems in radar maintenance.

Even complicated technical material can sometimes be adapted to the discussion method, if the group has the necessary background knowledge. The following description of one Air Force instructor's experiment with the discussion method suggests how this might be done.

MSgt. Rusler, an instructor in C–124 engineering, had been having considerable difficulty in developing a successful presentation on carburetion. In one period he was expected to teach his students the basic principles of carburetion. Finding that he could not, by lecturing, give his students a thorough understanding of these principles, he decided to experiment with one class.

Arranging the students in a circle around a cross-sectional mockup of the carburetor, he introduced the subject. Then he set the stage for a group discussion by saying, "Men, I want each of you to suppose you are a pilot of a C–124 aircraft flying at 7,000 feet. Your engines are icing. Here is your carburetor." Then he asked a lead-off question, "What is causing ice to form?"

In this different but more natural approach to ground-school instruction, the students felt relaxed. This was something out of the ordinary; it was almost like bringing the between-class 'bull session" into the classroom.

Because the students thought they knew very little about carburetors, they at first seemed to expect the instructor to give them the answers. But he kept asking questions: "What condition exists in the carburetor that would cause ice to form? How would you explain it?" After some hesitation, Airman Carroll volunteered, "Water condensation." The instructor then asked a follow-up question: "Why does this phenomenon exist? Explain it to the class." Airman Carroll was surprised but challenged by the question. The students looked to him for the explanation, and he saw that it would be natural for him to talk. He began by talking about the venturi principle of the carburetor. When he had trouble putting his thoughts into words, the class eagerly contributed information. And when he was in error, they were quick to correct him. Other students contributed ideas which helped clarify the discussion. By the time the class had answered the instructor's first questions, most of the group had participated in the discussion. They had covered the basic theory of the venturi, and they understood why ice forms in a carburetor. Through an interesting discussion, they achieved a desired learning outcome.

From this discussion, it was easy for the instructor to lead into the next topic by asking, "What can you do to get rid of ice in a carburetor?" The students began to discuss different techniques of reducing carburetor ice.

The sergeant continued to use the questioning technique until he was sure that his students understood the subject matter and had achieved the desired outcomes of the lesson on carburetion.

SUMMARY

The guided discussion allows students to express their ideas and pool their knowledge in arriving at the lesson objective. It gives the teacher direct

contact with his students, enabling him to adjust his teaching to their individual rates of learning and needs.

The good Air Force instructor accepts responsibility for getting his students to prepare for a classroom discussion in advance. The most economical way for him to do this is to plan his students' assignment while he is researching the discussion topic. During the process of examining references for his own use, he earmarks reading materials which will give the students a background for participating in the discussion.

In guiding the discussion, the instructor should avoid being the center of attention. Instead, he should use key questions to keep the students progressing toward the desired learning outcomes and the lesson objective. If he allows the discussion to wander aimlessly, it will soon become a boring affair. For that reason, the instructor must plan his questions carefully and use them skillfully.

The questioning technique is the lifeline of the guided discussion. The instructor must rephrase when necessary to be sure the students understand, and then allow them time to answer. In addition to asking the questions he has planned, the instructor should also encourage the students to ask each other questions. This encouragement may not be necessary, however, since students tend to question each other, once they become interested and have established a smoothly flowing discussion.

SAMPLE LESSON PLAN

(Guided Discussion)

LESSON TITLE: Psychology of Learning
COURSE: Academic Instructor Course
INSTRUCTOR: Capt M. R. Jones
ADVISOR: Maj N. P. Flack

PART I

LESSON OBJECTIVE: The objective of this lesson is for each student to understand three theories of learning used in Programmed Instruction that an instructor can use to increase his instructional effectiveness.

DESIRED LEARNING OUTCOMES: Each student should

1. understand that a student usually learns through the responses he makes.
2. understand that a student usually learns when experiences are pleasurable.
3. understand that a student usually learns when he can progress at his own speed.

INSTRUCTOR REFERENCES:

1. AFM 50–1, *Programmed Learning*, USAF, Washington, D. C., 31 July 1964.
2. Ofiesh, G. D. and Meirhenry, W. C. *Trends in Programmed Instruction*. Washington, D. C.: DAVI, National Education Association, 1964.

INSTRUCTIONAL AIDS: Flip Chart

STUDENT PREPARATION: None

HANDOUT MATERIAL: None

TIME REQUIRED: 35 minutes

PLAN OF PRESENTATION: The instructor will introduce the lesson by asking a rhetorical question and then motivate the group by making specific application of the adaptability of programmed learning theory to conventional teaching. He will then narrow the subject to three learning theories. Discussion for each theory will be stimulated by asking a lead-off question. Follow-up questions will be used as needed. Interim summaries for DLO 1 & 2 will be used to solidify the conclusions reached. DLO 3 will be summarized in detail in the final summary. The final summary will establish the relationships between each theory and the lesson objective. The students will then be encouraged to use these theories in their classes. End lesson by reading quotation from Quintilian.

PART II

Student Outcomes	*Student Activity*	*Instructor Activity*
	A. INTRODUCTION (5 minutes)	
1. Become attentive.	1. Responds mentally to rhetorical question. Concludes that lesson may have value.	1. Asks rhetorical question: Why have teachers with a knowledge of Programmed Instruction consistently stated they are better teachers as a result? Answers question: Programmed Instruction helps to provide a clearer understanding of the learning process. States that each participant should feel the same way when this discussion is concluded.
2. Desire to gain an understanding of the theories of learning used in Programmed Instruction (PI).	2. Accepts reasons that these theories can improve his teaching effectiveness. Visualizes relationship between PI and conventional instruction. Is ready to discuss the topic. Accepts lesson as a personal goal.	2. Motivates the lesson by stating reasons why this discussion can be valuable to each participant.
3. Recognize the lesson objective and its relationship to the desired learning outcomes.	3. Accepts the objective. Establishes relationship between objective and subject matter areas.	3. States objective and narrows subject to discussion areas.
	B. DEVELOPMENT (25 minutes)	
	Anticipated Responses:	*Asks:*
1. Understand that a student usually learns the responses he makes.	1. Students must be actively involved; learning is an active process.	1. How do people learn? Follow-up questions as needed.

Student Outcomes	*Student Activity*	*Instructor Activity*
	Students must do something; namely, learn by doing. Students must do something with what they hear and read in order to learn. Student responses can be controlled by the instructor.	
2. Understand that a student learns when experiences are pleasurable.	2. Students seek success. Students prefer to be correct at all times (conformity). Students avoid failure as much as possible. Students like subjects in which they have a good chance to succeed. Student success can be planned by the teacher.	2. Why can the remarks "excellent work," "good," facilitate learning? Follow-up questions as needed.
3. Understand that a student learns best when he can progress at his own speed.	3. Each student is different. Individual differences are usually reflected in learning speed. Competition can impede learning for the slow student. Fast learner is not limited by the average student. Student failure can be a result of group pacing.	3. How does the statement "I teach to the level of the class" influence classroom learning? Follow-up questions as needed.
	C. CONCLUSION (5 minutes)	
1. Understand the objective and the influences of each DLO on lesson objective.	1. Establishes rellationship between objective and each DLO. Establishes relationship between each DLO and supporting ideas developed.	1. Summarizes each DLO for retention of theory. Relates each theory to lesson objective.
2. Be able to determine specific uses for these theories in his classroom teaching situation.	2. Applies each theory to his classroom environment. Desires to use these theories in his classroom learning situation.	2. Explains how these theories will work in conventional teaching. Refers to the rhetorical question in the introduction of lesson. States that students should feel that they can be better teachers because of having learned the techniques of Programmed Instruction.
3. Realize the lesson is concluded.	3. Listens and desires to apply quotation to his classroom instruction.	3. Reads Quintilian quotation.

CHAPTER 18

Case-Situation Method

All Air Force schools prepare students to solve problems. The problems that the students will face when they leave a school determine the specific mission of the school. Therefore, the school must provide a learning situation that best prepares the student to deal successfully with these problems. The case method is based upon the premise that, if the student can solve hypothetical problems in the classroom, he will be able to solve actual problems of a similar nature when he faces them. This transfer of learning from the classroom to the real-life world is the sole justification for the existence of the school. Briefly stated, the case method requires the student to participate actively in problem situations which may be either hypothetical or real. He attempts to solve problems by applying sound principles developed through analytical thinking.

The case is first presented to the student in the form of a report which contains essential data concerning the problem. The student then analyzes this report, evaluates the problem, decides upon the applicable principles, and, finally, recommends a solution or course of action. Through these activities, he develops his ability to reason and apply principles. Working both individually and in small groups, the students experience the many facets of individual behavior and group dynamics. They are exposed to the dissimilar ideas of their contemporaries, and they arrive at a way to transfer new knowledge to specific situations. Since the purpose of the case method is to develop knowledge into understanding, this method of teaching is most effective when students have a general knowledge in the subject area under consideration.

There are many ways that the instructor can prepare and present a case. To present the Air Force instructor with a system for planning and conducting this kind of lesson, the "Case-Situation Method" has been designed.

The case-situation method can be used in various ways. It can be used whenever the instructor wants to insure that his students fully understand the application of selected principles. For example, in a management course, the instructor might be teaching principles of organization. The instructor may use a lecture or reading assignment to introduce the principles and to explain the fundamentals involved. Now, however, the instructor wants to give the student a chance to *apply* the principles, to demonstrate his understanding. Ideally, the student would then be placed in a real problem environment in which he would have an opportunity to apply the principles in actuality. This is usually impossible or impractical. So the instructor creates for the student a "case situation" in the classroom. He develops a hypothetical problem in which the principles of organization have been violated. The student is asked to solve the problem by using the understanding he has gained previously in the lecture or his readings. If he can do so, the instructor is reasonably assured that the student has acquired the ability to handle real organization problems he may face in the future.

The case-situation method is an effective means of simulating conditions that the student will find when he leaves the classroom. The method involves problem-solving by the student. The problems, which can vary from management procedures to engine malfunctions, are created by the mind of the instructor rather than by the world of reality.

STEPS IN PREPARING FOR CASE-SITUATION LESSONS

Of the many types of problem lessons only one—the case situation—is considered here. By using the case-situation method, the students resolve the problem through group discussion rather than by experimentation or by the application of manual skills. A good way to understand this method is to examine the steps in preparing a case-situation lesson.

State Lesson Objective

Clearly defining and stating the lesson objective is the first step in preparing for any type of lesson, including the case situation. If, for example, the instructor wants his students to understand the application of certain basic principles of lesson planning, he begins his own lesson planning by preparing a clear statement of the broad objective. His statement might be this: The objective of this lesson is for each student to understand the application of three basic principles of lesson planning.

List Desired Learning Outcomes

The desired learning outcomes are the principles that the instructor wants the students to understand. A principle might be defined as a statement of a fundamental or general truth, or of an established rule of action. Each principle should be clearly stated in one complete sentence that either specifies or implies what action is to be taken in applying that principle. An incorrectly stated principle would read: Unity of command. An acceptable version might read: The power to make decisions must be vested in one individual at each organizational level.

The instructor should be careful to list only as many outcomes as the students can accomplish in the lesson period. The complexity of the material, the background of the student, the amount of time available, and the number of students in the class are some of the limiting factors. Experience has shown that two to four desired learning outcomes can usually be satisfactorily presented in a 35 to 45-minute lesson period.

State Facts and Conditions

In this step, the instructor describes a situation in which the principles, or learning outcomes, are violated. This situation must include the facts and conditions that have brought about the problem. Each principle that has been listed as a desired learning outcome should be violated at least once. A violation may consist of someone's action or lack of action, but in either case, it directly contributes to the problem at hand. In a lesson on the principles of supervision, for example, the instructor may want his student to understand the application of the following principle: A supervisor should give credit when credit is due. The instructor might begin to develop a case situation involving a problem by visualizing a condition in which an airman successfully performs a difficult task. If the instructor can then bring out the failure of the airman's supervisor to express well-deserved appreciation, the case situation contains a violation of this principle.

Each violation must be carefully worded. If a violation is clearly apparent, the students are not sufficiently challenged, since they do not need to think reflectively to solve the problem involved in the situation. But if a violation is thoroughly hidden, the students may be frustrated in trying to identify it. Frustrated students are likely to engage in a confused and meaningless discussion that results in a vague understanding of principles. To make the lesson effective, the instructor should devise realistic violations and word them so that the students are challenged to think, to detect the violations of the principles, and then to recommend solutions for resolving the situation satisfactorily.

The following illustration shows how an instructor might state the facts and conditions of a case. In a period devoted to lesson planning, the instructor wants his students to gain an understanding of the application of the principles that are stated below as desired learning outcomes.

Desired Learning Outcomes: Each student should understand the application of the following principles:

1. The background and experience of the students should be considered in planning the content of a lesson.
2. The lesson should be planned to encourage as much meaningful student activity as possible.
3. The lesson objective should be sufficiently limited to permit the students to achieve it in the time allowed.

(In the following narrative, the italicized letters identify violations of these three principles.)

Facts and conditions:

We are a board of officers appointed by the Commander, Air Training Command, to investigate reports concerning the unsatisfactory Basic Armament Course being conducted at Rentip Air Force Base, and to make recommendations on the basis of our findings.

Several commands have reported that the armament graduates from Rentip Air Force Base have to be retrained after reporting for duty. The men are said to lack necessary knowledge in the theory and operation of armament equipment. Our investigation revealed that the armament curriculum allows enough time (12 weeks) to train the armament technicians.

A survey of the instructors in the Basic Armament Course shows them to be experienced armament men. They are familiar with current armament equipment, procedures, and problems. In the classes that we observed, the instructors explained and demonstrated the components of armament equipment, such as the bomb racks, computers, and weapons. The instructors also explained complex problems in field operation and maintenance of systems. *(a)*

Most of the instructors used their full 50-minute periods to talk about the equipment. The students all appeared to be interested and were busy taking notes. Since they did not want to miss anything the instructor said, they seldom had time to ask questions. *(b)*

Some students remarked that the instructors covered a great deal of material and consequently some lectures ran ten to fifteen minutes over the class time, *(c)* but that other lectures were excused in about thirty minutes to make up for the overtime periods.

In general, the students seemed to feel that they could not learn the basic theory and operation of the equipment in the time provided for the course.

To be effective, a case situation must violate each of the principles, or desired learning outcomes, covered in the lesson. The italicized letters (a), (b), and (c) mark the violations of the first, second, and third principles, respectively.

The instructors violated the first principle, "The background and experience of the students should be considered in planning the content of a lesson," by introducing complex problems in the field operation and maintenance of armament systems. It is unlikely that the background and experience of students in the Basic Armament Course have prepared them sufficiently to study material of this advanced level.

The instructors violated the second principle, "The lesson should be planned to encourage as much meaningful student activity as possible," by failing to give the students opportunities to ask questions to clarify any points they did not understand.

The instructors failed to observe the third principle, "The lesson objective should be sufficiently limited to permit the students to achieve it in the time allowed," by failing to comply with the period of time allotted to each class.

The facts and conditions of a case situation should not be written before the desired learning outcomes (principles) for the lesson have been determined. The principles stated as the desired learning outcomes can serve as guides while one visualizes the facts and conditions. By keeping these principles before him, the writer can make sure that he is including a violation of each of them.

Prepare a Clear, Concise Statement of the Problem

The problem in the example is this: How can instruction in the Basic Armament Course at Rentip Air Force Base be improved? This statement stems from the facts and conditions of *this* particular situation, not just *any* instructional situation. It is not too broad, as it would be if stated: "How can instruction in the Air Force be improved?" The latter statement would apply to any instructional situation anywhere in the Air Force, rather than to the specific situation described in this narrative.

A problem statement can be too narrow because of being limited to only one part of the situation, for example: "How can the instructors of the Basic Armament Course at Rentip Air Force Base improve the timing of their class periods?" The statement of any problem can be very simply tested with this question: "Will the answer to this statement of the problem solve the problem?"

The case-situation method of teaching is unlike other methods in one important way: the instructor does not reveal the lesson objective or the desired learning outcomes until after the students have thoroughly discussed the entire situation. If he reveals the objective and desired learning outcomes at the beginning of the lesson, he practically hands the solution to the students without asking for any effort from them. Though it is permissible in the *Facts and Conditions* to indicate or state that the principles to be discussed are in a certain area, care should be taken that the instructor's *Statement of the Problem* should not reveal the subject matter area from which he selected his principles. For example, a problem might be stated: "How can better lesson planning help to improve instruction in the Basic Armament Course?" But this would be a poor statement, since it tells the students that they can find a solution by considering the principles of lesson planning. Such a statement robs the situa-

tion of realism, because a discussible situation does not exist if the solution is clearly apparent.

Prepare a Proposed Order of Discussion

The proposed order of discussion or agenda for a case situation consists of key questions that are worded and arranged so as to stimulate and guide students toward a solution. The questions in this agenda are used as means of control, somewhat as lead-off questions are used in the guided-discussion.

The instructor plans and uses the questions in his agenda to bring about a discussion of the facts and conditions of the problem where the violations of principles occur, and eventually to draw recommendations for corrections. As with the statement of the problem, a question for the agenda should not be so general that it fails to direct the students to a specific part of the problem. For example, the question "Why haven't graduates of the Basic Armament Course been successful on the job?," is far too broad for use on an agenda. It asks the students to tackle the whole situation at once. Since it would not direct the thinking of the students to a particular segment of the situation, it does not fulfill the purpose of an agenda question. The instructor should divide the problem involved in the situation into simple units and prepare his questions accordingly. This insures that the students will discuss each violation separately. In the situation given as an example above, the students should be shown some of the effects of the instruction. In a discussion of this situation, the instructor would want the students to discuss the causes of the violations and to suggest changes or recommendation for improvements.

The following specific agenda for the situation would help the instructor guide the students' discussion:

1. How may the subject matter of the course be contributing to our situation? (This agenda question should cause the students to start a discussion that would lead them to recognize the violation of the first principle and to realize that this violation contributes to the problem.)
2. What is preventing the students from learning the intended objectives during the periods devoted to explaining the equipment? (This agenda question should cause the students to discuss the second principle. Then by using follow-up questions, the instructor can direct the discussion so that the students will indicate their understanding of the application of the second principle.)
3. What are the indications that lesson timing may be affecting the situation? (This question should cause the students to discuss the third principle.)
4. What specific recommendations should be included in our plan for improvement? (This final question is the instructor's means of insuring that the students understand how to apply the principles in resolving the situation.)

STEPS IN CONDUCTING CASE-SITUATION LESSON

After the instructor has carefully prepared the questions for his agenda, he must use skill in conducting the discussion. If he follows the steps that are discussed here, he should have little difficulty in channeling the discussion and in keeping it moving toward the lesson objective.

Prepare Students for Discussion

To make sure that the students are prepared to contribute to the discussion, the instructor should provide each student with the case handout. This handout should contain the facts and conditions (the case situation), the statement of the problem, and the proposed agenda. It should not, of course, divulge the lesson objective or the desired learning outcomes (the principles). It should have some blank spaces so the students can write in new facts or modify the proposed agenda. (See the sample lesson plan in this chapter.)

Introduce the Situation

In introducing the situation to the group, the instructor should establish both his and the group's role, motivate the students, review the facts and conditions, state the problem, and discuss the proposed agenda.

Establish the Group Role

The instructor should try to make the students feel as if they are the actual participants in a working group, such as a board of directors, a committee, or a staff, who have been called together to resolve the situation. This air of realism should be maintained throughout the discussion

until the instructor makes his final, out-of-role summary. By establishing the group's role as real decision makers early in his introduction, the instructor helps both the group and himself to "live" with the situation, rather than to approach it from the viewpoint of students and teacher.

In role-playing, persons can act in ways and make statements that are compatible with the real-life situation. Through role-playing, it becomes easier for group members to identify themselves with characters described in the facts and conditions. There are many examples on record of role-playing being used successfully by unions, management, business, and other government agencies, as well as by educational institutions.

Motivate Students to Participate

Since the instructor cannot reveal the objective or desired learning outcomes of the lesson, he will find it difficult, if not impossible, to motivate the students in terms of the value of what they are about to learn. For that reason, he should approach them as participants in the situations rather than as students. To do this he might stress the need for an immediate solution to the problem, or explain the importance to the participants and the organizations they represent of finding a solution, or appeal to them to maintain the established reputation of the group.

Review Facts and Conditions

Even if the instructor is sure that each participant has read and understands the facts and conditions of the problem, he should review them with the group. He can either read them verbatim or paraphrase the written situation that is provided to the group. This review of the entire situation enables the instructor to strengthen the interest of the group in its decision-making role, to point out and correct any errors in the copy, and in general, to prepare the group for discussion.

Obtain Agreement on Problem Statement

The instructor should allow the group time to consider the statement of the problem. After the students analyze the statement, they either accept it or modify it, so that it accurately, clearly, and concisely represents the problem growing out of the facts and conditions. The instructor obtains from the group some word or sign indicating its acceptance of the problem statement that is to be the basis for its discussion. Otherwise, the group lacks a common starting point or purpose for its discussion.

Supply Additional Facts and Conditions

After obtaining agreement on the statement of the problem, the instructor should ask whether anyone needs additional information or explanation to resolve it. If anyone shows a real need for information bearing directly on the situation, this information is given by the instructor and may be written in the space provided in the case handouts. However, the participants may request additional information at any time during the lesson. If the instructor has prepared a comprehensive description of the situation and if, at the request of the participants, he adds other facts and conditions during the introductory phase of the lesson, he will probably need to furnish little or no additional information during the discussion.

Have Group Adopt an Agenda

The instructor's next concern is the proposed agenda. He clarifies, rewords, deletes, or adds agenda questions, if these changes are needed to help the participants analyze the situation. If the group suggests changing the order of discussion, the instructor should allow it to do so, if the new arrangement helps it achieve the desired outcomes. When the instructor follows the steps described earlier for preparing a problem for discussion, the students are not likely to suggest any changes in the agenda. Like the statement of the problem, the agenda should be acceptable to the group before it is adopted and followed. To verify group acceptance, the instructor should get an oral or visible indication of its approval.

Start Group Discussion of the Case

At this point, the group should be ready to discuss the situation, using the agenda as a guide. From examining and analyzing the situation, the group should understand the task before it.

When the students start discussing the first agenda question, the instructor continues the role of case leader who is responsible for seeing that the discussion moves forward. Whenever the members digress from points pertinent to the agenda, the instructor leads them back by the skillful use of questions without dominating the discussion.

Whereas the instructor uses an oral lead-off question to initiate a guided discussion, the first written question on the agenda starts the discussion of a case situation. Occasionally, the instructor may have to use a follow-up question to narrow the discussion to a single issue or to expand a particular point to expose the violation and its relationship to the situation. Usually, however, the leader participates very little in a case discussion, because the group members have a written situation to support their discussion and an agenda to organize and direct their thinking. However, this directive material in no way relieves the instructor of his responsibility to guide and control the discussion. The group may digress, some members may talk in generalities, others may be reticent, and still others may find it difficult to play their roles as decision makers, so the instructor must be prepared to steer the group's thinking with appropriate comments and questions. He must also prevent premature recommendations based only on identifications of violations.

The instructor should make an interim summary, whenever necessary. Such a summary can be a useful means of reviewing comments, making a transition to the next agenda item, reorienting the group after a major digression, explaining and emphasizing key ideas and concepts, counseling members with divergent opinions, or restating and summing up what has been achieved. However, interim summaries are not always needed after the discussion of each item on the agenda.

As the case discussion develops and the group proceeds toward a solution, the instructor should encourage the members to analyze, think reflectively, and carefully evaluate each suggestion.

While meeting the responsibilities discussed above, the instructor should also be prepared to (1) clarify and restate, or summarize contributions; (2) recognize the personal-social needs of the students for self-esteem, recognition, conformity, and security; and (3) prevent and resolve frustrations or conflict.

Summarize Group Recommendations

After the group has proposed realistic corrective measures, the instructor brings the discussion to a conclusion by restating or summarizing these recommendations in role. Since this is the responsibility of the leader of any group that meets to discuss and resolve a situation, the instructor tries to present the summary as if the situation is real. The summary usually consists of a short review of the recommendations and an expression of gratitude to the group for its efforts, even though the recommendations do not completely resolve or improve the situation.

Summarize Lesson Objective and Learning Outcomes

After summarizing the group recommendations, the instructor changes from the role of case leader to his position as classroom instructor. At this point, the role-playing ends. He summarizes the learning outcomes and relates them to the lesson objective. His summary should have three parts:

1. He should disclose the lesson objective and the supporting principles, which he has stated as desired learning outcomes in the lesson plan.
2. He should show how the comments, suggestions, and recommendations made by the group apply the principles being taught. If the students have not achieved the desired learning outcomes, the instructor should identify the principles that are violated in the case situation. He should then explain how the group might have applied the principles, had they made certain recommendations. If the group discussed principles other than those planned as the desired learning outcomes, the instructor should give the students credit and show how their discussion relates to the lesson objective.
3. He should provide for further transfer of learning by asking the students to cite examples of other situations in which each of the principles just discussed may be applied. The instructor should be prepared to supply examples, if students do not, or if they give erroneous illustrations. This part of the summary may lead naturally into the remotivation step, but it should never be used as a substitute for that step.

Remotivate and Establish Closure

To remotivate the students, the instructor reemphasizes the importance of the principles discussed. Then he establishes closure, just as in any other lesson.

Like lessons taught by any other method, the case situation should be based on a written lesson plan similar to the example given.

SUMMARY

The case-situation method is an effective means of helping students learn to apply principles. In preparing a case-situation lesson, the instructor should follow these steps:

1. Prepare a clear, concise statement of the lesson objective.
2. State the desired learning outcomes (principles) in complete sentences that either direct or imply the specific action to be taken.
3. Prepare a lifelike case situation that violates the principles stated in the desired learning outcomes. To insure a case situation that is not only realistic and challenging but also suitable to the lesson objective, the instructor must state the desired learning outcomes (principles) before devising the situation.
4. Prepare a clear, concise, problem statement that stems from the facts and conditions causing the unsatisfactory situation.
5. Prepare an agenda of key questions, arranging them in a sequence that will stimulate the students and direct them toward resolving or improving the situation.

To help the group prepare for the situation discussion, the instructor should give each student a handout that lists (1) the facts and conditions underlying the situation, (2) a statement of the problem, and (3) an agenda (proposed order of discussion). In introducing the situation, the instructor should try to make it as realistic as possible. He should establish a role for the group and help the members relate themselves to the situation by reviewing it and by establishing a mutually acceptable approach to resolving the situation.

During the introductory discussion the instructor should not reveal the desired learning outcomes (principles), because an awareness of these is likely to destroy the group's incentive to resolve the situation. The instructor should conduct this phase of the lesson as he would the development of a guided discussion.

As the case leader of the group, he should, in role (at the end of the discussion) restate or summarize the group's recommendations.

Finally, as the teacher of the class, he should state the principles, showing where the group applied the principles during the discussion. The instructor should further aid the transfer of learning by having the group point out ways in which the principles would apply in other situations.

SAMPLE LESSON PLAN

(Case-Situation Method)

LESSON TITLE: Principles of Counseling
COURSE: Academic Instructor Course
INSTRUCTOR: Capt Woodrow Patton
ADVISOR: Maj George J. Pershing

PART I

LESSON OBJECTIVE: The objective of this lesson is for each student to understand the application of two basic principles of counseling.

DESIRED LEARNING OUTCOMES: Each student should understand the application of the following principles:

1. The successful counselor must show a sincere interest in the problem of the counselee.
2. The counselor should take follow-up action to determine whether or not the counselee was helped by any specialists to whom he may have been referred.

INSTRUCTOR REFERENCES:

1. Froelich, Clifford P., and John G. Darley. *Studying Students.* Chicago: Science Research Associates, 1952.
2. Jones, Arthur J. *Principles of Guidance.* New York: McGraw-Hill, 1963.
3. Williamson, E. G. *How to Counsel Students.* New York: McGraw-Hill, 1939.

INSTRUCTIONAL AIDS: Chalkboard

STUDENT PREPARATION: Read the case situation before coming to class

HANDOUT MATERIALS: Copies of case situation

TIME REQUIRED: 55 minutes

PLAN OF PRESENTATION: The instructor will distribute copies of the case situation to members of the seminar 24 hours before class. The group will take time in the seminar to consider the situation and the proposed order of discussion. After accepting a statement of the problem and an order of discussion, the group will start discussing the situation, using the agenda as a guide. After the group has made appropriate recommendations for resolving the situation, the case leader will revert to his real role as instructor of the class. As teacher, he will identify the desired learning outcomes and show how the group applied or failed to apply the principles. He will then ask the group to show further applications of the principles to other areas. Then he will remotivate the class as to the importance of the principles, and establish closure.

PART II

I. Introduction:

A. Facts and Conditions: Here at Ponder AFB the AWOL rate is higher than at any other base in the command. As a board of officers, we are to study the problem involved in the situation and recommend corrective action to the commander as soon as possible.

I have collected preliminary information for our study this morning. From various staff agencies I have learned that we have had a 30 percent turnover of airmen during the last three months. Practically all of the new personnel are in the lower grades, have less than a year's service, and came here directly from technical schools. Eighty percent of the Article 15 and Summary Court-Martial actions are among these young airmen. The most frequent offenses are failure to report for duty, drunkenness and disorderly conduct, and absence without leave. The Chaplain has stated that his workload has increased during the last three months.

When I visited Squadron A, the commander was sitting on a court-martial. His clerk-typist told me that the commander would be flying in the afternoon, but would be available starting at 7 A.M. the next day. I talked to Lieutenant Bond, the Administrative Officer, who appeared to be a very hard working and conscientious officer. He complained that he just didn't have time to listen to the men's complaints. He said, "I made First Sergeant James responsible for the kids. It's his baby now, and everything seems to be working pretty well. At least, I haven't had any of the boys come back and bother me."

I next interviewed Sergeant James and asked if he had any ideas concerning the causes of the high disciplinary rate. Sergeant James said, "Sir, I've seen a lot of new recruits during my 25 years of service, but I've never seen such a bunch of 'pantywaists' as these kids we've been getting lately. If we would quit coddling them and keep them busy with drill, inspections, and such, we'd make men out of them and they wouldn't have time to get in trouble."

The Squadron B Administrative Officer, Lieutenant Sharpe, said: "These recruits have a lot of genuine problems. When the lads started coming in to see me, I remembered some of my college courses that might help me advise them. After I got out some of my textbooks and brushed up a bit, we started doing a pretty good job — if I do say so myself. I keep a complete file on each man that comes in to see me. The following example is a typical case. A young airman came in about three weeks ago and said he needed some money to straighten out his finances. We talked it over and decided that $300 would be enough. I made an appointment for him to see Mr. McGraw at the Red Cross. I don't think he had any trouble, but if I hear that he couldn't borrow the money from the Red Cross, I will suggest another place where he can apply for a loan."

B. Statement of the Problem: How can the AWOL rate at Ponder AFB be decreased?

C. Additional Facts and Conditions:

D. Proposed Agenda:

1. What are the indications that the situation in Squadron A might be aggravating our problem?
2. How may Lieutenant Sharpe be influencing the morale of our airmen?
3. What corrective actions should we recommend to the wing commander?

E. Accepted Order of Discussion

II. Out-of-Role Teaching Summary:

A. Summary of the group's analysis and discussion of the case situation and further application of the principles in other areas (transfer of learning).

Student Outcomes	*Application*[a]	*Further Applications*[b]
1. The successful counselor must show a sincere interest in the problem of the counselee.		In the classroom (as a teacher): Listen to the students' problems. Treat them as individuals. Recognize that one student's problems may not be the same as those of another. Show your sincere interest, and thus make better students. In the home (as a parent): Be close to the child and hear his "tale of woe." Recognize that sons and daughters in each age group have problems peculiar to themselves. Realize that small problems can become major issues. Take an interest; gain the child's confidence, and raise a healthy, happy child.
2. The counselor should take follow-up action to determine whether or not the counselee was helped by any specialists to whom he may have been referred.		In the classroom (as a teacher): To prevent or minimize the detrimental effects of personal problems on learning, follow-up on each student referred to a specialized agency. At work (as a military or civilian supervisor): Clerks, instructors, and others go to their supervisors with personal problems that must be referred to specialists. The supervisor is responsible for follow-up on each case to insure that the individual's problems do not make him an ineffective worker.

REMOTIVATION AND CLOSURE

1. Remembers the personal value of understanding the application of the two principles of counseling.	1. Listens and visualizes the possible areas where these principles can be applied to further the mission of the Air Force.	1. Remotivate the class by explaining the importance of the application of the two principles of counseling.
2. Realizes the value of applying the two principles of counseling.	2. Listens and visualizes the effects of the proper application of the two principles of counseling.	2. Close with a quote from a prominent psychologist and counselor.

[a] This space is provided for the instructor to enter notes of specific statements made by the class during the discussion which relate to the principles to be taught.

[b] These will serve as anticipated responses of the students. If the students cannot supply "further applications," the instructor should be prepared to point out these pre-planned situations.

CHAPTER 19

Lecture Method

Every instructor should know how to use the lecture method to help his students achieve lesson objectives and desired learning outcomes. He should know how to prepare a lecture, and he should understand the advantages and limitations of this method of teaching.

Although the trend in education is away from the lecture toward more actual activity for the student, certain times and situations still point to the lecture as the most suitable instructional approach. The lecture is used primarily to introduce students to a new subject, but it also is a valuable method for summarizing ideas, showing relationships between theory and practice, and reemphasizing main points.

To use the lecture to best advantage, instructors often combine it with other instructional methods. An instructor might, for example, use a brief lecture to introduce a group discussion. Through the lecture he interests the students in the subject and motivates them to discuss it.

TYPES OF LECTURES

Oral presentations take many forms. Of the various approaches, educators in the Air Force seem to favor four: the illustrated talk, the briefing, the formal speech, and the teaching lecture. Each of these variations is discussed here.

The Illustrated Talk

In this type of presentation the speaker conveys most of his main ideas through the use of visual aids. He uses speech merely to describe or clarify ideas that the visual aids introduce. Many educational television programs use this approach. Because of its increasingly technical nature, instruction in the Air Force usually requires more than visualization to bring about the required depth of understanding.

The Briefing

In a briefing, the speaker presents an array of significant facts as concisely as possible. Details are avoided unless they are critical and necessary. The briefer provides supplementary material only if asked to do so.

The combat briefing exemplifies this type of presentation. The crews are assembled in the intelligence room to hear several concise, factual talks. Usually the group commander points out the importance of the coming mission; the navigation officer reviews the route, the initial point, the secondary targets, or the targets of opportunity; the weather officer forecasts weather conditions that will be encountered; the intelligence officer covers vital information such as enemy defenses and escape and evasion tactics. The crews ask questions if they need more specific details.

The briefing is a unique type of oral presentation that fills many military needs. Whenever precise, compact, current information must be presented in a minimum of time, a briefing is effective. It must be tightly organized and skillfully presented. Visual aids, therefore, are extremely valuable to the briefer.

The briefing does not attempt to develop basic knowledge or understanding; it is built upon the assumption that the selected audience possesses these. This method of presentation does not often fit the customary classroom lesson objective.

The Formal Speech

The formal speech generally has one of three basic purposes: to inform, to persuade, or to

entertain. Each type of formal speech has its own special characteristics, which are briefly discussed here.

The speech to inform is a narration concerning some particular topic. The formal speech to inform is usually not related to any sustained effort to teach something. The listeners come together on one occasion only, to hear something new about the topic the speaker has chosen. What they gain from hearing a speaker depends on the speaker's skill and on their own efforts to understand and retain what he has to say. A travelogue is an excellent example of a speech to inform. Other examples are orientation lectures and presentations at commander's call on such topics as communism, cold war, and current political or international happenings.

The speech to persuade is designed to move an audience to take action pertinent to some topic, product, way of life, or other matter. Like the informative speech, the speech to persuade is generally an isolated event that is not related to any sequence of oral presentations. Recruiting speeches to the graduating class of high school, political barnstorming before an election, Sunday sermons, and the character guidance lectures are examples of the speech to persuade.

The purpose of the speech to entertain is to give enjoyment to the members of the audience. The speaker usually relies on humor and vivid language as his primary means of entertaining his listeners. The after-dinner speech is frequently a presentation of this type.

Speeches to inform, to persuade, and to entertain serve useful purposes on various occasions. They are not, however, designed to further the education of those who hear them.

The Teaching Lecture

The teaching lecture makes the instructor responsible for planning, presenting, and supporting a lesson, with the result that the success of the lesson depends upon the instructor's ability to communicate effectively with his class.

In the teaching lecture, the instructor is not only responsible for the support of his lesson but also for the direction and depth of ideas presented. He must determine if his ideas should progress from the known to the unknown or from the concrete to the abstract. At the same time the instructor must also determine the depth of the ideas presented. In other words, how far should he carry his students from the known to the unknown or from concrete ideas to ones of a more abstract nature?

In other methods of teaching (i.e., demonstration-performance, guided discussion, and case-situation), the teacher receives direct reactions from the students in the form of verbal or motor activity; however, in the teaching lecture the feedback is not as direct and therefore much harder to interpret. In the teaching lecture the instructor must develop a keen perception for subtle responses from the class (i.e., facial expressions, manner of taking notes, and apparent interest or disinterest in the lesson). He must be able to interpret the meaning of these reactions and adjust his lesson accordingly.

In developing his lesson the instructor presents a number of main ideas or points which support his overall objective and help the student visualize, know, or understand these assertions.

PREPARING THE TEACHING LECTURE

The competent instructor knows that careful preparation is one key to successful performance as a classroom lecturer. This preparation should start well in advance of the presentation date. In Chapter 15, four steps are specified in the planning phase of preparation: (1) establishing the objective and desired learning outcomes, (2) doing research on the subject, (3) organizing the material, and (4) planning productive classroom activities. In all stages of preparing for the teaching lecture, the instructor should support any point to be covered with meaningful examples, comparisons, statistics, or testimony of the types discussed in Chapter 10.

In supporting key points or ideas in the lesson, the instructor must carefully consider the nature of his audience and work on the assumption that students may neither believe nor understand any point to be covered without the use of testimony from experts in the topic area or without meaningful examples, statistics, or comparisons to further explain the ideas. In developing the lesson the instructor should also strongly consider the use of some of his own ideas and concepts concerning the chosen subject of his lesson.

After completing his preliminary planning and writing his lesson plan, the instructor should rehearse his lecture to build self-confidence. In

rehearsals, or dry runs, he can smooth out the mechanics of using his notes, visual aids, and other instructional devices. He should ask some colleagues to attend the practice sessions and observe his presentation critically, so they can point out weaknesses and make constructive suggestions. Their critiques will help him judge the adequacy of his supporting materials and visual aids.

Suitable Language

In the classroom lecture, simple rather than complex words should be used whenever possible. Good newspapers offer examples of the effective use of simple words. Picturesque slang and free-and-easy colloquialisms, if they suit the subject, can add variety and vividness to a classroom lecture. The instructor should not, however, use substandard English. Errors in grammar and vulgarisms detract from an instructor's dignity and reflect upon the intelligence of his students.

If the subject matter includes technical terms, the instructor should clearly define each one so that no student is in doubt about its meaning. Whenever possible, the instructor should use specific rather than general words. For example, the specific words "a leak in the gas line" tell more than the general term "mechanical defect." Figurative language can add interest and color to a lecture. Here, for example, are two ways to express the same idea, one dull and the other lively: "During most of his lesson period the instructor spoke at random and made no particular points," and "The instructor spent most of his lesson period 'revving up.' "

Another way the instructor can enliven his lecture is to use sentences of varying lengths. The consistent use of short sentences results in a choppy style. But unless long sentences are carefully constructed, they are difficult to follow. Long sentences, inexpertly used, can become as tangled as a plate of spaghetti. To insure clarity and variety, the instructor does well to use sentences of short and medium length.

Types of Delivery

The instructor can deliver a speech in one of four possible ways: (1) by reading from a typed or written manuscript, (2) by reciting memorized material without the aid of a manuscript, (3) by speaking extemporaneously from an outline, or (4) by speaking impromptu without preparation.

The teaching lecture is probably best delivered in an extemporaneous manner. The instructor speaks from a mental or written outline but does not read or memorize what he is going to say. Because he leaves to the moment the exact words with which to express an idea, his lecture is more personalized than one that is being read or spoken from memory. Since the instructor talks directly to the students, he can readily observe their reactions and adjust to their responses. Because he has not memorized what he is going to say, he has better control of the situation; he can change his approach to meet any emergency and can tailor each idea to suit the responses of his students. For example, if he realizes from their puzzled expressions that a large number of students fail to grasp an idea, he can elaborate upon that idea until the reactions of the students indicate that they understand.

The extemporaneous presentation reflects the instructor's personal enthusiasm and is more flexible than other methods. For these reasons, it is likely to hold the interest of students.

Formal Versus Informal Lectures

The lecture may be conducted in either a formal or an informal manner. The informal lecture includes active student participation. The primary consideration in the lecture method, as in all other teaching methods, is the achievement of desired learning outcomes. Learning is best achieved if students participate actively in a friendly, relaxed atmosphere. Therefore the use of the informal lecture is encouraged. At the same time, it must be realized that a formal lecture is still to be preferred on some subjects and occasions, such as graduation addresses or lectures introducing new subject matter.

The instructor can achieve active student participation in the informal lecture through his use of questions. In this way, he encourages the students to make contributions that supplement the lecture. The instructor can use questions for one or more of the following purposes: to determine the experience and background of his students to tailor the lecture to their needs, to add variety and stimulate interest, and to check student understanding.

The instructor should not depend upon the participation of his students to develop his lesson for him. It is the lecturer's responsibility to plan, organize, develop, and present the major portion of the lesson.

ADVANTAGES AND DISADVANTAGES OF THE LECTURE

In a lecture, the instructor can present many ideas in a relatively short time. Facts and ideas that have been logically organized can be concisely presented in rapid sequence. Lecturing is unquestionably the most economical of all teaching methods in terms of the time required to present a given amount of material.

The lecture is particularly suitable for introducing a subject. To insure that all students have the necessary background to learn a subject, the instructor can present this basic information in a lecture. By using the lecture in this way, the instructor can offer students with varied backgrounds a common understanding of principles and facts.

The lecture is a convenient method for instructing large groups. If necessary, a public address system can be used to amplify the speaker's voice.

The lecture can be used to present information that would be difficult for the student to get in other ways. If the students do not have the time required for research or if they do not have access to reference material, the information they need can be presented to them by the lecture method.

The lecture can usefully and effectively supplement other teaching devices and methods. A brief introductory lecture can give direction and purpose to a demonstration. A lecture can also prepare students for a discussion by telling them something about the subject matter to be covered.

Although the lecture method can help the instructor meet the special challenges discussed above, it does have drawbacks. Too often the lecture does not provide for student participation, and as a consequence, many students willingly let the instructor do all the work. Learning is an active process, and the lecture method tends to foster passiveness and teacher-dependence on the part of the students. As a teaching method, the lecture does not bring about maximum attainment in certain types of learning outcomes. Speech skills, cooperative group thinking, and motor skills, for example, can hardly be learned by listening to a lecture. The only way that students can perfect such skills is through practice in performing them.

The lecture does not enable the instructor to estimate his students' progress before he gives them an examination. Within a single period, the instructor may unwittingly present more information than students can absorb, and the lecture method gives him no accurate means of checking student learning.

Many instructors find it difficult to hold the attention of all students in a lecture lasting throughout the class period. To achieve desired learning outcomes through the lecture method, an instructor needs considerable skill in speaking.

LESSON PLANNING TIPS

After the instructor has established his objective and desired learning outcomes, he should ask himself the following questions as he plans for his teaching lecture presentations:

- Are the desired learning outcomes adequately supported by pertinent material? Is the supporting material varied enough to stimulate and maintain interest, to allow for changes in pace, and to provide diversity? Does the supporting material contain hasty generalizations, emotional appeals, or other fallacious reasoning? Does the support for one point blend naturally into the next idea to be presented?
- Does the teaching guide in the lesson plan stipulate meaningful activities to help students achieve the desired learning outcomes? The student activity column must specify the activity that the student is to perform to achieve the outcome. Is he to recall something from his past experience? Is he to visualize a concept? Is he to imagine a hypothetical situation? If the student is to learn what the instructor wishes him to learn, just what must his behavior (activity) be? Has the instructor been specific in listing this activity?
- Is the support for each desired learning outcome suitable for the level of learning? Is the *what* of the subject described to insure the student's achievement of the *knowledge* level? Are the *hows* and *whys* developed adequately to help the student achieve *understanding?* Is the depth of the support for each outcome compatible with the desired level of learning?
- Does the introduction prepare the student for the learning situation? Does it offer the student good reasons for learning the material? Does it present a clearcut, logical organizational pattern to be followed in the body of the presentation?

• Does the plan exploit every opportunity to help the student visualize facts, ideas, and concepts? Do the visual aids clarify the organization? Do they further the lesson objective? Is color used to highlight main concepts? Are the aids simple?
• Has the presentation been thoroughly prepared? Have other instructors listened to it and critiqued its effectiveness? Is the instructor familiar enough with the organizational pattern to give a successful extemporaneous presentation?

If an Air Force instructor checks his planning against these questions as he prepares to lecture, he can improve the overall effectiveness of his lessons. It takes hard work to become a good lecturer, but through sound planning, an instructor can present teaching lectures that effectively meet lesson objectives. A sample plan is given.

SUMMARY

In planning a lecture, the instructor should follow four steps: (1) establish the lesson objective and the desired learning outcomes, (2) do research on the subjects, (3) plan class activities, and (4) organize the lesson. The instructor should complete these steps in time to rehearse his presentation as many times as necessary to insure a strong, poised delivery.

Lectures are primarily of four types: (1) the illustrated lecture in which the lecturer relies heavily on visual aids to convey his main ideas to the listener; (2) the briefing in which the lecturer presents a concise array of facts to listeners who do not expect elaboration or supporting material; (3) the formal speech in which the lecturer's purpose is to inform, to persuade, or to entertain; and (4) the teaching lecture for which the instructor must plan and deliver an oral presentation in a manner that helps students reach the desired learning outcomes.

In the teaching lecture, the instructor should realize that he has almost sole responsibility for directing his ideas, gaining the desired depth, and supporting, amplifying, and clarifying key points presented in the lesson. The instructor must also note that the effectiveness of his entire lesson depends largely upon his ability to interpret subtle feedback from his students. He must so adjust his lecture as to allow students to reach the maximum amount of comprehension.

To make his ideas clear to his students, the instructor should use familiar words of the type found in the daily newspaper. When he needs to use an unfamiliar technical term, he should define it the first time he uses it. Vivid, informal language is more expressive than dull, flat language, and short, straightforward sentences are easier to understand than long, involved ones.

Although lectures may be presented in a number of ways, the instructor is likely to find extemporaneous delivery to be the most effective. This type of delivery does not bind the instructor to a rigid text, and therefore gives him greater control of the speaking situation. Since extemporaneous delivery permits the instructor to talk directly to the students, he can adjust his presentation to the responses of his students and at the same time evaluate his own effectiveness as an instructor. The teaching lecture may be conducted in either a formal or an informal manner. The informal lecture is usually more effective, because it encourages active student participation.

The lecture method has several advantages. It permits the instructor to present many ideas in a single class period. It is an effective means of introducing a subject. It is an efficient means of rapidly summarizing facts. It is a convenient method for instructing large groups. It is a good way to present information not readily available to the students from other sources. It lends itself to effective use with other teaching methods.

The instructor should always weigh the advantages of the lecture method against its disadvantages. It does not adequately provide for student participation. It is not suitable for certain types of learning outcomes, especially those involving performance skills. It reduces the instructor's opportunity to observe and adjust to student responses. It requires above-average ability in speaking.

SAMPLE LESSON PLAN

(Lecture Method)

LESSON TITLE: Critiquing for Improvement of Performance
COURSE: Academic Instructor Course
INSTRUCTOR: Lt J. T. Johnson
ADVISOR: Maj B. L. Williams

PART I

LESSON OBJECTIVE: The objective of this lesson is for each student to understand three principles of critiquing in order to increase the effectiveness of his critiquing as an instructor.

DESIRED LEARNING OUTCOMES: Each student should

1. understand that the critiquer should gain the acceptance of the individual he is critiquing.
2. understand that the critiquer should present an organized critique.
3. understand that the critiquer should respect the personal-social needs of the individual being critiqued.

INSTRUCTOR REFERENCES: ATC Instructor 4:22-24, *Training Evaluation Critiques.* Travers, Robert M. W., *Essentials of Learning,* New York, Macmillan, 1963: Guthrie, Edwin R. and Powers, Francis F., *Educational Psychology,* New York, Ronald Press, 1960.

INSTRUCTIONAL AIDS: Chalkboard and easel for magnetic aids. Tape of Student Critique — AIC Laboratory
STUDENT PREPARATION: None
HANDOUT MATERIALS: None
TIME REQUIRED: 35 minutes

PLAN OF PRESENTATION: The instructor will introduce the hour by telling about a personal experience of witnessing an unsatisfactory student critique and about the results of the critiquer's poor judgment. He will then motivate the class to recognize the importance of becoming a good critiquer and present an overview and a brief outline of the lesson. He will develop the lesson objective in detail by using a variety of means of support and by stressing the philosophy of the lesson, namely, that critiquing is primarily for the purpose of improving future performances. The period will close with a summary of the main ideas of the lesson and by showing how these tie together to support the objective of the lesson. The instructor will remotivate the class by pointing out how the ideas that were presented can be used effectively in a variety of situations. During closure, the instructor will tell about his experience of witnessing a student critique which resulted in the use of the principles listed below.

PART II

Student Outcomes	*Student Activity*	*Instructor Activity*
	A. INTRODUCTION (5 minutes)	
1. Become attentive to the instructor and to his presentation of the subject. 2. What a good critiquer can do to improve a student's future performance.	1. Begins the learning process by listening and asking himself "How will this lecture help me?" 2. Realize that he can benefit from the class session; and that, by correctly using the material in the lesson, he can help others in their work.	1. Tells a personal experience of witnessing an unsatisfactory student critique and about its effect on the class. 2. Explains: a. how an understanding of these principles will help him be a better teacher. b. how this knowledge can help, not only in teaching situations, but throughout his entire military career. c. why satisfaction will result from accomplishing a sound critiquing job.
3. Know the basic structure of the lesson.	3. Envisions the blueprint of the lecture, either mentally or by writing an outline of the lesson.	3. Establishes the pattern for the lesson and outlines the three areas of activity: a. Achievement of acceptance. b. Organization of critique. c. Extending of respect for students' personal-social needs.
	B. DEVELOPMENT (27 minutes)	
1. Understand that the critiquer should gain the acceptance of the individual he is critiquing.	1. Recalls instances where he was either being critiqued or was listening to the critique of another. Recalls when the critiquer gained the acceptance and when he did not, but most of all, the results of each.	1. Explains the philosophy of critiquing and how it can affect learning. In discussing the importance of gaining this acceptance, points out some of the misconceptions of critiquing. To support this point of view, the instructor gives the class examples of the DO's and DON'Ts for a critiquer, and explains why each is important. DO's: Be friendly. Be sincere. Be qualified.

Student Outcomes	*Student Activity*	*Instructor Activity*
		DON'Ts: Roar and condemn. Do as I do. Act bored or disgusted.
2. Understand that the critiquer should present an organized critique.	2. Recalls a critique that was well organized and one that was not. Remembers that transfer of learning was evident during the organized critique, and that confusion existed during the disorganized effort.	2. Explains: a. the importance of having an organized critique, how it can bring success, and why disorganization may only result in negative reactions. b. that every critiquer must have a philosophy so that the class will understand his approach to the lesson. c. that each critique should be tailored to suit the immediate lesson; why the critiquer must eliminate generalizations, verbal garbage, and the tendency to skip around during a critique. d. why the critiquer needs a pattern to follow, why he must be objective, but not a "nit-picker" or full of "sugar and cream" in his presentations. e. two generally accepted organizational patterns for the oral critique of a presentation: (1) content, that is, what is said; and (2) delivery, how it was said. The instructor further points out that the critiquer should remain flexible enough so that he may use a pattern best suited to the situation.
3. Understand that the critiquer should respect the personal-social needs of the individual being critiqued.	3. Recalls examples which support the concept of recognizing the student's personal-social needs. Also realizes that more learning will be transferred when this idea is adhered to by the critiquer.	3. Explains that the critiquer must respect the feelings of the person he is critiquing and that he should illustrate with examples of desirable and undesirable approaches. At this time, the instructor also develops the relationship of the first two DLO's to this one, and shows how each is related to the other. Examples should relate to the three most important principles to be considered in critiquing. a. Self esteem. b. Recognition. c. Need to belong. The instructor will conclude by showing the value of these principles.
C. CONCLUSION (5 minutes)		
1. Recall in total the three principles, their value, and how each is related to the other.	1. Mentally reviews the main ideas presented by the instructor, and re-evaluates all of the major thoughts.	1. Reconstructs what he said previously, with emphasis on the three major points. Briefly restates the philosophy of critiquing.
2. Be interested enough in the value of critiquing to consider the immediate application of all three principles in his future critiquing activities.	2. Realizes that he can use these principles in his work as an instructor; that, above all, the only reason for critiquing is to improve one's future performance.	2. Remotivates the class by telling it how easily it can employ these techniques. Indicates the true value of these techniques in many of life's situations.
3. Feel that he has received worthwhile information and that he will take away with him the main ideas of the lesson.	3. Assumes a positive attitude toward the lesson and feels that he has acquired some valuable information for future use.	3. Close with a story about a critiquer who was dedicated to the task of improving instructor performance, and of the results he obtained by following the techniques employed in the present lesson.

CHAPTER 20

Other Teaching Methods

Previous chapters have dealt with four basic methods of instruction. In mastering these, a teacher develops required fundamental skills, such as planning, lecturing, questioning, group guidance, situation writing, role playing, motivating, and adjusting to individual differences. However, the experienced teacher often wishes to adapt these skills in different combinations. These new combinations can provide variety, motivation, additional student involvement, and increased challenges for student and teacher alike. The instructor is limited in his use of new methods only by his own creativity and the requirements of the learning situation. The following methods should provide Air Force instructors with tools for stimulating new and more challenging learning situations.

TEAM TEACHING

Team teaching, in its simplest form, is an approach to teaching in which more than one teacher is responsible for the teaching-learning process for a given group of students at the same time. This means also that both (or "all," as the case may be) the teachers involved must have participated in planning, presenting, and evaluating the learning experiences of the student group. For the successful use of team teaching, other factors besides joint planning should also be taken into account. These are the need for flexible scheduling, the use of teaching assistants and clerical help, and special school building design.

• Current team teaching plans use a scheduling system which allows flexibility in the arrangement of periods. The traditional one-hour or 45-minute period is often replaced by 15-or 20-minute "modules." These modules of time can be arranged to facilitate maximum learning, depending on the type of activity scheduled. For example, students often become restless in a lecture situation after 45 minutes, whereas a group discussion may just "get rolling" in that time.

• Another desirable ingredient for the successful team teaching program is the liberation of the fully qualified teacher from routine tasks. Such tasks as keeping student records, taking roll, monitoring tests, and making instructional aids can and should be performed by personnel with less than the educational background or pay required for a fully accredited teacher. The teacher can use the time thus saved for the extra planning and coordination that effective team teaching requires.

• Studies indicate that team teaching can be used most effectively in a school specifically designed for that purpose. Such designs generally feature small seminar rooms for small group activities, space or provision for individual study by students, and a well-equipped auditorium for large group presentations. Within the framework of team teaching, any specific method may be used, when appropriate.

THE ASSIGNMENT

The assignment applies to that part of instructional activity which helps the student recognize, accept, and prepare for the next unit of learning. It is a valuable teaching method, rather than merely a preparatory plan for teaching. It is also an aid in developing good study habits. The following suggestions will help the instructor make effective assignments:

• Be clear and definite. Do not confuse stu-

dents with a vague, purposeless assignment. Tell them exactly what material is to be covered, what product should result, when it is due, and suggest a general plan of approach. Tie the assignment in with previous classroom activity which was planned to prepare the students for later units of study.

• Identify special problems. If there is something new and unusual in the assignment, identify it in advance. Try to create a challenge for the students. Suggest possible means of overcoming the obstacle. This will be a good source of motivation for the above-average students, and it can be used to good effect in later classroom discussion. If the assignment involves special materials, either make them available to the class or specify where they can be obtained.

• Motivate the students. Motivation is a basic principle of learning. The instructor should motivate his students to complete each assignment, giving particular attention to immediate needs and class background. The key point is to encourage feelings of self-confidence and pride in independent accomplishment.

Types of Assignments

Everyone is familiar with the traditional assignment: read certain chapters, pages, or paragraphs in the text or research a particular area of study. Some newer and very effective ways should be considered: (1) problem solving, in which a student or group of students must devise a course of action to overcome an obstacle; (2) illustrated notebooks, in which students place clippings, maps, or pictures pertinent to the area of study; and (3) projects, such as constructing a terrain map, building a model engine, or organizing committees to stimulate business operations. In fact, variation in assignments is limited only by the teacher's energy and imagination.

Making the Assignment

The technique of presenting the assignment to the class is a critical factor. Here, again, motivation is the key. Assume that the instructor has planned for the students' needs and interests. The factor which challenges the student to do his best is the instructor's personality—his personal motivation. An indifferent "by-the-numbers" approach to assignments invariably produces a feeling of doubt and insecurity in the students. Making assignments cheerfully and enthusiastically indicates that the instructor really wants his students to benefit from a new experience.

The instructor should allow sufficient time to make the assignment effectively. Some teachers prefer the beginning of the period, which insures adequate time and the attention of the class. Others prefer to wait until an appropriate time during the lesson, particularly if the assignment will serve as a means of clarifying some problem before the class. Still others prefer to wait until the end of the period so that the students will more closely associate class activities with the home assignment. Each technique has merits, and whichever the instructor chooses, he must plan for it carefully.

Evaluating the Assignment

Students are only human. They tend to lose interest or to postpone their work when the instructor fails to follow up on his assignment. Through evaluation techniques, the instructor has many opportunities to measure learning. The traditional recitation has now been largely superseded by more efficient devices. The short quiz is usually effective, as well as economical in time. The socialized recitation and other discussion methods are being used more frequently. The choice of approach naturally depends on the subject under study and on the established objectives.

The assignment can be a challenging, effective teaching instrument. Well-chosen and varied assignments help to develop a sense of pride, comradeship, and creativity within the class. The assignment can also provide efficient, meaningful, and useful learning experiences.

THE FIELD TRIP

Modern transportation facilities offer many possibilities to the teacher. Factories, bases, and schools can be visited by relatively large groups of students with little difficulty. The advantages are obvious. Students constantly search for variety. The instructor has an opportunity to demonstrate the theories he has been teaching. The field trip is a planned learning experience in which students observe operations that illustrate the classroom area of study. The field trip is not new; however, its effectiveness depends on the instructor's ability to plan wisely. Several important planning factors are considered below.

Coordination

The instructor should not allow a field trip to interfere unnecessarily with the activities of other classes in the school. By coordinating with other teachers and with the school administration, he can effectively fit the trip into the curriculum. Plans should be made far enough in advance to schedule the trip for a time that is entirely acceptable to the facility being visited.

Conducting the Group

Unless the students see what they are supposed to see, the trip is of little value. The instructor should direct the attention of the group to the pertinent aspects of the facility. Any undisciplined behavior not only destroys the learning situation but may create a safety hazard as well.

Transportation

Military or commercial transportation officials must have sufficient advance notice and definite information, such as the number of participating students, the time of departure, the duration of the trip, and the destination.

Class Preparation

The instructor informs his students about the trip and explains its purpose. He reviews the areas to which they should give particular attention. If he divides the class into sections, he must post lists and assign monitors to each unit.

Review

No set procedure is prescribed for evaluating the trip. Projects, discussions, and individual reports are all useful in getting the student to reveal what he saw and in determining the effectiveness of the various areas of planning.

THE LABORATORY METHOD

In the minds of most students, the term "laboratory" is almost invariably associated with science. However, the laboratory method has been extended to a wide range of subjects. Now, it is possible to apply the axiom that "we learn to do by doing" to any given area, including languages, history, and mathematics.

Although the laboratory method is generally used as a directed study device for individual students, it can be used with groups as well. Whatever its use, the laboratory method must meet these criteria: (1) emphasize the solution of a problem, (2) provide firsthand experience with aspects of the problem, and (3) make use of raw data—specimens, materials, experiments, and source books—as far as practicable.

The laboratory can be used in many ways in the Air Force. Practical problems in radio, electronics, mechanics, and photography can be solved and applied by individuals or by groups. The laboratory method is also very effective in studying and solving intellectual problems in speech supervision, management, counseling, and administration.

The chief advantage of the laboratory method is the practical, firsthand experience in handling raw data, current materials, case studies, and appliances, all of which are more realistic and stimulating than textbooks. Another strong point is the emphasis on individual responsibility and pride in accomplishment.

The success of the laboratory method, as with other methods, lies with the teacher. He must arrange for the use of the facilities and equipment necessary to conduct the laboratory. This responsibility includes use of the classroom and the necessary tools, source books, and other materials to permit a comprehensive study of the problem. The teacher must also keep a careful check on the time. It is easy to allow a group to pursue a subject beyond the goals of the lesson or to waste time on unimportant areas. The teacher must plan to exercise close supervision and to offer advice when it is needed.

SOCIALIZED RECITATION

The oldest method of determining what students know or have learned is the recitation. Nearly everyone can remember being asked to quote a poem, recite dates in history, and explain the syntax of words in a sentence. After dutifully complying, the student would sit down to watch someone else go through the same routine. Modern education has done its best to get away from the sterile, meaningless type of recitation. But for all the criticism leveled at recitation, authorities still agree that it has a place in effective learning.

The modern, or socialized, recitation serves many purposes that are not necessarily of equal value, but their variety may suggest possible uses to the Air Force instructor. Bossing, in *Teaching*

in Secondary Schools, lists these uses of socialized recitation:

1. To stimulate reflective thinking.
2. To stimulate interest in learning activities.
3. To train the student in attacking problems.
4. To supplement knowledge acquired or data necessary for understanding.
5. To train the student in the power of critical evaluation.
6. To guide the student in further study.
7. To stimulate and develop ability in creative expression.
8. To develop wholesome social attitudes.
9. To train the student in cooperative effort.
10. To train the student in the organization and expression of ideas.
11. To train the student to do group thinking.

Such a variety of objectives can be approached in different ways, and the techniques described in this chapter can be easily adapted to recitation. Perhaps the most important factor in effective recitation is the instructor's role in planning and conducting it. Modern educational theory has developed several principles which can be considered as guidelines.

• The instructor is responsible for establishing favorable attitudes. Unless he can immediately win the interest of the class, the recitation is doomed to failure. Fortunately, there are many ways to gain attention. Posing a problem for the class to solve is always challenging. Sometimes an anecdote or a related reference to current events is effective. Audio-visual aids are particularly successful attention-getters. In the end, however, it is the instructor's personality and his attitude toward the lesson that count for most.

• The recitation should be well planned. In the socialized recitation the instructor must keep pace with his students. He must see that the students are constantly aware of the objective, and he must keep them working toward it. Any confusion on his part will be immediately reflected in the class.

• The class should be prepared for the recitation. For all the instructor's motivation and planning efforts, it is still necessary for the students to accept the responsibility of the recitation. The instructor must be flexible enough to supplement their information with a brief lecture or with questions directed to selected members of the class.

• All members should participate in the discussion. The attitude of the class should be such that the members are eager to contribute something to their common goal. Each student should recognize this participation as an individual responsibility. The class as a whole should accept the fact that it holds the key to success or failure in the project.

• Emphasis should be on the class rather than on the instructor. The most frequent criticism of the recitation method is the tendency of the instructor to do all the talking. He can overcome this weakness by asking questions of sufficient scope and importance to require extended response and to provoke subsidiary questions and comments from the class.

• The instructor should encourage students to talk with each other. The criticism that the recitation is individualistic rather than social in nature grows out of the natural tendency of the instructor to ask questions and receive direct answers. Sometimes this procedure is necessary and desirable, but usually the best results are achieved when the student thinks of the instructor as a counselor and source of information. Members of the class then turn to each other to solve the problems in the natural give-and-take of equals. Thus each student learns that his solution is not the only one and that several solutions are possible from the same set of facts. He learns the value of courtesy and open-mindedness, and he learns to accept the decision of the class. This is the most wholesome kind of socialized instruction.

• The instructor should seek student cooperation before the recitation. Student cooperation is largely a matter of permissive atmosphere which only the instructor can create in his classroom. If he shows the students that he is sincerely interested in meeting their needs and that he is willing to use their advice or their special skills in accomplishing this goal, he develops a highly satisfactory instructor-student relationship. Both he and the class will profit by the existing spirit of harmony.

DISCUSSION METHODS

The discussion technique in teaching lends itself to many forms and to combination with other basic methods. Some of the well-known and frequently used combinations are the informal student-led discussion, the dialogue, the panel, the symposium, dramatization, and the lecture-forum.

Informal Student-Led Discussion

To help develop the competent leadership that is necessary in the Air Force, instructors often allow a student to lead the class discussion. This encourages the other students to relax and to participate actively. The instructor who is a good discussion leader thus gains an ideal opportunity to transfer his skill to his students. Obviously, the instructor must use judgment and discretion in selecting the student leaders. He should brief them thoroughly on the objectives of the lesson and on the techniques of leading a discussion. The wise instructor also gives the student a helping hand in getting the group started, and in reconciling any problems that arise.

The Teaching Interview

The teaching interview gives recognized resource people or students who have done special study a chance to share their knowledge with the class. The method involves two people who are qualified in the subject. One, usually the instructor, acts as questioner, guiding the direction of the discussion, and presenting clarifying or supplementing information when appropriate. The other initially answers questions and develops ideas. The atmosphere is informal, and the discussion soon becomes a free interchange and mutual development of ideas. This contrasts with the customary news interview, in which only one person must be an authority and the other person's participation is limited to asking questions. Whenever possible, time should be provided for student questions and for comments following the teaching interview.

Panel

Television has brought about a public awareness of the panel discussion. The major function of the panel is to retain the advantages of a discussion group in a large audience where total participation is not feasible. It provides to the group the benefits of vicarious participation in a discussion situation carried on by a few selected members. Each panelist should be sufficiently qualified, without special preparation, to make a worthwhile contribution. The chairman, whether student or instructor, must make sure that the members discuss the problem. He should prod them with questions or cut off overlong or irrelevant speeches. This gives the remainder of the group an opportunity to observe group dynamics in action.

Symposium

The symposium differs from the panel chiefly in the special preparation that is required of the participants, who speak in turn without interruption. Each person is permitted to outline his position and his suggestions in a brief lecture. The audience is then given an opportunity to question the speakers, either to obtain more information or to take issue with the speakers' assertions. The instructor selects the qualified guests or students and assigns to each the responsibility for a particular aspect of the topic. He should see that all divergent points of view are presented. And further, he should encourage all members of the class to research in advance, so as to form their own conclusions and to participate in the question period. This method has many worthwhile implications, often leading to continued and independent work by students.

Dramatization

From infancy, people like to create a world of make-believe. An imaginative instructor can take advantage of this natural inclination and thus promote learning. Modern education is using this technique extensively, whether in dramatizing a play, in organizing a mock courtroom, or in staging a historical pageant. It is an excellent method for arousing student interest in a possibly dull subject. Air Force instructors have used this method effectively in military law, management, counseling, and problem-solving; however, a certain degree of skill and considerable time is required to write an effective dramatization. This method can also be used effectively in conjunction with other methods. The instructor can use it as a project or as an assignment.

Lecture-Forum

One of the chief objections to the lecture is its one-sided character. Contemporary speakers try to overcome this disadvantage by providing for a discussion period at the end of the lecture. This period encourages students to ask for clarification or further development of the ideas presented. Emphasis is on informality in wording and organization, as well as in classroom management. This method is especially valuable in medium- to

small-sized classes where a larger cross-section of the class is apt to participate.

SUMMARY

Of the many teaching methods, other than those discussed in previous chapters, some of the best known and most frequently used are team teaching, the assignment, the field trip, the laboratory method, the socialized recitation, and the many variations of the discussion method. The Air Force instructor's understanding and appreciation of these supplementary teaching methods will make him more conscious of the many opportunities inherent within them. His skill in actually using these methods will enable him to meet the needs of his students more fully.

CHAPTER 21

Programmed Instruction

Interest in, and emphasis on programmed instruction is increasing among civilian and military educators. This educational method is perceived by many authorities as the first major advance in education and training in years. As such it merits the consideration of Air Force instructors.

Programming techniques are not altogether new to educational psychologists, but only within recent years have these techniques been used in developing self-instructional materials in textbook form or for display in teaching machines.

As a student progresses through validated programmed instructional materials, he speaks, writes, or makes some other overt, relevant response to each increment of instruction. The material offers him immediate feedback (knowledge of how well he is doing) by informing him of the correctness of his response. The successful completion of each of these increments takes the student one step closer to the learning objectives (desired behavioral changes) that were defined before starting to plan, test, and develop the programmed instructional materials.

The major characteristics of programmed instruction are:

- Clear specification of what the students must be able to do after training.
- Careful sequencing of material.
- Presentation of material in steps which challenge a student but do not exceed his ability.
- Active student responses.
- Immediate confirmation of answers.
- Test and revision of instructional material until it has been proved able to teach to the desired objective level.

This approach systematically carries the student, step by step, to the learning objectives he is to attain. In this respect, programmed instruction is generally more tutorial in nature than the instruction in the typical classroom situation. That is, programmed instruction not only gives the student what he is to learn but also guides him in the way he is to learn.

THREE METHODS OF PROGRAMMING

A number of methods have been used in developing programmed instructional materials. The three that appear most often are referred to as the linear method, the intrinsic branching method, and the mathetics method. The following paragraphs should help you gain some understanding of each of these three methods.

Skinner Linear Method

Psychologist B. Frederick Skinner has developed a system of programming that is based largely on reinforcement (rewarding the student) for accurate performance. According to Skinner, in ideal programmed instruction the student cannot make an error. The material in linear-programmed instructional material is itemized and presented in small steps. A student is prompted, or cued, as necessary, so that he almost invariably gives a correct response. Materials are carefully designed to offer as much review as needed to insure the degree of retention appropriate to the subject matter, the learning situation, and the needs of the students. (Fig. 10)

The student responds to a frame (the printed matter for one step or increment in the instruction) usually by writing words into spaces provided for that purpose. Linear-programmed material may, however, be designed to elicit other types of responses. Answers may be given men-

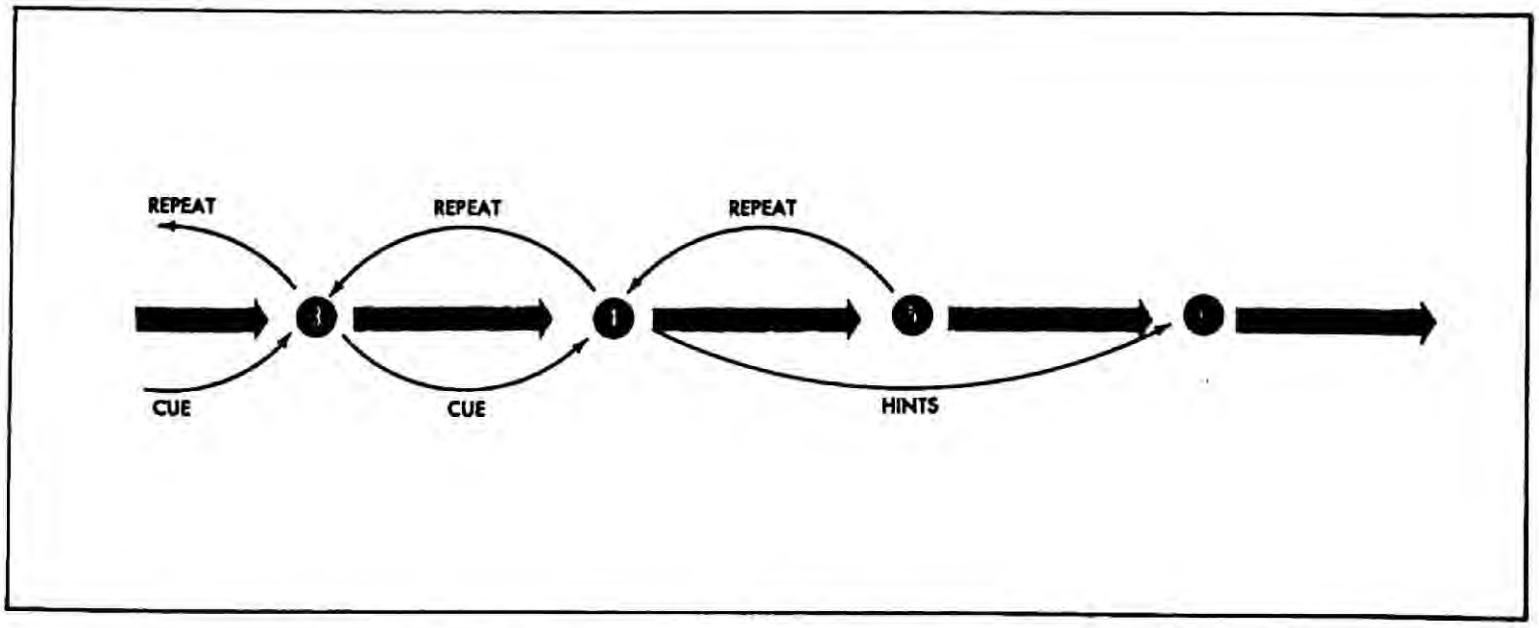


Figure 10. Structure of Linear Programmed Text (Skinner)

tally or orally. Simple tasks may be performed. Sequences of more complicated acts that make up a complete procedure may be required.

After completing his response to a frame, the student immediately confirms the correctness of his response by comparing it to the program answer before continuing to the next frame. Thus the student progresses smoothly with a continuous awareness of being correct to give him a sense of satisfaction. If the programmer has met the challenge of properly constructing materials in a linear format, the student will, at his own rate, and almost effortlessly, learn the material thus presented.

Proponents of this system attribute its success to the reinforcement it provides and repetition it uses. If a student encounters the same fact, idea, or concept in a variety of ways and if he is reinforced, or rewarded, each time he answers correctly, he learns. Apparently, the more often he is rewarded, the more lasting is his learning.

In each block of new subject matter, initial frames contain obvious cues to correct responses. Thus, a student finds it virtually impossible to make errors. In subsequent frames, cues are gradually withdrawn and finally eliminated. As a student approaches each terminal behavior, or learning objective, cues are withdrawn until the student supplies complete answers without being cued.

The following sequence of frames[1] illustrates the linear method. These sample frames are typical of initial frames. They offer obvious cues and require only simple responses.

To the casual observer, this sequence may seem unduly simple. To the student who is totally unfamiliar with the subject matter, however, it offers a sort of "learning game" in which he is always a winner. The programmer explains,

1. Education deals with teaching and learning. Other things being equal, the better the teaching the greater the _____

1. Learning

2. People have differing notions about what "learning" is and how it occurs. In the next few steps or statements, one very specific and practical explanation of _____ will be discussed.

2. Learning

3. We infer that learning has occurred when, through practice, the student can make a *response* he was unable to make earlier. For example, when you say "4" to the question "2 + 2 = ?" you have made a _____ which you have learned — probably in school.

3. Response

4. By the same token, if you reply "H_2O" when you are asked for the chemical symbol for water, in saying "H_2O" you are making a _____.

4. Response

. . . .

[1]West, Leonard J. and Ohmer Milton, *P.I., Programmed Instruction*, New York; Harcourt, Brace, and World, Inc., 1961.

among his introductory materials, that the student is not being tested, but is being given an opportunity to progress through carefully planned and sequenced material in order to help him learn this new subject matter.

Crowder Intrinsic Branching Method

Norman A. Crowder, a well-known American educator, emphasizes a different major approach to programming known as intrinsic branching. Intrinsic branching more closely parallels conventional teaching methods than does the linear approach. Crowder presents large segments of material, often a full paragraph or more, in each frame of programmed instructional material. Unlike Skinner, the Crowder approach permits mistakes. In fact, he tries to anticipate errors in order to use them as an integral part of the learning.

In intrinsic branching materials, a frame starts with an explanation of the subject matter to be learned. This is followed immediately by a question or problem. The student is given a choice of two or more alternative answers, one of which is correct. Each alternative refers the student to a different, new frame. If he chooses the correct alternative, he is referred to a frame that repeats his answer and tells him that his solution was correct. The resulting sense of achievement and self-satisfaction should motivate the student to continue learning. This answer frame gives the reason for the correct answer and includes some elaboration of it. Finally, this answer frame presents a new segment of learning, with necessary explanations, and another problem with alternative choices.

If the student's original answer choice is incorrect, he is referred to another page that explains why his choice is wrong and tells him how to find the right answer. In most cases, he is directed to return to the page on which he made his first choice and reconsider the original problem before making another selection (Figs. 11 and 12).

Intrinsic branching is often structured in a more complicated manner to carry a student along a series of relatively small steps that parallel a mainstream of ideas. In this type of structure, the material in the mainstream is selected so that only a few students will consistently choose the correct response and avoid branching. (Fig. 13)

The key to this method of programming rests in its efforts to anticipate, just as any good instructor does, errors that students will make and then to provide the feedback necessary to correct these errors. By carefully developing alternatives that are to serve as answer choices, a programmer can provide a valuable means of diagnosing student weaknesses.

Mathetics Method

This third method follows the mathetical approach as developed by Dr. Thomas Gilbert. This approach assumes that the material itself, and the reasons for preparing a particular program, influence the form in which the material can best be presented. Adherents claim that mathetics is not so much a programming method as it is a technology, or system, for finding the best way to arrange materials so as to insure learning.

A process for finding the best way of arranging materials for learning is worked out, both in broad outline and in significant detail. Decisions about format (such as whether to use linear, branching, or other display methods) are made near the end rather than the beginning of the program development process. The resulting programmed instructional lessons and materials differ from each other. The major factor that determines these differences is the type of subject matter involved.

Educational objectives are rigidly specified in detailed statements of behavioral stimuli and responses in the mathetics method just as in the linear and intrinsic methods. This stimulus-response identification is called the "prescription" of behavior. It is essentially a convenient and standardized way of presenting the terminal behavior to be achieved. A "backward" approach may be used in developing a behavior chain (the series of connected stimuli and responses that occur from the start to the finish of a given task). By a backward approach, the learner begins with the behavior at the end of the chain. With each exercise, he then starts with an earlier phase of the task, adding new stimuli and responses to his repertory. In this way he is always finishing a task. Another more common approach to the organizational strategy of programming consists of sequencing in the same order as the tasks to be learned are actually performed.

Such discriminations as language-use and

Page 21

Your answer: 52.5

Good. Now you know how to compute centile rank. Memorize the formula:

$$\frac{\text{Below} + \text{½ tied}}{\text{Total}} = \text{Centile rank}$$

Another way of expressing a relative score is by means of Rank Order. We are now ready to compute it. Rank order is just another way of showing the relative position occupied by any individual in the group. It is expressed as a fraction in which the denominator indicates the number in the group; the numerator is the individual's position from the top of the group. For example, 3/75 tells us that this person is third highest in a group of 75 people.

In order to compute rank order we must first arrange the raw scores, as we did for centile rank, from the highest to the lowest, including all duplicate scores. The following are the raw scores for a group of nine students:

38, 36, 35, 34, 32, 29, 27, 26, 22

What is the rank order for the person whose raw score is 29?

		Page
A.	4/9	24
B.	6/9	18
C.	1/3	27

You came from page 20.

Page 18

Your answer: 6/9

Good! You are on to the mechanics of the method and it isn't difficult to count down. However, all cases aren't as easy as this one.

When you have more than one person at any given score it would be unfair to assign different ranks to each of them. We must arrive at just one rank order for these three people as no one of them ranked higher or lower than the other two. We do this by determining which positions these scores would hold in the sequence of scores and average them. For example; if the score 84 was held by three people and there were eight other scores higher, these three would actually occupy positions 9, 10, and 11 in the sequence of scores (the eight higher scores would have used up positions 1 through 8). We would then average 9, 10, 11 $\frac{(9 + 10 + 11)}{3}$ and get 10.

This is the one rank order we would assign to *each* of the scores, 84. If there were 40 people in the group we would report this rank order, 10/40.

Try this:

In the following distribution of raw scores,

73, 68, 69, 74, 74, 67, 74, 70, 71, 75

what is the rank order for a score of 74?

		Page
A.	8/10	19
B.	4/10	23
C.	3/10	26
D.	2/10	30

You came from page 21.

Page 24

Your answer: 4/9

You must have started counting from the bottom instead of from the highest score down.

Page 21 is your destination.

Page 27

Your answer: 1/3

Your mathematical instinct fouled you up. This is one computation where you never reduce fractions.

You probably know the basic methods but go back to page 21 and be sure.

Figure 11. Example of Intrinsic Branching Program

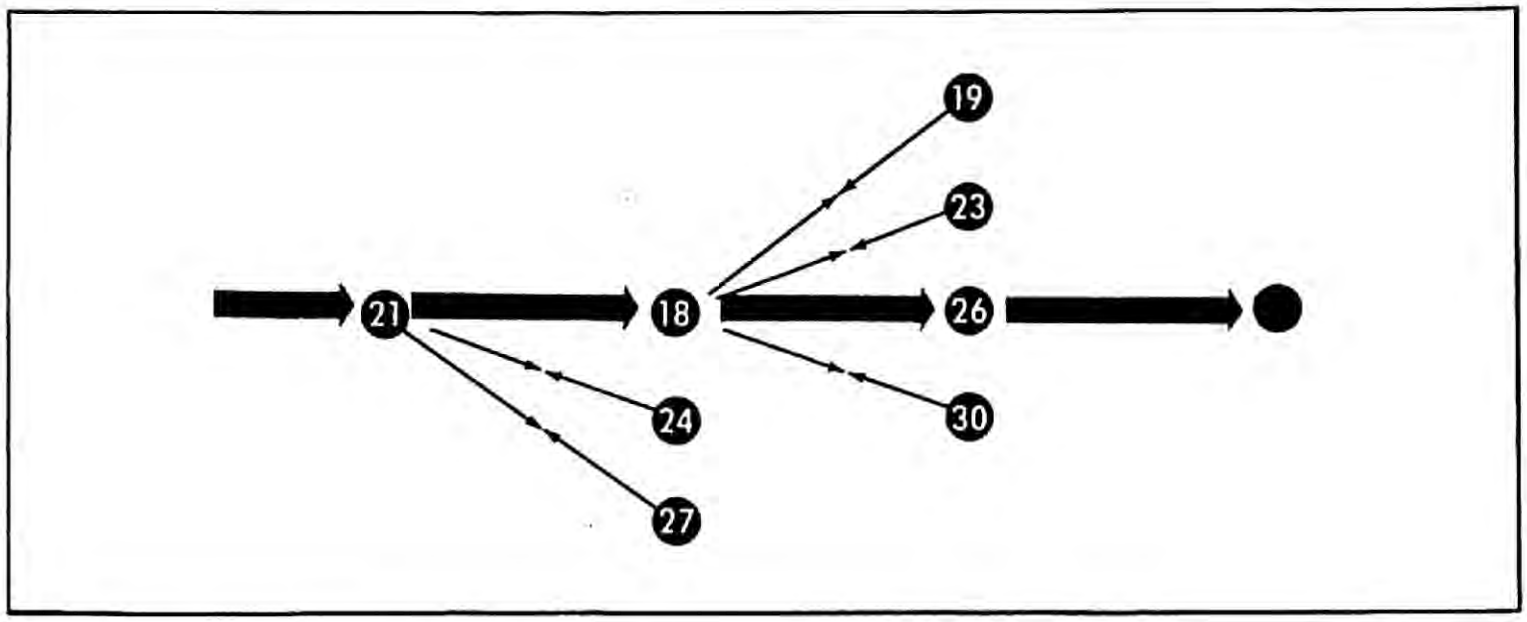


Figure 12. Structure of Pages Shown in Figure 11 to Represent Intrinsic Programming (Crowder)

decision-making processes are taught all at once to provide optimal opportunity for students to compare all parts of a complex. Branching is used when the student population (students for whom the programmed materials are prepared) is likely to differ with regard to knowledge of the subject matter. If a student can correctly answer a particular exercise designed to test certain knowledge, he is then told to skip a specified number of subsequent frames.

The mathetical approach makes use of "graphics." These devices are designed to enable the student to learn not only verbal knowledge but other knowledges as well. Each lesson contains a theory section and an operational section. In the operational section, the student runs through the

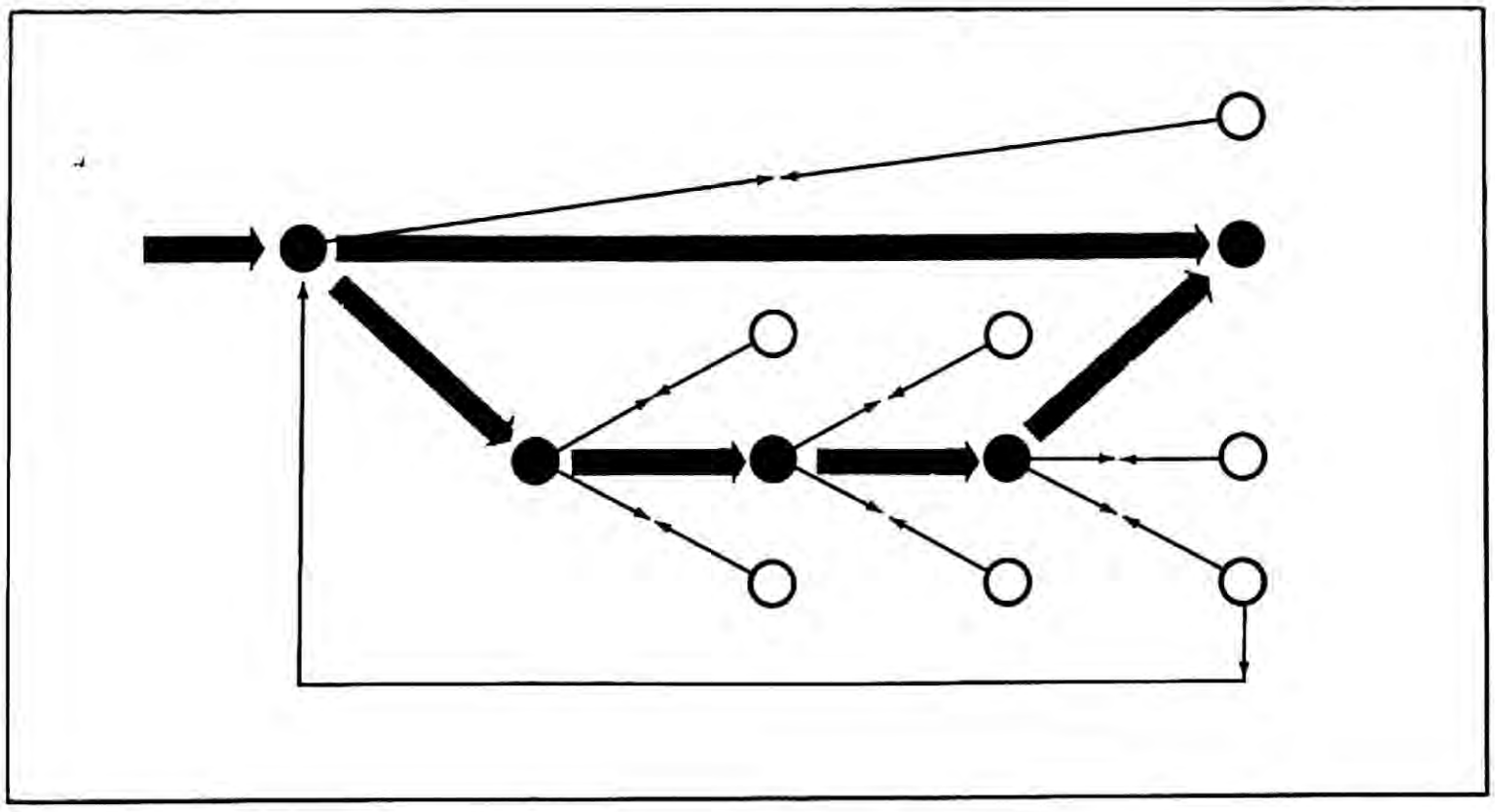


Figure 13. Complex Intrinsic Branching

actual operations he will later be required to perform.

DEVELOPING PROGRAMMED INSTRUCTIONAL MATERIALS

The process of developing programmed instructional materials, as with all curriculum planning, involves several steps or operations. The first step is the selection of the course material to be developed into a program. Since many Air Force courses exist, the selection of subject areas with the greatest potential for programming is essential. Such factors as annual student flow, length of course, content stability, desired date of implementation of the system, and possible savings in time, manpower, and other resources must be considered.

The next step is task analysis. Because training must prepare personnel to perform specific tasks within an AF specialty, all instruction must be job relevant. The job must be analyzed to define its elements. Experienced instructors should be used as subject matter specialists to provide further insight into course materials and content. Performance tasks should be observed and, when necessary, field surveys should be conducted to determine what is required for job success.

The next step is the development of clearly defined instructional goals or learning objectives. Well-conceived learning objectives define the minimum conditions under which desired behavior should occur and specify acceptable performance standards. (The specific objectives of a training program need to be fully defined—in terms of required terminal behavior—so that achievement can subsequently be verified.)

Based on these objectives, a criterion examination must be developed. If the objective requires performance, the student must perform; if the objective demands that the student be able to select a correct answer from a number of alternatives, he must so select. The criterion examination is first included as a part of an entry test. This entry test, sometimes called the threshold knowledge test, is given to a sample of typical students to determine their background and knowledge in the subject area. The entry test consists of the criterion test along with test items on terminology, specialized knowledges or skills, etc., thought to be a requirement for satisfactory performance in the course. These test results should reveal the entering behaviors of the typical student so that material already known by the student can be identified and eliminated. The elimination of material from the course is possible only if the entry test shows the material does not have to be taught, and the course content is finalized at this point. Remedial training may then be provided those students with deficiencies in the areas eliminated. The criterion test then is used to validate all programmed instructional material, and it must measure student achievement of learning objectives as well as effectiveness of the materials as an aid to learning.

The next step requires determination of instructional strategy. Based on the results of preceding analyses and knowledge of programming technique, decisions must be made regarding methodology, training devices, and logical and effective sequencing of content to achieve learning objectives.

The actual development of programmed instructional materials is accomplished in the production step. Any of the three methods previously discussed may be employed during development, but other less common programming methods may also be used when it is determined that they are most appropriate to achieve the objectives. More than one method has been effectively used to program portions of the same unit of instructional material. As segments or subsystems of the materials are integrated into the curriculum, some changes in methodology, sequencing, or statement may be required.

VALIDATING PROGRAMMED MATERIALS

When validating the instructional materials, portions are tried out on student samples (often on selected individuals first, then on groups). The students who are selected to participate in testing the materials should be typical of the students who will later be expected to learn from the finished product. After each tryout, the programmer should revise the materials to correct errors in step size, sequencing, technical content, terminology, etc., that may be brought to light during that particular test. Materials may be combined, revised and edited until a complete programmed text, programmed instruction package, programmed lecture, instructional subsystem, or even the whole system of instruction is developed. An operational tryout should then be conducted by personnel who

will be using the validated materials. Ultimately, 90 percent of the students should accomplish the learning objectives as measured by the criterion examination.

MODE OF PRESENTATION

After programmed instructional material has been developed, the programmer must present it to the student by means of some type of "holder." At this point the teaching machine and the textbook come into the picture.

Both Skinner and Crowder believe that the teaching machine is the best device for presenting programmed instructional material. Among the many advantages claimed for the teaching machine are that it controls the student's actions, prevents "cheating," and keeps a record of the student's performance. A survey of the student's actions provides data for an analysis of his learning and for an evaluation of the material by the programmer. Knowledge of the individual student's performance can also be the basis for analyzing weaknesses in his background and determining what curriculum changes are required. Another advantage of the machine approach seems to be the motivation provided by the challenge to "beat the machine." A large number of teaching machines have been developed for use with linear and with intrinsic branching materials.

Some educators and psychologists claim that the fascination of using a machine wears off and that machines are too expensive to gain wide acceptance. These authorities are convinced that a programmed textbook will do all that is needed. Many textbook forms of programmed instructional materials using both the Skinner and the Crowder methods have been developed. The "scrambled book" is particularly well suited to materials based on the Crowder method. Crowder and other programmers have published intrinsic branching materials in such subjects as algebra, electronics, computer arithmetic, and contract bridge. In these books, pages are numbered in the usual way but they are not read consecutively. Each response that the student chooses directs him to a page in another part of the book. This may lead him either backward or forward in the book since the information is thoroughly scrambled so that no answer ever appears opposite the question that it answers. This technique embodies motivation similar to that of the teaching machine in that it challenges the student to "beat the book."

It appears that the use of the programmed text or teaching machine as a device for presenting programmed instructional materials is limited primarily to teaching knowledges. Teaching skills or performance may require the use of actual job equipment or a simulator as the "teaching machine." It is important that the instruction take place in an environment which duplicates the operational environment as closely as possible.

SYSTEMS ENGINEERING APPROACH TO CURRICULUM PLANNING

An instructional systems engineering approach is now being applied rather widely to curriculum development. Using this approach, curriculum content is systematically determined and sequenced, and the principles of programmed instruction are used in the actual development of instructional materials. This is a pragmatic approach which results in predictable learning because performance testing and evaluation are essential parts of the development process. The systems approach to the design of training courses has gradually been accepted by many educators as a far-reaching contribution to instructional technology.

A test-redesign-retest procedure is followed (as with development of programmed instructional materials) until the effectiveness of the entire instructional system has been established. The result is a course in which each subject matter skill is presented at an optimum time using the most efficient teaching techniques available (including, but not limited to, the use of programmed instructional materials). As in any curriculum planning, the final step after the system is initiated is to insure that there is adequate provision for maintenance of quality. As required proficiency levels of course content change, compensating adjustments are required within the system. Generally changes in course content would only affect one or two of the instructional subsystems. Such changes can be quickly integrated.

SUMMARY

Programmed instruction offers a solution to some of the basic problems presented by the demand to mass produce education and training.

Clearly it is no fad or passing fancy. In a nation with an exploding population, a technological revolution, and personnel obsolescence, instructional programming offers promise in meeting these and other problems.

Programmed instruction provides the instructor with still another teaching tool. In the Air Force, it holds promise as one means of solving critical instructional problems. The key to successful programmed instruction, whether through machine or textbook, is the quality of the instructional material used. The nature of the learning, the objectives of the course, and the needs of the students influence the type of programming approach selected.

The three major methods of programming are the linear method, developed by Skinner; the intrinsic branching method, developed by Crowder; and the mathetics method, developed by Gilbert.

The principles basic to programmed instruction can be applied to complete training courses or large blocks of instruction. The programmed instructional system that results when this is done can lead to more efficient learning.

CHAPTER 22

Television and the Air Force Instructor

For the Air Force instructor, television may be one of the most important technological developments of recent years. Like all other new developments in the field of education and training, television requires those who use it to understand how it can be used most effectively. Television does not produce or teach a lesson; it does not make a lesson good or bad; nor does it automatically make a lesson more interesting or challenging. Many experiments with televised instruction have failed because both the instructor and supervisory personnel have failed to recognize these facts.

The key to effective televised instruction lies in the proper indoctrination and training of the instructors who are to use the medium. Those who use television must understand its advantages and limitations. Only by a thorough understanding of the medium are they able to identify those lessons which can be improved by using it, and, conversely, to recognize that certain lessons are best presented in the lecture hall or classroom. Equally important is the attitude of the instructor. He must be willing to adopt a new approach, experiment, and exercise his imagination.

ADVANTAGES OF TELEVISION

Distribution

To stay current with changing technology and meet the increasing demands for more and better trained personnel, Air Force personnel must spend considerably more time in the classroom. This problem has created a shortage of instructors to meet educational demands. Television helps to solve this problem by enormously expanding the number of students one instructor can reach at a given time. For example, just as a performer in commercial television can be seen in millions of homes throughout the country, so can an instructor in educational television be seen by hundreds of students in many classrooms or schools. Because of this advantage of distribution, superior teaching in a wide range of subjects and the influence of the good instructor can become the common experience of all students.

Attention

The television screen acts as a magnet for attention. The eye is attracted to light and movement and, of course, the ear is attracted to sound. If a television set is operating within seeing range, it is difficult to avoid looking at it. The student in the classroom may be expected to react similarly; television, therefore, has a "built-in" advantage over conventional instruction. Once the initial attention has been gained, it must be maintained throughout the lesson. A variety of audio and visual effects lend interest to the lesson and aid in maintaining the student's attention.

Selection

With television, the instructor can choose the exact portions of his material which he wants the student to see. This capability allows him to guide or focus the attention of the student and to exclude distracting and unimportant material. For example, if the instructor is using a map to teach geography, the viewer's attention can easily be focused on any area of map the instructor selects. Thus, T V directs attention to the proper place while eliminating extraneous material.

Magnification

The capability of making small and minute objects appear as large as the viewer's TV screen is one of television's greatest assets. This characteristic is especially valuable to medical, dental, and technical schools. In the past, only a few medical or dental students could observe an operation or extraction, but through the use of television, an unlimited number of students can witness such an event. This capability can be applied to instruction in many areas, but is especially useful in the magnification of minute technical equipment and delicate demonstrations.

Presence

Through the use of television, the student can visit such places as the flight line, the operating room, or even the jungles of Southeast Asia without leaving the classroom. The "you are there" feeling lends interest and authenticity to the lesson. Television, with its supporting devices such as film and videotape, can provide the instructor with current support material, specialists, or authorities in his area of instruction. Many subjects which were once restricted because of time or distance can now be effectively presented to the student.

Flexibility

In the average classroom, the use of conventional training aids gives rise to many problems. For example, if the teacher plans to use a film, he has to arrange for the projection equipment, transport it to the classroom, set it up, and adjust the screen and lights. Furthermore, projector noise can be a problem, and a darkened room makes it difficult for the students to take notes. Television minimizes these frustrations. The student's view can be switched from one live scene to another or to a film sequence. He can be transported from one educational situation to another without leaving his seat. Slides, charts, and remote demonstrations can be integrated into a lesson with ease. Several methods of teaching can be used in a single presentation without creating a distraction. The opportunities of using film and video tape add to television's flexibility. Recorded telecasts are not dependent upon availability of instructors at specific times, thus the problem of scheduling is simplified.

Standardization

A long-standing goal of military training, particularly in technical fields, is being achieved through the use of television. The use of prepared scripts and prompting devices standardizes live telecasts when repeated to succeeding classes. Video film and videotape can standardize material in a single lesson for several classes at the same time, or for several succeeding classes. In schools where several groups work toward a solution of the same problem, television is used to give each group the same initial instruction, plus supplemental instruction as the problem progresses.

LIMITATIONS OF TELEVISION

When comparing television instruction with conventional classroom instruction, the novice TV instructor may encounter what would seem to be definite limitations of television. These limitations, however, diminish as he becomes more experienced and knowledgeable in the use of this medium. Consider the basic problem areas in teaching by television, and note how they can be minimized.

Lack of Feedback

The most universally recognized problem area in television teaching is a lack of feedback. Teachers who have been teaching in the classroom often use questions, comments, facial expressions, and other reactions from their students to judge the effectiveness of their presentations. The television instructor cannot see the puzzled brow or the comprehending smile. He must plan his lesson carefully to insure that all probable questions are anticipated and covered in the material. Through experience before the camera, he gains confidence in himself as he teaches his unseen students and, consequently, immediate feedback becomes of less importance.

Preparation Requirements

Many instructors regard the preparation time and effort involved in presenting a televised lesson as a serious limitation on teaching by television. Much time is consumed by script writing, script conferences, visual aid conferences, dry runs, camera rehearsals, taping sessions, and coordination with the television production crew. The novice television instructor spends approximately three times as long on a televised lesson as he

would for a comparative period of conventional classroom instruction. However, the time varies in proportion to the complexity of the production involved and the experience of the instructor in teaching by means of television. This means that as the instructor gains more experience in teaching by television, the time involved is greatly reduced.

Studio Environment

Many new television instructors consider the television environment to be distracting and, in this respect, a limitation. Hot lights shine on him, seemingly from all directions. Cameras move about the studio. Confusing cues and hand signals are relayed by a man wearing a headset. The instructor is confined to specific areas from which he may not depart, and in the control room a director follows a pre-planned script concerning movements, aids, and cues from which there must be no deviation. This atmosphere of seemingly organized confusion understandingly upsets many instructors who are new to the television medium.

As the instructor gains experience, however, he also gains an understanding and appreciation for those elements which previously were distracting to him. He becomes accustomed to the lights and knows that he must stay in the lighted area. He learns to speak to one camera, disregarding the others. The floor director's hand signals become meaningful and helpful to him in presenting his lesson. He learns to work closely with the director—planning, preparing, and presenting the lesson as a team. Most important of all, he learns that the entire television crew is working with him to produce a good lesson.

To an instructor who is new to television and the techniques involved, and especially those instructors who are accustomed to teaching in the classroom or lecture hall, the lack of feedback, time and effort of preparation, and the television environment are limitations. However, with experience in television teaching, the instructor overcomes the absence of a live audience, he requires fewer and shorter rehearsals, and he becomes more at home in the television environment.

TELEVISION INSTRUCTION

The two principal ways in which televised instruction is used are total instruction and supplementary instruction.

- In total instruction, student learning results from observing and listening to a television monitor. Total instruction is not widely used in the Air Force, but it may be used to a greater extent in the future. It is valuable in circumstances where there are few highly qualified instructors available, or where a high quality of standardized instruction is to be given at several locations. The classroom instructor acts as a proctor and performs routine administrative duties.
- Most Air Force instruction is of the supplemental type. Parts of the curriculum are presented on television as an adjunct or a supplement to classroom instruction.

The classroom instructor plays a key role in the learning situation. His knowledge, skill, competence, and imagination largely determine student learning and student attitude. Televised lessons are introduced into his classroom to provide variety, different points of view, or standardized instruction on complex technical procedures. The television instructor and the classroom instructor become a teaching team, with the television instructor presenting the material and the classroom instructor amplifying, clarifying, and answering questions.

USE OF TV IN THE AIR FORCE

The Air Force uses television to a large extent throughout its many commands. While the primary use of television is in education and training, increasing emphasis is being placed on using television as a management tool.

Management

Television can greatly reduce the time element in the process of decision making. Instead of laboriously reading and digesting written communications, the commander and his staff can receive briefings from any or all of the subordinate agencies which are tied into a closed circuit network. The commander can make his decision and relay it to the subordinate agencies. Much time is saved through the immediacy of aural and visual communication.

Education and Training

The Air Force is using TV as a means of instructor training. With workshops and laboratories already in existence, and with a definite possibility that more will be established, instructors are being trained in the techniques of teaching by televi-

sion. For example, the Academic Instructor and Allied Officer School offers a Television Laboratory which formalizes training for television instructors. For a period of six weeks the student is involved in planning and preparing lessons for television presentation. By means of video tape, the student can make a self-critique, in addition to his advisor's critique, when the tape of his lesson is replayed. The use of television in this respect is unsurpassed as a means for showing instructors how they perform in a teaching situation. By this use of television, the Air Force is turning out better prepared and better trained instructors.

Television is not limited in the Air Force to the training of instructors only, but is used extensively in all areas of instruction and training. In Air Force medical facilities, television instruction affords possibilities once not dreamed of. For example, at one time only a small number of students could view such an operation as transplanting a kidney or the removal of a lung. Today, by means of television equipped with special microscopic lenses, any number of students can view this operation and, by means of video tape, watch the same operation over and over again, even stopping the tape (a still-frame device) for prolonged study of certain portions of the operation.

Leaving the medical facilities, television can be found as a means of teaching other areas of instruction. For example, in Air Training Command, some courses are taught completely by television. This has come to be known as "total television instruction." In this instance, courses such as basic electronics or basic aircraft mechanics can be recorded on tape and played over again for each new class. Standardization is the greatest benefit derived from this means of televised instruction, without mentioning the fact that any number of students can be taught at once.

SUMMARY

Television, like all other media, has certain advantages and limitations. Instructional television provides a means for training greater numbers of students in a shorter period of time than is possible in conventional classes. Television standardizes instruction and often makes more time available to the classroom instructor because his presence during a telecast is not always necessary. Educational television has certain limitations as compared to conventional classroom instruction; however, the extent to which television can assist in Air Force education and training is limited only by the initiative and imagination of the instructor and the production staff. In fact, television has become one of the most stimulating instruments at the disposal of Air Force instructors.

part four

EVALUATION

This part covers some procedures used to evaluate student learning and to assess teaching effectiveness. Chapter 23 discusses the meaning of evaluation, describes a complete evaluation cycle, and lists the characteristics of an effective evaluation process. Chapter 24 describes the construction and use of performance ratings as evaluation devices. Chapter 25 describes how to construct and administer examinations. The last two chapters provide detailed guidance on the use of grading systems and on the analysis of individual test items and tests as a whole.

CHAPTER 23

Meaning of Evaluation

Evaluation is an integral part of the learning process. Whenever significant learning takes place, the result is a definable, observable, measurable change of behavior. It is this defining, observing, and measuring or judging of this specific new behavior with which educational evaluation is concerned. True evaluation is a continuous process. Once instruction has begun, some sort of evaluation is essential to determine both what and how well the students are learning. Only with this information can the instructor intelligently plan how to improve his instruction.

NATURE OF EVALUATION

Evaluation in education can be defined as the process of making a meaningful estimate of

value for some useful purpose. Anything that can be seen, heard, or otherwise sensed can serve as the basis for educational evaluation. Necessarily, such observations are made of only a sample of the individual's behavior; reliable and effective evaluation is possible only if the sample represents the individual's total behavior in the area measured.

Differences can be expected in the observations made by instructors because of their own individual differences—in intelligence, learning ability, aptitudes, attitudes, job knowledge, and ability to verbalize their thoughts. Since these differences do exist, they must be recognized in establishing any evaluation procedure. Failure to do so can only result in unfair and inaccurate measuring of student achievement.

The evaluation process must be systematic and continuous. Often the student's progress toward meeting course objectives can be observed in class discussions, interviews, term papers, laboratory exercises, and special projects, as well as in tests. Weighing all observations so that their real value is established is an important part of evaluation. Informal day-to-day evaluations made by instructors are influenced by their own hopes and wishes. Instructors are naturally prone to remember the actions of students which indicate that they are learning than those actions which indicate that they are not. Thus, there is a need for a more systematic approach.

EVALUATION CYCLE

In a large sense, evaluation is the means of determining how well both the instructor and the student are progressing toward certain goals or objectives.

Objectives

Goals are common to any educational or training activity, although they are called by many names and are stated in a variety of ways. Regardless of form, each objective specifies exactly what is to be accomplished (in terms of the subject matter to be learned or the skill to be acquired) and why it is to be accomplished (the purpose). These objectives serve as the starting point for any effective evaluation process (See Fig. 14).

Standards

From the statements of purpose come the basic criteria or standards which are necessary to any meaningful measurement or judgment. These criteria define what is considered successful and what is unsuccessful or failing. They are the "yardstick" for educational evaluation.

From the stated objectives (the specified tasks to be accomplished), samples which are related to the criteria must be selected. As previously suggested, it is impractical to measure all of the behavior changes that could result from a learning activity. The samples selected, regardless of how they might be stated, represent the specific abilities or traits which successful students should possess as a result of their learning activity. To be useful in the evaluation process, these traits must be observable, definable, and measurable. In addition, the combination of samples must cover the essential elements of the original objective.

Evidence

Next, the samples must be weighed against the criteria by some suitable means. What means would be most effective depends in large part upon the specific circumstances under which the instructor is operating. The instructor might select such means as testing, rating, research, or even expert opinion. Ideally, every student should be evaluated on the job for which his learning is designed to prepare him; thus his real successes and failures would be a basis for judging his success in the course. As a practical matter, this is seldom possible. Therefore, the evaluation instrument should simulate the job as closely as possible and the closer the simulation, the better the chances for a true evaluation.

Frequently, instructors use written tests for formal evaluation. These help him estimate how well his students meet the criteria for each sample—especially in subject areas involving basic theory, principles, or abstract facts, ideas, and concepts. Performance ratings are a second means of evaluation. Such ratings, because they are based on actual performance of students, provide the instructor with the truest possible judgment about his students if the subject matter is such that observable performance is one of the teaching goals. Research (follow-up studies, questionnaires, course critiques, etc.) are also a practical means of evaluation, along with expert opinion.

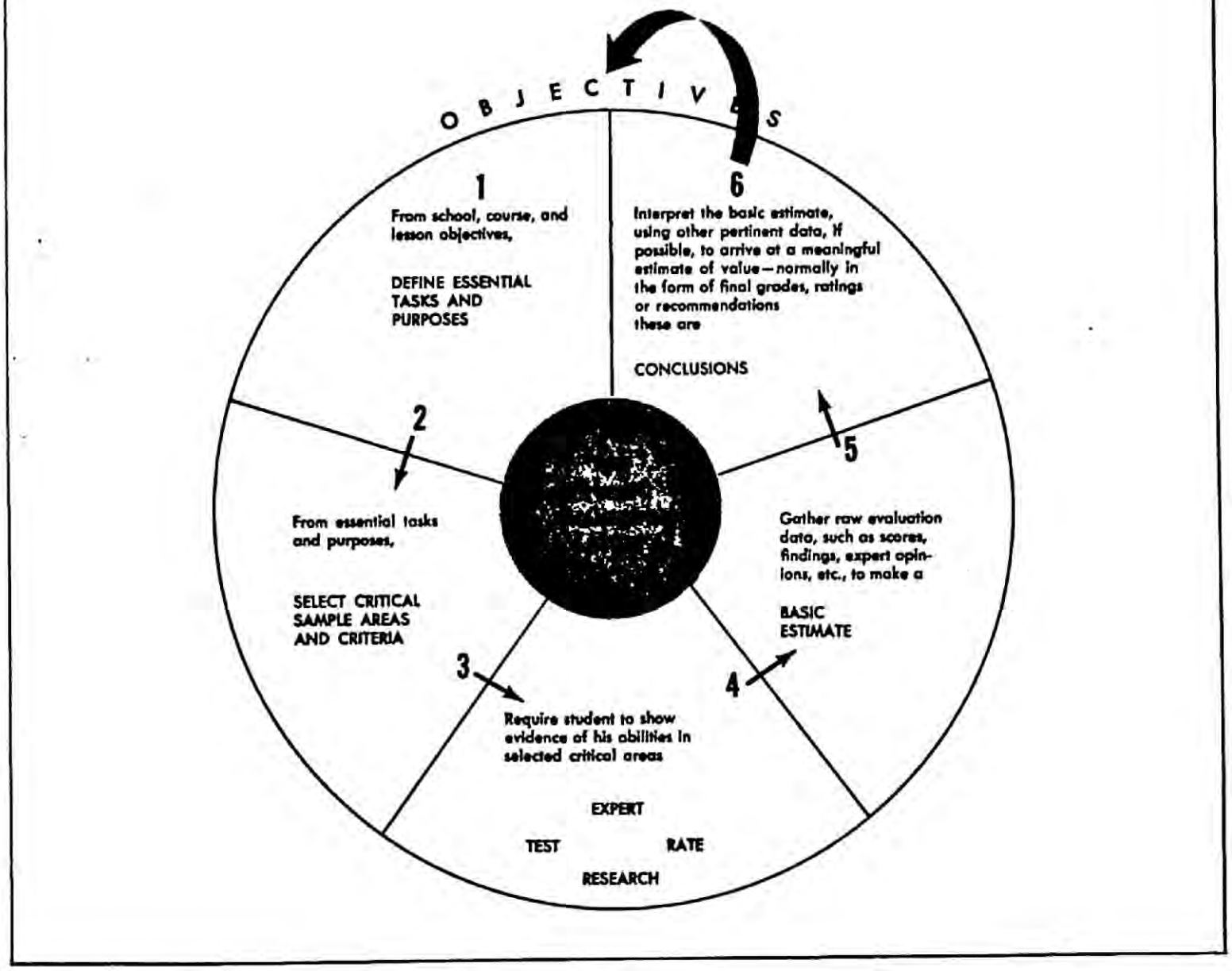


Figure 14. Evaluation Process

These are usually aimed at the general improvement of instruction rather than at the measurement of learning by any individual. Since testing and performance rating are closely related to the instructor and his individual students, subsequent chapters deal extensively with test and rating scale construction and procedures.

All of these means of evaluation tend to overlap in their actual application, but every means is used to bring the sample and the criteria into some reasonable and informative relationship. Whatever the means, it should possess the five characteristics of evaluation described later in this chapter.

Estimate

Weighing samples against criteria results in some basic estimate—often in terms of findings, raw scores, ratings, or reports. Even in the simplest situation, evaluation does not end here. At the very least, the meaning of the basic estimate must be interpreted in relation to course objectives.

Conclusions

The final step in the evaluation cycle (so far as an individual student is concerned) is the formulation of conclusions about the student, based upon estimates of his achievement (see Chapter 26, Assigning Grades). The instructor must al-

ways bear in mind that evaluation is a process of estimating value for some purpose. The conclusions reached, therefore, must have meaning in terms of that purpose. In addition, these conclusions must have meaning to the school, the instructor, and the student; all must be able to effectively interpret grades and ratings. Unless these conclusions can be used as a means of communicating to those who need and can use them, much of the value of the entire evaluation process is lost.

CHARACTERISTICS OF EVALUATION

If any evaluation instrument is to provide an effective estimate of achievement, it must be reliable, valid, objective, comprehensive, and differentiating. Whenever the instructor's judgment is used in the evaluation process, he must consider these characteristics as his basic guidelines. Actually, each of these characteristics is inherent, to some degree, in all evaluation instruments. For example, there is no such thing as a completely valid or invalid, reliable or unreliable, instrument. Any given test or rating scale might possess these characteristics, to the extent indicated for a hypothetical test in Figure 15.

After considering the five characteristics, the instructor can easily understand how evaluation instruments may vary in quality. It is extremely difficult to think of these characteristics independently; indeed, the effects of these characteristics are so interrelated that it is perhaps less important to show their differences than their interrelationships. Comprehensiveness, for example, can materially affect validity. To be valid, an evaluation must be comprehensive; that is, it must be inclusive enough to do what it is supposed to do. Lengthening a test usually increases its reliability. Comprehensiveness is frequently achieved by the use of multiple-choice, true-false, and other selection-type test items, because they take less time per item and more of the subject can be covered. Also, such tests can be scored objectively. Increased objectivity, in turn, usually makes test results more reliable. When efforts to differentiate are carried to an extreme, however, reliability is decreased. The most efficient evaluation instrument achieves a satisfactory balance among all five characteristics.

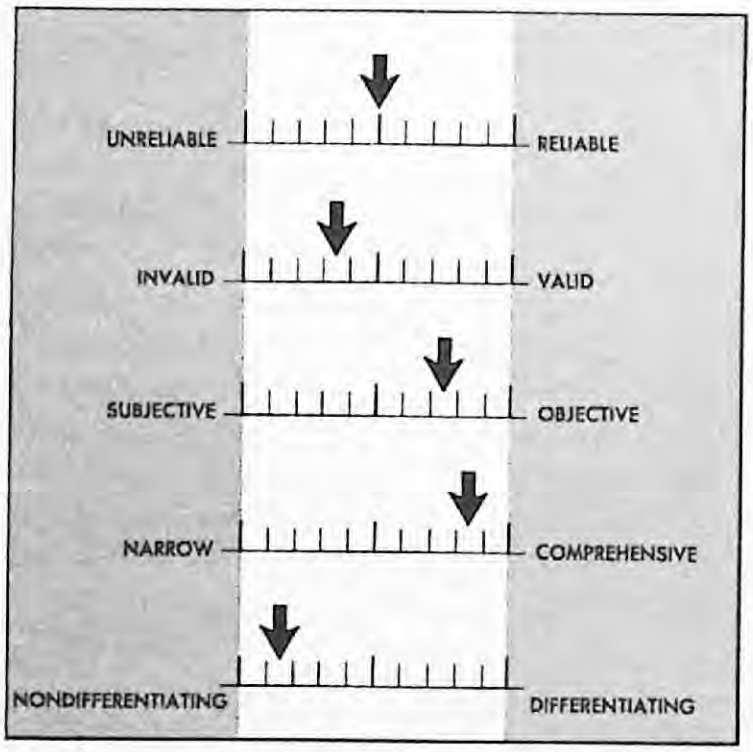


Figure 15. Hypothetical Test Scale

Reliability

A reliable measuring instrument is one which yields consistent results. If identical measurements are obtained every time a certain instrument is applied to a certain dimension, the instrument is considered reliable. An unreliable instrument cannot be depended upon to yield consistent results. An altimeter that has play in its moving parts, a steel tape that expands and contracts with temperature changes, or cloth tapes that are affected by humidity cannot be expected to yield reliable measurements.

No instrument is perfectly reliable. But it is obvious that some instruments are more reliable than others; for example, laboratory balances are more reliable than those used in grocery stores.

The reliability of an instrument can be estimated by taking many measures of the same item. For example, a rough measure of the reliability of a thermometer can be obtained by taking several readings of the temperature of a fluid held at a constant temperature. Except for the errors made by the person taking the readings, the amount of scatter in the readings can be considered as the degree of unreliability in the thermometer.

Reliability has the same meaning whether applied to educational tests and ratings or to balances, thermometers, and altimeters. The term refers only to the consistency of the results obtained from the instrument. To measure the reliability of a rating scale or examination is, how-

ever, a more complex problem than to measure the reliability of a mechanical device. If the same calipers are used at different times to measure the bore of the same cylinder, the results should be nearly identical each time, because the size of the cylinder does not change appreciably between measurements. This is not the case with educational evaluation. Knowledge, understanding, abilities, or skills measured by an educational instrument do not remain constant. For example, in educational testing, the student changes from one application of the test to another because he learns some things and remembers some solutions.

Validity

An evaluation instrument is valid when it actually measures what it is supposed to measure and nothing else.

The fact that a measuring instrument is highly reliable does not necessarily mean that it is valid. The instrument which has maximum consistency (high reliability) may not be measuring what it is intended to measure. That is to say, an instrument may have very high reliability and low validity at the same time. For example, the butcher who hides a lump of solder under the pan of his scales might get reliable measurements but invalid results (at least from the customer's point of view).

If a mechanic wishes to measure the diameter of a bearing with a micrometer, he must be sure that the contacting surfaces of the bearing and the micrometer are free from grease and dirt. Otherwise, he is measuring the diameter of the bearing plus some extraneous matter. His measurements are invalid.

A test used in educational evaluation follows the same principles of validity. If an examination is intended to measure the ability of students to apply knowledge, it must measure application and not the ability to recall and write down facts. If an examination is intended to measure ability to visualize blueprints in three dimensions, a student's score should not be affected by his ability to describe his visualization in writing. If an examination is designed to measure the student's understanding of the operation of a four-cycle internal combustion engine, his ability to read printed matter should not be a factor in his score.

The validity of an evaluation instrument is always determined by comparing it with some criterion or standard that is relevant to the test, test item, or rated trait. For example, when the purpose of the test is to identify or measure a special aptitude, the student's subsequent performance in that area is the most relevant criterion for test validity. If a written test is designed to measure aptitude for piloting an airplane, the validity of the test is determined by comparing the test results with the demonstrated ability to fly an airplane (Fig. 16). If students who score high

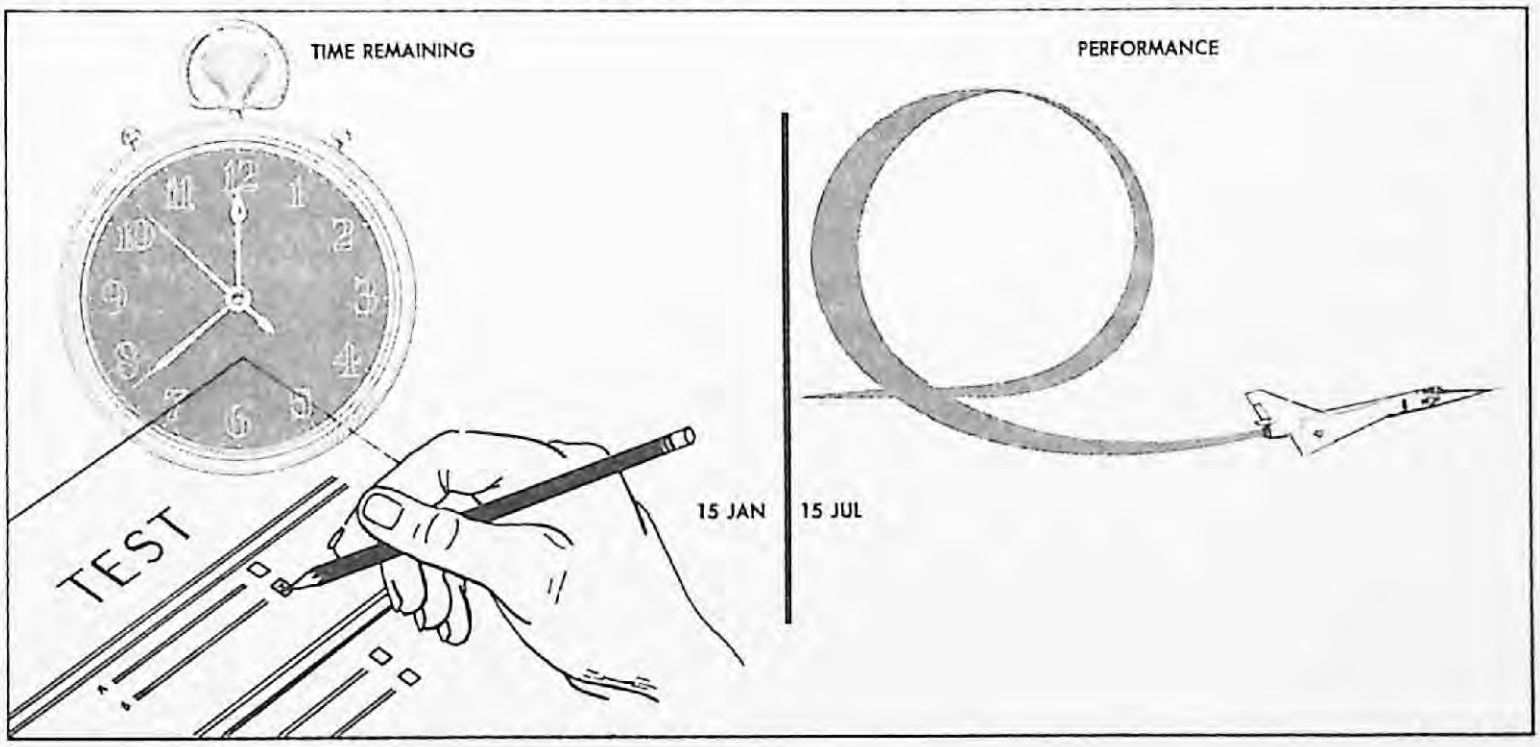


Figure 16. Validity of a Test

on the pilot selection test later prove to be excellent pilots and if those who score low on the test are unsatisfactory pilots, the test is highly valid.

The degree of relevance of the test, test item, or rated trait determines the acceptability of the validity attained. Relevance may be logical or empirical. Logical relevance is estimated by using criteria such as on-the-job performance, behavior on the job, course objectives, pooled judgments, or curriculum and text analysis. These criteria are listed in the order of their acceptability for determining validity. Empirical relevance is estimated by using statistical analysis of the test results, item to be validated, or data gathered from previously validated evaluations. These evaluations may be the results of other tests, grades, or ratings attained in equivalent or similar materials.

The validity of educational evaluation is sometimes determined by comparing results with later performance on the job. The real objectives of instruction in the Air Force are frequently concerned with improving job performance. If the objectives are relevant to the job, then job performance should be the criterion for determining the validity of evaluation instruments used during the course.

It is frequently impossible or impracticable to compare evaluation results directly with job performance. The comparison is difficult because of four considerations: (1) follow-up contacts with students must be maintained, sometimes for long periods; (2) genuine job ability and quality of performance are difficult to measure; (3) the factors which contribute to job performance are interrelated, and many of them do not begin to function until after the evaluation has been performed; (4) much time usually elapses between the administration of the test and an adequate opportunity for students to demonstrate their ability to perform.

Sometimes the curriculum in an Air Force school is not designed to improve performance at a specific job but rather to raise the student's overall level of ability. Most advanced courses of study in both military and civilian educational systems are of this type. Most of the educational achievement evaluation instruments used in these curricula are designed to measure overall achievement that cannot be related to specific job performance. In such situations, it is difficult to identify a relevant criterion for determining validity.

When job performance cannot be used as the criterion of validity or when a curriculum is not directed at improving performance at a specific job, the validity of an evaluation instrument is best measured by the overall objectives of the curriculum. Evaluations used in the classroom are valid only to the extent that they measure achievement of the objectives of instruction. When the objectives of instruction are stated in terms of specific abilities, the evaluation instrument which measure achievement should require the students to demonstrate these abilities. When the objectives of instruction are stated in terms of understandings, applications, and factual knowledge, the instruments which measure achievement should place the students in problem situations in which they demonstrate achievement by solving the problems.

A rough estimate of the validity of a classroom test may be obtained from the judgment of several competent instructors. To estimate validity, they read the test critically and consider its content in relation to the stated objectives of the instruction. Items which do not pertain directly to the objectives of the course are modified or eliminated.

Because it is related to purpose, validity is the most important feature of any evaluation instrument. The instructor must carefully consider whether his test or rating scale actually measures what it is supposed to measure.

Objectivity

The personal bias of the rater or test scorer should not affect the score. For example, an officer in an aviation engineer squadron is responsible for selecting three men for a team to complete an emergency construction job before an attack. He calls in the six available men for a conference and an evaluation. He compares their weight, height, age, and general physique—all physical characteristics to be considered. The officer can make these comparisons objectively, but these facts are not enough; he must estimate how each of the men would react under stress. He reviews what he knows about the emotional stability of each man, his attitude toward his work, his loyalty to the squadron, and the degree of his skill. In making these evaluations, the officer tries to be objective, but his personal bias will undoubtedly influence the results of his evaluation. Thus part of his evaluation lacks objectivity.

The opposite of objective is subjective. In the preceding illustration, the officer's judgments of personal qualities are subjective. In classroom evaluation, essay tests tend to be subjective, since the grade given any answer may be influenced by the scorer's opinion of the student's manner of expression, handwriting, or personal qualities or by other extraneous factors. The grades that one scorer gives on an essay test may vary from day to day, or grades may vary between scorers. In either case, personal bias tends to affect the scores.

If an examination is completely objective, different persons scoring any one test paper or one person scoring the same paper at different times will arrive at the same score. Such a high degree of objectivity may be achieved at the expense of more desirable qualities. However, if tests and rating scales are carefully constructed and if the most likely responses are anticipated and planned for, classroom evaluation today can be much more objective than it was in the past.

Comprehensiveness

An evaluation instrument must sample liberally whatever is being measured. Suppose, for example, the owner of a grain elevator wants to evaluate a carload of wheat. If he analyzes a bushel of wheat from the top of the carload, he would have a poor test—one that is not sufficiently comprehensive. A judgment based on this evaluation could not be safely applied to the entire carload; the wheat at the bottom of the car might be infested with insects. But if the owner takes 50 test tubes of the wheat from scattered positions in the carload, he might analyze less than a bushel of wheat, but he would have a much more comprehensive evaluation of the contents of the car.

In classroom evaluation, a test or rating must sample liberally the objectives of instruction. At best, however, any evaluation is but a sample of the entire course. Just as the owner of the wheat elevator has to select samples of wheat from scattered positions in the car, the instructor has to make certain that his evaluation includes a representative and comprehensive sampling of the objectives of the course. In both instances, the evaluators must deliberately take comprehensive samples. Neither should depend on chance.

Ability to Differentiate

The evaluation instrument must be constructed in such a way that it will detect small differences. Suppose, for example, that a machinist wishes to measure six bearings that are slightly graduated in size. If he uses a ruler to measure the diameters of the bearings, he finds little or no difference between the smallest bearing and the second smallest one. If he compares the third bearing with the first bearing, he might detect a slight difference in size, but he could not depend upon the ruler in accurately assorting the six bearings. But if he measures with a micrometer, which can measure very fine gradations, he can easily differentiate between the diameters of the first and second bearing, the second and third bearing, and so on up the scale.

In classroom evaluation, a test or rating must be able to measure small differences in achievement in relation to the objectives of the course. When a test or rating scale is constructed to differentiate achievement, it has these three features: (1) there is a wide range of scores; (2) all levels of difficulty are included; (3) each item distinguishes between the students who are low and those who are high in achievement of the objectives.

DETERMINING MEANS OF EVALUATION

Having now developed an understanding of the evaluation process and the five characteristics of evaluation, the instructor must choose the evaluation instrument to be used. This choice is determined by whichever means best meets the requirements of the five essential characteristics. This, in turn, depends upon the circumstances surrounding the school, the instructor, and the student.

The instructor must consider at least the following factors when arriving at his decision regarding the best means to evaluate his students:

Reasons for Evaluation

If evaluation is solely for the purpose of assigning grades, simplicity would probably be an overriding factor in deciding whether to test or rate. If, as should be the case, evaluation is to improve instruction, pinpoint student deficiencies, identify specific degrees of skill achievement, or predict success on a future job, then each means by which these purposes can be accomplished must be analyzed.

Nature of Required Behavior

Can any or all of the behavior to be evaluated be realistically represented by words or pictures, or must students perform in real situations for the evaluation to be valid?

Relative Importance of the Behavior

Does the life of some person or expensive piece of equipment depend on the student's correct performance the first time he attempts it on the job? In some cases (medical or maintenance fields, etc.), at least the critical elements of the acquired skill should be performed by the student for evaluation. Less important or less critical skills might be effectively represented on a pencil and paper test. The instructor and his supervisors, as qualified experts, are the best judges of this factor.

Time and Facilities Available

Are the students required to perform the skill during the learning process? If so, evaluation might be merely an extension of this same activity; if not, actual performance may be less critical. In either case, the facilities available for evaluation are an essential factor in making the choice. Time may also influence the decision; e.g., how much time must be set aside for evaluation by each means, and is that time available?

Availability of Qualified Faculty

When choosing the best means to evaluate, the instructor must consider the availability of a qualified faculty to (1) judge performance of students in terms of a rating, and (2) judge responses of students in terms of grading specific instruments, such as essay and other supply type tests.

Only when these factors, at least, have been considered and weighed can the instructor choose the best means for evaluating his students. Quite likely, he will come to realize that no one means will accomplish all his purposes. Under such circumstances, the instructor must either use a variety of evaluation instruments or compromise by accepting the achievement of his purposes to a lesser degree than desired.

SUMMARY

Educational evaluation is a process for making an estimate of value for a useful purpose. It is concerned with the estimation of learning effectiveness and is, therefore, inseparable from the learning process itself. The process begins with a clear definition of objectives, in which specific criteria (standards) and samples (test items or traits) are defined to serve as vehicles for estimating the effectiveness of individual students in the essential elements of the subject area being evaluated. These criteria and samples are the tools for constructing whatever means of evaluation seem most valid—test, rating scale, research, or expert opinion. In practice, either testing or performance ratings are the almost exclusive means used to estimate how well students meet the criteria for each sample.

To be most effective, the evaluation process must be systematic and continuous—occasional or disorganized observations usually lack comprehensiveness, validity, and reliability. To be usable, the conclusions reached must be presented in a form which can be properly interpreted by the school, the instructor, and the student. Whatever means is used, it should possess—to the maximum possible degree—the five characteristics of evaluation: *reliability,* it yields consistent results; *validity,* it actually measures what it is supposed to measure and nothing else; *objectivity,* the personal viewpoints of the scorer do not affect the score achieved; *comprehensiveness,* it provides a liberal sample of all course material being measured; and *differentiation,* it possesses the ability to detect small differences between the levels of achievement of students.

How well each of the various means of evaluation will meet the requirements of the five stated characteristics is the test for choosing one means rather than another. Frequently, to evaluate students correctly, a variety of means should be used. In choosing between any two equally valid means of evaluation, simplicity is the deciding factor.

CHAPTER 24

Evaluation by Rating

Rating is a process teachers and supervisors use to evaluate all sorts of things. For example, ratings can be used to evaluate inanimate things, such as devices, programs, facilities, methods, and data. Ratings can also be used to evaluate human performance. Since learning involves a change in behavior, evaluation can be based on observations and judgments concerning that behavior. A paper-and-pencil test can be devised to measure a person's knowledge of administrative procedure, but judgment must be exercised to determine how well he actually administers. It is possible to devise examination items to determine a pilot's knowledge of flight principles, but judgment is needed to determine how well he actually applies those principles during flight. When performance or traits are being evaluated, judgment is often the only satisfactory basis for evaluation.

Evaluations by rating should incorporate validity and reliability. Ratings are valid when they measure the trait or ability they are supposed to measure. Ratings are reliable when they measure traits or abilities consistently.

The reliability of a rating is not difficult to determine. If a pilot is to be rated on his ability to land an airplane, a number of qualified people observe the performance and rate the pilot. The extent to which the observers agree on the pilot's ability is a measure of the reliability of the rating. If the observers are in complete agreement, the rating is perfectly reliable.

Determining the validity of a rating presents a different problem from determining the validity of a test. One way to determine the validity of a test is to compare the student's test grade with his performance on the job. When performance is rated, there is no further situation with which to compare the rating to determine validity. The fact that the evaluation is being made on the job contributes validity to the rating, but this question might be asked: Did the observer rate what he was supposed to? If the observers who rated the landing were pilots of equal competence, they would, in theory, agree on the ability of the student pilot. If they actually did agree, it can be assumed that the rating is valid. Therefore, for lack of a better criterion the reliability of a rating becomes the measure of its validity.

Rarely will several people agree perfectly on the adjective describing a performance. For purposes of illustration, ratings may be considered as being perfectly reliable, whereas in actual practice semantic difficulties may cause apparent unreliability. Two observers who agree on the quality of a performance may use different words to describe it in the rating. For example, in Figure 17, one observer might describe a performance as Excellent and the other describe the same performance as Good. Each could be trying to say the same thing in different words.

To avoid unreliability that arises from se-



Figure 17. Adjectives Describing Driving Abilities

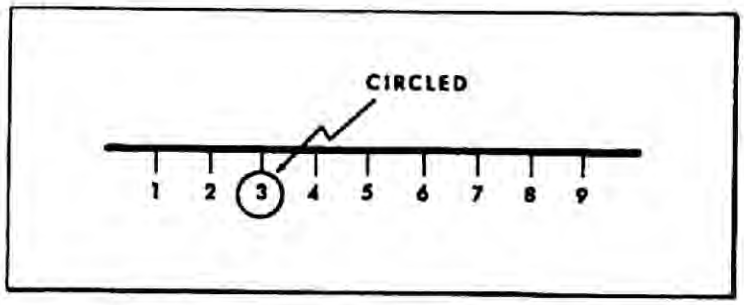


Figure 18. Numerical Scale Rating Driving Ability

mantic difficulties, the instructor may use a scale that has numbers instead of words (Fig. 18). In this scale, 9 represents the highest point, and 1, lowest. The midpoint, 5, represents average performance. An observer using the scale to rate a performer on ability to drive a car might circle 9, if he thought the car was driven in the best possible manner; 1, if in the worst possible manner; 5, if average; and so on. Simple numerical scales of this sort provide the observer with too meager a frame of reference. Numbers are probably no more likely to mean the same things to observers than words do, although numbers have the advantage of being equally spaced.

COMMON RATING ERRORS

Whenever scales are used to judge quality, observers differ in their judgments. These differences are often called rating errors. Numerous attempts have been made to identify and categorize the errors that occur when rating scales are used. Some errors appear to be caused by the design of the scale, some occur only with certain groups of observers, and some with individual observers. Some observers are subject to errors when rating all persons, some when rating certain groups, some when rating only certain individuals. Other errors occur only when certain traits or attributes of individuals are rated. No classification of these errors is completely satisfactory.

In this text, errors are classified into four broad groups: (1) error of central tendency, (2) error of standards, (3) error of halo, and (4) logical error. The first two kinds of errors affect all individuals rated by an observer who is subject to either of the errors. The third type of error affects only certain individuals within a group. The fourth appears only when two or more traits of individuals are being rated. These common errors may all be reduced, and some may be eliminated, through the training of observers and the careful design of a rating scale.

Error of Central Tendency

Many observers hesitate to give either extremely good or extremely bad ratings. They tend to group their ratings close to the center of the scale. This error occurs most commonly with inexperienced observers. Even with experienced observers, it may appear in ratings of personal qualities or abilities that are difficult to identify, such as teaching ability or personality. An analysis of a number of ratings made by a single observer may reveal the error of central tendency. Using a nine-point scale, an observer made 100 ratings of administrative ability; all of which were either 4, 5, or 6 (Fig. 19). In a sample of 100 people, it could be assumed that administrative ability would vary more and that the observer made an error of central tendency.

Some observers place too many ratings at the extremes and too few near the center of the scale, but this tendency is rare. Although the error is the opposite of central tendency, it may be considered in that category.

Error of Standards

Some observers tend to overrate or underrate because of the difference in their standards. Stand-

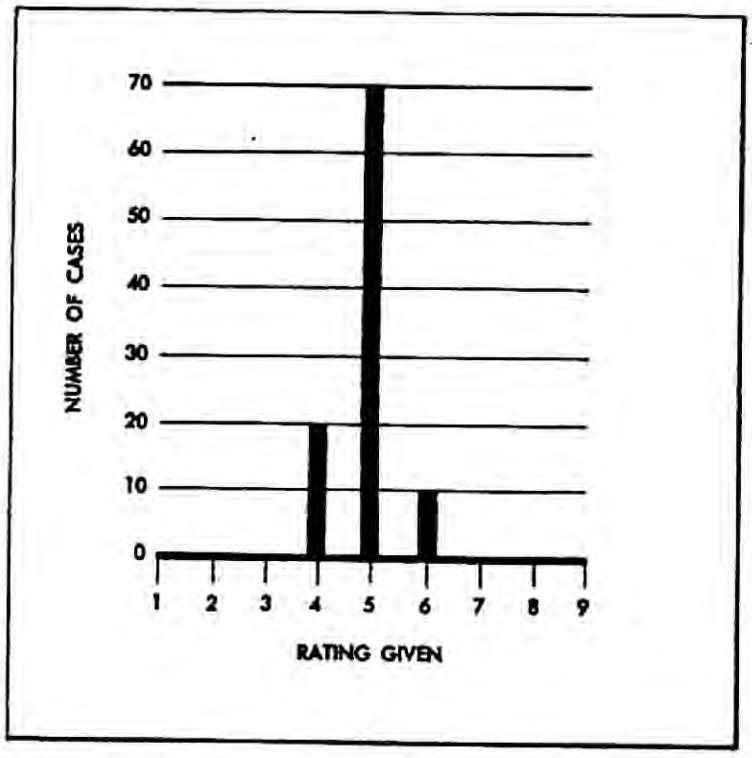


Figure 19. One Hundred Ratings by a Single Observer

ards of physical measurement are fixed units—inches, centimeters, ounces, and grams. But in rating with only mental standards for comparison and relying upon his own mental standard, there may be as many different standards as observers.

Well-trained and experienced observers usually distribute their ratings similarly. This agreement indicates that similar standards are used. Inexperienced and untrained observers are less likely to have similar distributions.

Thirty persons, representing an average group, were simultaneously rated on posture by observers A and B (Fig. 20), who have different standards of posture. If A and B were inexperienced observers, they might have different ideas as to what constitutes posture. If A and B were to rate an additional group of thirty persons, their standards would probably be more nearly alike. As A and B receive more training and gain experience in rating posture, their distributions should tend to agree more closely.

If A and B were already experienced raters of posture, it would appear that A has strict standards and B, lenient standards. If experienced observers have consistent, yet quite different standards, training should reduce the difference. When the difference in standards is consistent but sufficiently stable to be corrected, it may be termed a "systematic error." One partial correction procedure would be either to add a certain number to all of A's ratings or to subtract that number from all of B's; another would be to add to A's ratings and subtract from B's. An effective correction procedure can be determined after comparing the ratings given by A and B with the ratings of several other competent observers. Better still, however, the instructor can inform A and B of their error in standards, give them further training, and encourage them to make the correction themselves.

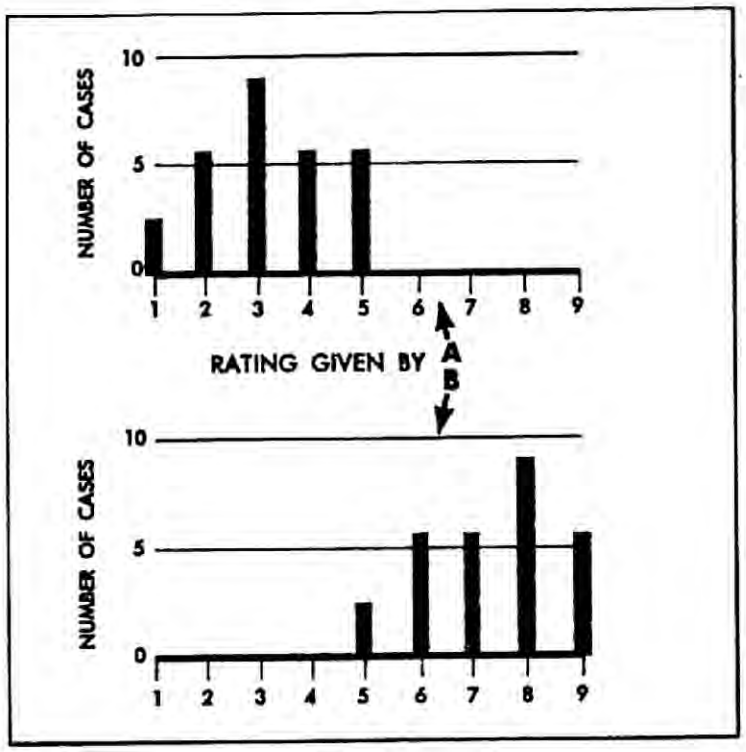


Figure 20. Simultaneous Ratings by Two Observers

Error of Halo

Observers sometimes allow their rating of performance to be influenced by their general impression of the individual. Such an impression is usually formed on the basis of observations or knowledge extraneous to the rating, and if allowed to influence judgment, it would result in a shift of the rating. This shift is called an error of halo. If the observer is favorably impressed, he rates the individual too high. If the observer is unfavorably impressed, the shift is toward the low end of the scale. It should be noted that *halo error can be either favorable or unfavorable,* and that it affects only certain persons rated.

The error of halo may be suspected in many situations, but can be positively identified only when many competent and experienced observers rate a number of persons under identical conditions.

Jones and nine other observers simultaneously rated six persons on teaching ability. In Figure 21, all ten observers agreed reasonably well on the teaching ability of five of the six persons rated. All but Jones agreed on the teaching ability of the sixth (E). Apparently Jones allowed some general impression regarding E to influence his rating unduly, or he made an error of halo.

Halo error has its sources in the likes, dislikes, opinions, prejudices, and moods of people. When considering friends or close acquaintances, observers tend to give undeservedly high ratings in all favorable traits. Such a halo error is often called error of leniency.

Some people believe that close-set eyes show dishonesty. An observer who holds this belief is likely to be affected by it when rating a person with close-set eyes. Some people have preconceived concepts about certain racial groups. They

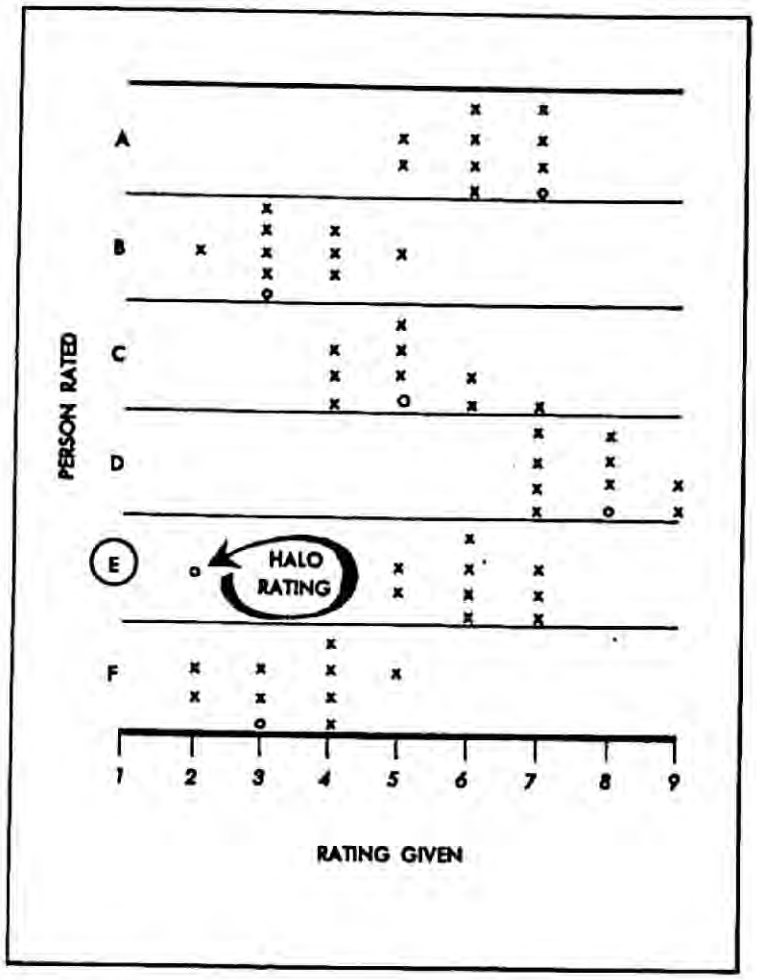


Figure 21. Simultaneous Ratings of Six Persons by Ten Observers (Jones' rating is indicated by O; other ratings by X)

may believe that the Dutch are industrious, the Scots thrifty, and the French excitable. Others have an aversion to or a special liking for Jews, Catholics, or Protestants. All these preconceptions influence observers. When halo error is traced to such sources, it is sometimes called error of stereotype.

Halo errors frequently go undetected even though they may be suspected. Usually only extreme cases are detected, even under controlled conditions. The simultaneous use of a large number of raters is often uneconomical and administratively inadvisable. Even when halo error has been identified, its reappearance cannot usually be predicted. It is the most difficult error to overcome.

Logical Error

A logical error may occur when two or more traits are being rated. It is present if an observer tends to give similar ratings to traits which do not necessarily go together. For example, some observers may think that a person who is industrious is also efficient, or that a person who is prompt is also industrious. Industrious persons may often be efficient, but not necessarily so.

Presumably, the term "logical error" is used to mean that the traits are related in the mind of the person making the error. The relationship may not appear to be logical to someone else. As a matter of fact, the person who exhibits an error of this sort is probably not really aware of it.

Six observers (A, B, C, D, E, and F) rated a certain person on four traits (industry, promptness, efficiency, and courtesy). Their ratings are shown in Figure 22. In three of the traits, the six observers agree reasonably well. However, E gave a much higher rating on efficiency than did the other observers. Since E assigned the same rating to both efficiency and industry, it appears that he thinks industry and efficiency are much the same—a logical error. There may be many reasons for this error: E may not have had adequate opportunity to observe the per-

	1	2	3	4	5	6	7	8	9
INDUSTRY							B,F	A,D,E	C
PROMPTNESS					A,C	D,B,E	F		
EFFICIENCY			A,B,D	C,F				E	
COURTESY		C,D,E	A,B,F						

RATING GIVEN

Figure 22. Ratings on Four Traits by Six Observers (A through F)

former's efficiency; he may have an erroneous conception of efficiency; or he may not be able to distinguish between efficiency and industry. In any event, in rating efficiency, E and the other observers have not rated the same thing. In effect, E rated industry twice.

Eliminating or Reducing Errors

Because injustice can result from the four types of rating errors, they should be eliminated, if possible, or at least reduced to a minimum. Errors can be reduced both by improving the rating scales and by training the observers who are to use them.

RELATIVE RATING METHODS

Rating methods are grouped into two general classes: relative and absolute. Relative methods of rating can be used when several persons are being rated, with each person being evaluated only in relation to others. When using purely relative methods, no attempt is made to assign individual values.

Rank Order

One of the relative methods is called ranking, or the rank-order method. The trait, performance, or ability of each person is compared with that of other persons in the group and is ranked within the group. The result is that the group is arranged, or ranked, from best to worst.

To make a rank-order rating, the observer should first select the most effective in the group and the least effective, then the second most effective and the second least effective, and so on. For greater objectivity, several observers may rank the group, and the mean rank may be computed. (The mean is the sum of the ranks given by all observers divided by the number of observers.)

The rank-order method of rating eliminates the error of central tendency and errors of standards. Since someone must be at the bottom of the scale and someone at the top, the maximum spread is obtained. Generally, logical error is reduced by assigning rank order to one trait at a time. Judging the rank of a number of persons on one trait requires concentration. As the observer progresses from one trait to another, he tends to forget ranks assigned on the previous trait and, in this way, any logical connection between the traits is broken.

Of the many objections to rank-order, one is that this procedure forces the observer to give extreme ratings; someone must be placed at the bottom of the group. Ranking a person at the bottom of a list does not indicate that he is unsatisfactory; it merely indicates that he is the least effective in the observed group.

The rank-order method does not reduce halo errors. It may, instead, accentuate them. The observer tends to base his ranking largely on his general impression of the individuals, even though he is presumably ranking them on a specific trait.

Ranking does not make allowances for the varying distances between persons. Let us assume that five persons have pilot ability which should place them on a nine-point scale, as shown in Figure 23. A and B are close together, whereas C and D are widely separated. If these pilots are ranked on the basis of this scale, they retain their same relative position, but the true differences in ability are lost. The fact that the difference in ability between C and D is far greater than that between A and B is not revealed.

For some purposes the distance between persons is not important; for example, when selecting the best two persons in a certain group for a new job, or when eliminating the poorest one or two persons from the group. In such instances, the observer is concerned only with the extremes of the group.

The ranks in one group cannot usually be compared with those in another group. The Number 1 man in a ranked group is the best man in that group, but this ranking does not indicate how he compares with the Number 1 man from a different group. For example, it would not be reasonable to rank all second lieutenants on each Air Force base, and to consider all the Number 1

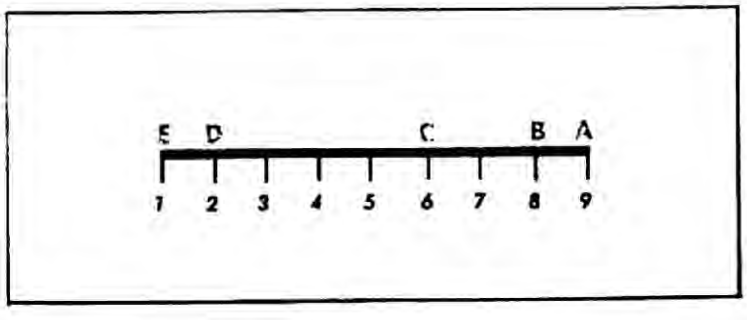


Figure 23. Rankings for Five Persons on Nine-Point Scale

men collectively as the best second lieutenants in the Air Force. It is highly probable that the second-best men on one base may be better than the best men on another. The average or poorest student of Instructor A is not necessarily of the same quality as the average or poorest student of Instructor B. Nevertheless, under certain conditions observers can make groups comparable, within broad limits, before the ranking is begun. Specified comparisons between the groups may then be made.

Another objection to the rank-order method is the problem of differentiating among the members of a large group. Most observers cannot reliably rank more than about ten persons.

Equal Appearing Intervals

When many persons are to be ranked, the method of equal appearing intervals is effective. Using this variation of the ranking technique, the observer ranks students in groups which appear to him to be equally spaced. Those who appear to be the same are placed in the same rank. Figure 24 shows how an observer might rank 26 persons on leadership. The students in the group are identified by the letters of the alphabet.

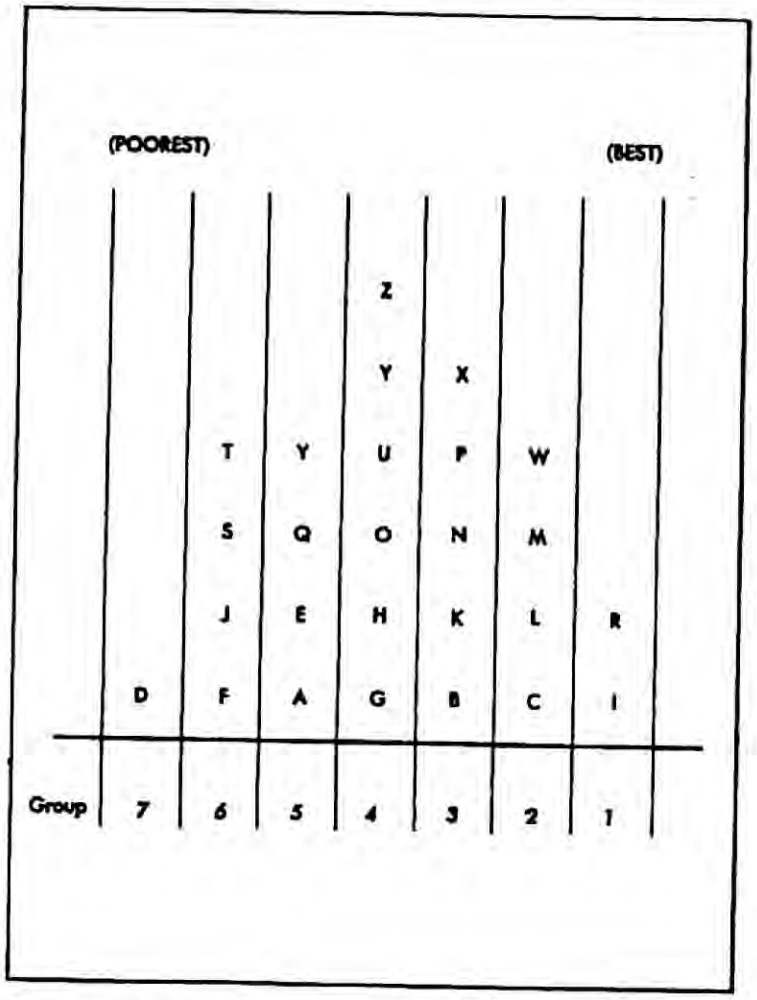


Figure 24. Leadership Ranking of 26 Persons by Equal Appearing Intervals

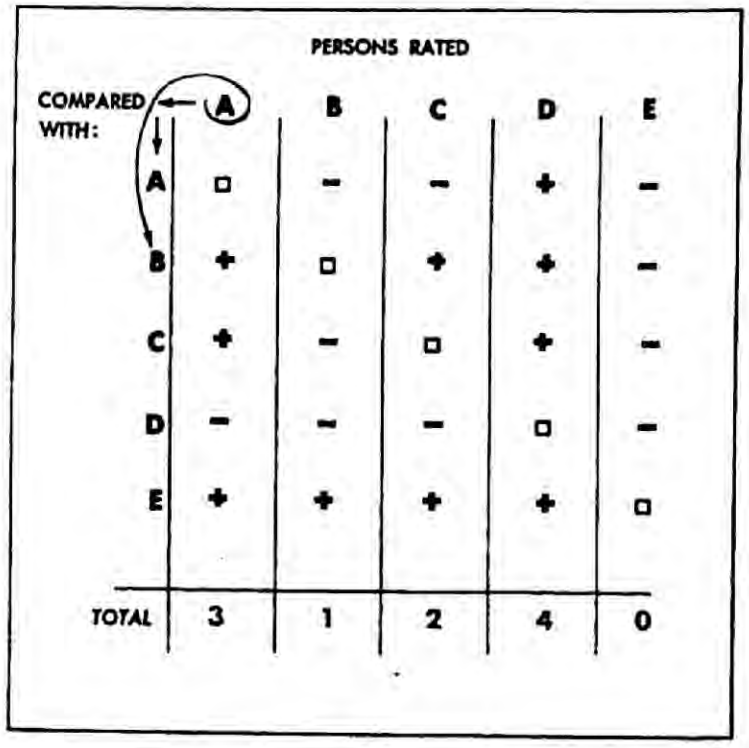


Figure 25. Chart for Rating by Paired Comparisons

Paired Comparisons

The most refined procedure for making a relative rating is the method of paired comparisons. This method requires the observer to compare each individual in a group with each of the other individuals. To be most dependable, only one trait or factor should be compared at a time. The correct use of this technique is shown in the following example.

Five persons to be rated on cheerfulness are designated by the letters A, B, C, D, and E, which are arranged on a chart (Fig. 25). The observer starts by comparing A and B. He decides that A is more cheerful than B. Because of this decision, he places a plus sign in A's column (beside B). Since this judgment automatically means that B is less cheerful than A, he places a minus sign in B's column (beside A).

In comparing A and C, the observer decides that A is more cheerful than C, and places a plus sign in A's column (beside C). He also places a minus sign in C's column (beside A).

The observer compares A with D, and then with E. He then compares B with C, D, and E, in turn. This process of comparing pairs of persons is continued until the chart is completed

(ten comparisons are necessary in this illustration).

When the chart is complete, it is necessary only to find the number of plus signs in each column. The total number of plus signs in the column shows the rank in the group for the trait being rated.

If carefully used, this technique produces more dependable results because it requires the maximum number of comparisons. Its principal weaknesses are that it allows halo errors to operate freely, and it becomes unwieldy when more than eight or ten persons are to be ranked. The number of comparisons which must be made is computed by the following formula:

$$\frac{n\ (n-1)}{2},$$

in which n is the number of persons in the group. For a group of 10 persons, 45 comparisons must be made; for a group of 200 persons, 19,900 comparisons are required.

ABSOLUTE RATING METHODS

In using absolute methods of rating, the observer must assign an absolute value to the trait, performance, or ability of an individual without reference to the performance or ability of any other person. In effect, the observer rates the person, trait, or performance according to a fixed scale. Either experience or training, or both, aid the observer in identifying positions on this scale.

Numerical Scale

The simplest form of an absolute scale is the numerical scale. Any number of points would be feasible, but an odd number is commonly used so that the center figure can stand for average. The number of points on the scale should depend upon the number of differentiations required and upon the ability of observers to differentiate. For example, a squadron engineering officer needs to know which of his aircraft maintenance men are below average in performance of duty so that he can give them on-the-job training. He may not need to use a nine-point rating scale. A three-point scale may provide the differentiation required. But suppose the engineering officer wants to organize his section so that he will have three maintenance teams, each team having the same proficiency. Since a three-point scale will not provide him with the necessary differentiations, he will have to use a scale with more points. But just how many points are needed will depend, in part, upon how well his observers can differentiate.

Most people are able to make at least five differentiations, which break a group into highest, slightly above average, average, slightly below average, and lowest. Few trained observers can reliably make more than nine differentiations. As a result, most rating scales contain five to nine points.

Descriptive Scale

The descriptive scale uses phrases to indicate levels of ability. Figure 26 shows a descriptive scale for rating pilot ability. Five levels of ability are described. Such a scale is more versatile than the numerical scale because the degrees of excellence can be varied to suit the occasion. For example, suppose an operations officer wants to evaluate the flying ability of his pilots. He feels that all his pilots are satisfactory, but he wants to know to what degree each is better than satisfactory. A numerical scale might be useful, except for the common impression that the lowest numbers on the scale indicate inferior performance. By using a descriptive scale, like the one shown in Figure 26, the operations officer gives his observers a frame of reference. Here the lowest rating possible is labeled acceptable. Had a numerical scale been used in this instance, observers would have tended to shift ratings to the high end of the scale.

A good choice of descriptive phrases helps to reduce the error of central tendency. If observers

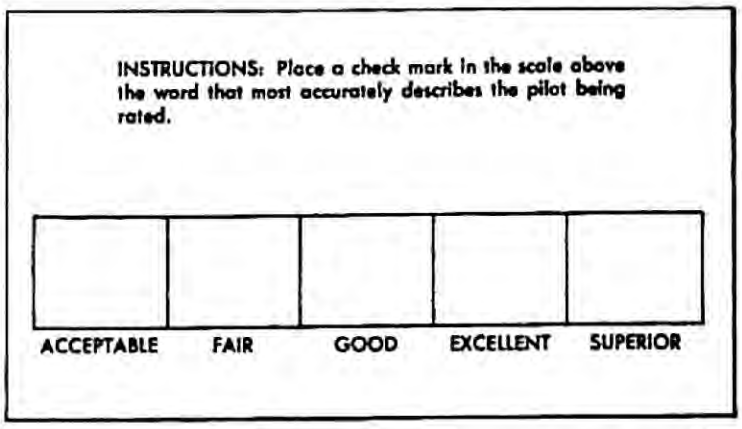


Figure 26. Descriptive Scale for Rating Pilot Ability

do not use extreme descriptions, the categories at the end of the scale are less objectionable.

The major disadvantage of the use of descriptive scales is a semantic one. An "excellent pilot" does not mean the same thing to all observers. Another disadvantage is the difficulty in selecting phrases which describe degrees of performance that are equally spaced. When the scale shown in Figure 26 is used, most people feel that there is less distance between "excellent" and "superior," than between "fair" and "good."

Graphic Scale

The graphic scale is a combination of the numerical and descriptive scales. Besides a numerical scale, various adjectives or phrases are set below a continuous horizontal line, which represents the range of the ability or trait being measured. In using the graphic scale, the observer must consider not only the numerical range of the scale but also the phrases which describe the various positions on the scale.

Three typical forms of the graphic scale are shown in Figure 27. In Example A, the observer is given instructions for judging industry. He is instructed to mark the scale after considering energy and application to duties, day in and day out. These instructions help reduce error of halo and improve objectivity and reliability; they also encourage observers to consider the same things about each person.

The descriptive phrases below the scale, however, allow errors of standards to affect the rating. Phrases that describe observable behavior would help reduce error of standards and would probably reduce error of halo to an even greater degree.

If observers refuse to use Points 1 and 5 on this scale (error of central tendency), these points could be made more attractive by strengthening the words at the low end of the scale and weakening those at the high end. Point 1 might be described as "indifferent"; Point 5, "energetic." Such manipulation of the phrases in the scale produces a greater spread in the distribution of ratings and, therefore, greater differentiation. The manipulation can be justified, since the numerical part of the scale shows the observer the limits of his judgment. Whether Point 1 is called "lazy" or "indifferent," the observer knows that he is giving the lowest possible score.

Example B in Figure 27 shows a graphic scale in which certain types of behavior are described for each point on the scale. With most scales, the observer must not only observe but also evaluate his observation to form a rating. People can observe more accurately than they can evaluate what they have observed. The difficulty of evaluation increases errors of rating. Whenever ratings can be based on observations alone, reliabil-

Example A

Industry: Consider energy and application to duties day in and day out.

1	2	3	4	5
Lazy	Indifferent	Diligent	Energetic	Untiring

Example B

Cooperation: Demonstration of willingness to work with others.

1	2	3	4	5
Creates friction.	Indifferent to others.	Gets along with most people.	A harmonious team worker.	Actively promotes harmony in working with others.

Example C

Initiative: Action taken on own responsibility.

1	2	3	4	5
Slow to act, even when a decision is much needed. Waits for others. Lets opportunities pass. Does not volunteer. Reticent.		Takes needed action without delay. Volunteers for some tasks. Undertakes all routine jobs without supervision. Dependable.		Anticipates needs. Works ahead and prepares for possibilities. Actively seeks opportunities. Eager.

Figure 27. Typical Forms of the Graphic Scale

ity is greatly improved. With the scale in Example B, the observer is required only to record, not evaluate, the actions of the person being rated. Hence, this type of graphic scale incorporates much objectivity. If a trained rater observes accurately and records honestly in using this scale, all rating errors except that of halo should be eliminated. The halo error itself should be considerably reduced because of the objectivity built into the scale. In preparing this type of scale, the instructor must make sure that the behavior described for each point is actually an improvement over that for the point just below it. In each case, distances between the points should appear to the observer to be about equal.

The scale in Example C is similar to that in B except that descriptive phrases are not provided for all points on the scale. In some respects this is an improvement. Many times observers feel that the rating should fall somewhere between two points. Such a rating is possible with this form of the graphic scale. The fuller descriptions in Example C increase the likelihood that observed behavior can be pin-pointed on the scale. Generally speaking, the more detailed descriptions should contribute to better rating results.

Checklist

The checklist is sometimes considered a separate rating method, but actually it is a two-point rating scale. A checklist is useful for rating ability to perform a set procedure. It is also a simple method of rating skills when the purpose is to determine whether students have reached a certain minimum level. Figure 28 shows a portion of a checklist which might be used for rating instrument flying proficiency. In using the scale, the observer indicates whether the completion of each step was satisfactory or unsatisfactory. Breaking a performance into many observable elements eliminates the error of central tendency and greatly reduces the error of standards.

Reliability is usually high in checklist rating because of the nature of the decisions required. For example, if apples are to be sorted into a hundred different categories ranging from rotten to top quality, the possibilities of error would be enormous. If the categories are reduced to rotten, partially rotten, fair, good, and excellent, the number of possible errors is greatly reduced. Fewer choices require fewer and less refined judgments. When the number of choices is reduced to two, rotten or sound, the chance for either error or bias is still further reduced, and reliability and objectivity improve correspondingly. Because of its many broad differentiations, the checklist is comparatively reliable.

On the debit side, however, only a limited amount of information can be obtained from a checklist. The scale in Figure 28, for example, does not indicate how well the satisfactory pilot performed each maneuver. For purposes of an instrument check, the information obtained may be sufficient to determine whether each pilot has reached a certain minimum level of proficiency. But if an operations officer needed to select his best instrument pilots, he would probably find that the checklist is not adequate.

Product Scale

At times, the product of a performance, rather than the performance itself, is to be rated. This problem is different from that of rating a performance. For example, an apprentice instrument repairman undertakes to repair a speedometer for the standard price of $1.50. Because he is still learning the job, he spends two days repairing the speedometer. When repaired, the speedometer

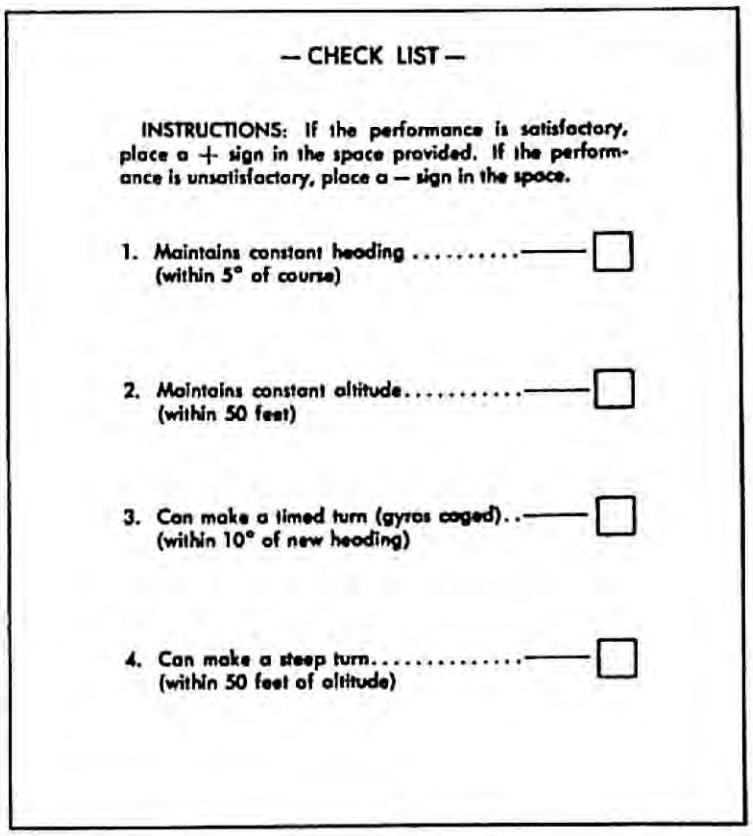


Figure 28. Checklist for Rating Proficiency in Instrument Flying

is in excellent condition. The end product is excellent, but the performance is poor because two days were required to complete the work. An experienced repairman might have done the same job in 30 minutes.

Since the product, unlike the performance, is usually a tangible thing, product rating is more reliable than performance rating. Figure 29 shows a product scale for rating the ability to fly a link trainer. The pilots being tested are required to fly a pattern which corresponds with the pattern shown at A. At the completion of the exercise the pattern produced is compared with the patterns on the scale. From the comparison of the product with the scale, a rating is produced.

If followed carefully, this procedure can eliminate nearly all rating errors. The scale provides a tangible standard which a rater can use to measure the product. It eliminates the errors of central tendency, standards, and the logical error. Halo error is not a problem, since the rater does not know who is responsible for the product.

Because product rating scales have proved to be highly reliable, a quasi-product scale was developed for use in rating performance. This was the man-to-man rating scale used by the U.S. Army in 1918. To make comparisons definite, as in the product scale, the names of five men known to the observer were selected. These men varied in ability, representing points on a scale. Observers compared the persons being rated with the persons in the different positions on the scale. Figure 30 shows a man-to-man rating scale for leadership.

This type of personal scale is subject to double halo errors: those related to the persons who

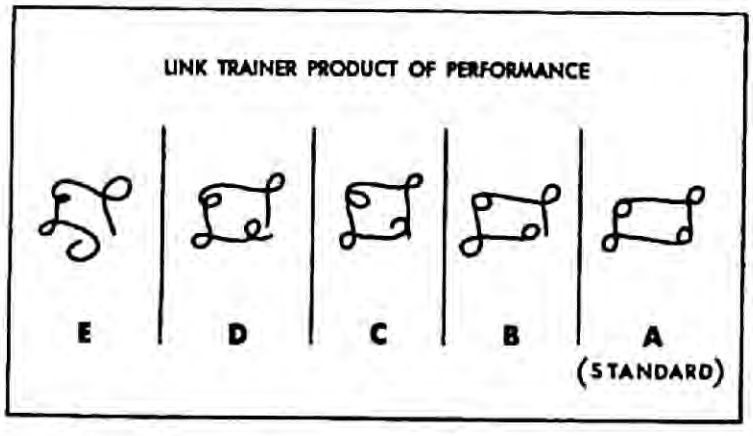


Figure 29. Product Scale for Rating Proficiency in Simulator

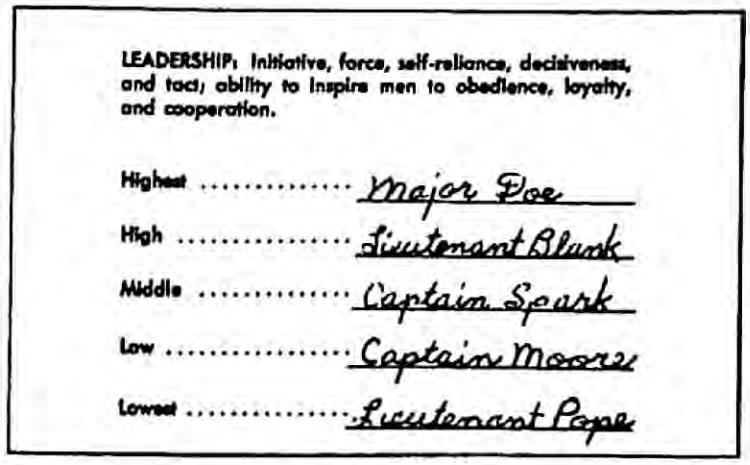


Figure 30. Man-to-Man Scale for Rating Leadership

identify points on the scale, and those related to the persons being observed. The result may be either overestimation or underestimation.

Distances between persons on the scale are not necessarily equal. Indeed, some observers may disagree as to the relative positions. In spite of these faults, the man-to-man scale does provide the observers with visible standards for rating.

Forced Choice

Another approach to absolute rating is the forced-choice technique which uses two to five descriptions of behavior in each block. Both favorable and unfavorable statements may be included in a block. Most instruments contain 25 to 30 blocks. Figure 31 shows a single block containing four descriptions—two favorable and two unfavorable. The rater is asked to select the statement that is most characteristic and the one that is least characteristic.

Although the favorable and unfavorable statements are easily distinguished, the observer does not know whether A or B receives more credit.

The decision is so precise that the observer is usually forced to ignore his general impression and think back to specific instances of behavior. Because the observer reports behavior without being permitted to judge the quality of the behavior, reliability is greatly improved. The question of standards is involved only to a slight degree. The errors of central tendency and logical error disappear, since the rater observes but does not evaluate. Halo effect is also reduced because the rater does not know which of two statements will increase or decrease the rating.

An objection to the forced-choice technique is that considerable research is necessary to pro-

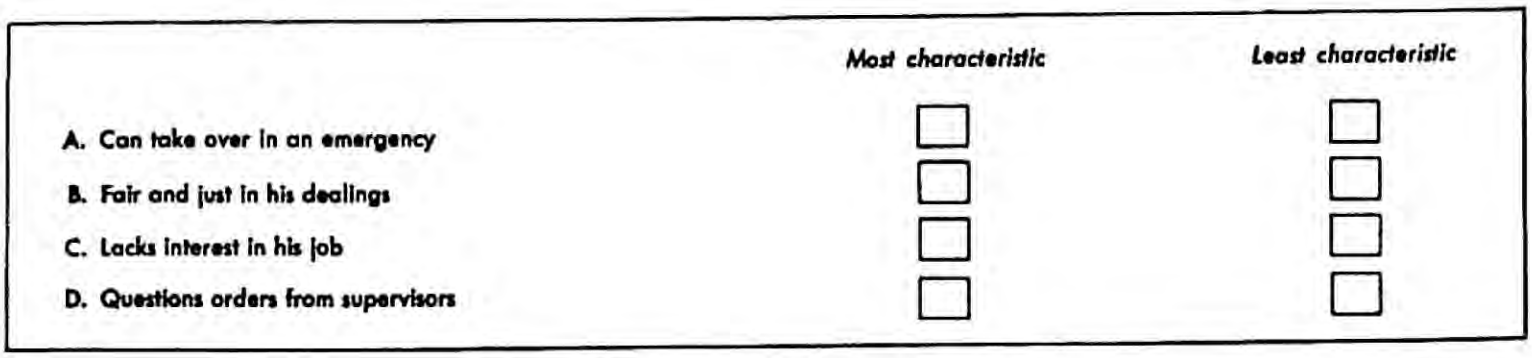


Figure 31. Single Block of Forced-Choice Instrument

duce a scale for any given purpose and to devise a fair method of keying the responses. For example, before the scale is constructed, items that are known to differentiate between good and poor performances are paired with items that do not differentiate. Both items in the pair must be shown to have approximately equal appeal to the rater. Because of such factors, educators seldom try to construct forced-choice rating scales.

Some observers object to the scale on the ground that they are unable to influence the rating. They fear that, unless they know in which direction they are forcing the rating, injustices will result. Untrained observers who feel this way are actually insisting that halo errors should be allowed. If the observer tries to manipulate the score, there is a 50-50 chance that he will force it in the wrong direction.

Other Rating Scales

The scales which have been described so far are probably the most common ones encountered in education. Except for the forced-choice, most of the scales considered (or variations of them) can be designed by classroom instructors. Naturally, they should be constructed carefully, to serve specific purposes.

There are other, more sophisticated types of rating scales. Since these are normally developed by experts, they will be mentioned only briefly here.

There is a variety of sociometric techniques which an individual can use to rate himself, or to rate others according to their performance in a group. Some sociometric techniques are useful to evaluate social traits and attitudes. Others can be applied in the classroom to judge the amount or quality of participation by students in projects and discussions. Some techniques employ diagrams, often called sociograms, which are easy for an instructor to use.

Q-techniques can be used to rate traits as well as performances of students and teachers. Often there is a predetermined set of descriptive terms which are to be sorted and scored. The rater makes his selection of terms after a specific period of observation.

The semantic differential scale depends upon key words with opposite meanings. The words are placed at opposite ends of a line with numbers representing a spectrum of values, in this manner:

autocratic 1 2 3 4 5 6 7 8 democratic

Surprising success has been reported by researchers working with such scales.

Self-anchoring scales, which use the rater's opinion as a point of departure, are frequently written for self-evaluation. One might begin: "Here are the numbers 1 through 10. Let *1* represent the untrained beginning teacher; and let *10* represent the ideal master teacher. Now circle the number which you feel best represents your ability level as a teacher today." From this point, one might estimate his ability two years ago or five years from now. He may even estimate the abilities of others.

ANALYZING RATINGS

Many different techniques are used to analyze the effectiveness of ratings. Some of these excellent techniques require competence and training in psychometrics. Certain broad analyses, however, can be made by simple methods.

Because of the common rating errors, it is possible for ratings to be a function of the ability of the observer to rate rather than a difference between people rated. Six persons were rated on

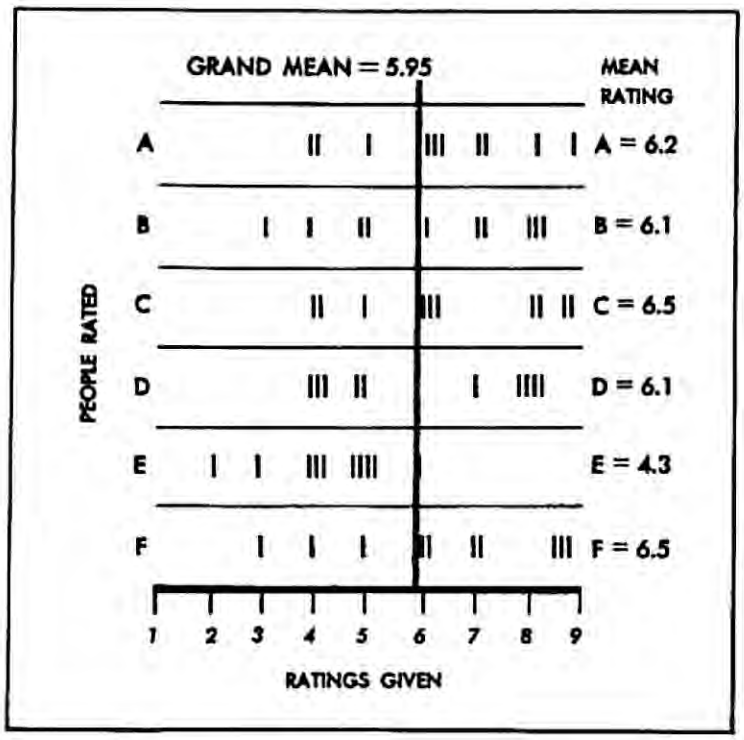


Figure 32. Leadership Ratings of Six Persons by Six Teams of Ten Untrained Observers

leadership by 60 observers organized into six teams. The ten members of each team rated one of the six persons. The outcome was a wide scattering of ratings, representing considerable differences of opinion (Fig. 32). When each person's mean rating was computed and compared with the mean of these means (the grand mean), it was found that the average ratings of A, B, C, D, E, and F differed only slightly from the grand mean. The ratings show fairly wide scatter about the mean for each person. In fact, the observers differ more in their opinion about each person's leadership ability than the mean ratings differ from each other. Unless the six persons rated are really alike, each rating is a function of the observer's ability to rate rather than of the difference in ability of the persons rated.

The same number of persons were rated on leadership, each person being rated by ten different observers (Fig. 33). In this instance the observers agree closely for each person rated, yet the persons being rated seem to have widely varying abilities. The scatter of the ratings assigned each person by different raters is less than the scatter of the mean ratings about the grand mean. The average ratings indicate a real difference in leadership, rather than in the ability of observers.

The two cases just described are extreme. Usually, it is not possible to tell merely by inspection whether a rating is a function of the observer's ability or the performer's ability. The value of the rating can, however, be determined by a competent statistical analysis.

When comparable groups are arranged, rating errors can be identified by simple analysis. Sixty student papers were divided among six instructors, each instructor being assigned ten papers at random. All papers were solutions to the same navigational problem. Because the papers were assigned at random, each instructor should have had a similar distribution of ratings.

Each instructor was asked to rate his ten papers on a 9-point scale. The ratings assigned are shown in Figure 34. It appears that the instructors can be divided into three groups, according to their standards. Instructors A, E, and F have comparatively low standards, whereas Instructor C apparently has a high set of standards. Instructors B and D seem to have the same set of standards, since their mean ratings are the same. However, Instructor D is apparently making an error of central tendency. Although Instructors B and D assigned similar ratings to an average paper, an outstanding paper would suffer, and a very poor paper would benefit by D's rating. Instructor C has high standards, but he appar-

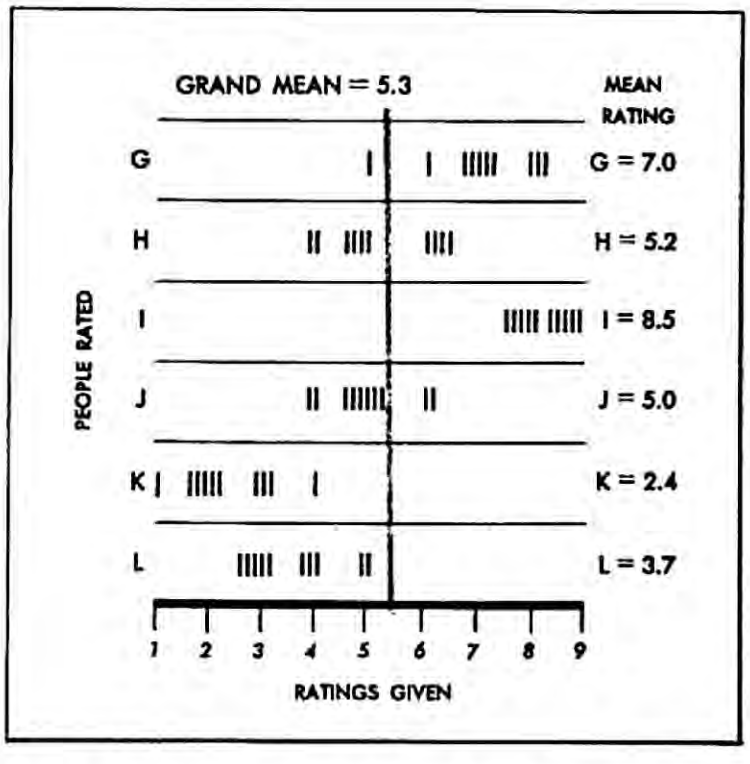


Figure 33. Leadership Ratings of Six Other Persons by Six Teams of Ten Trained Observers

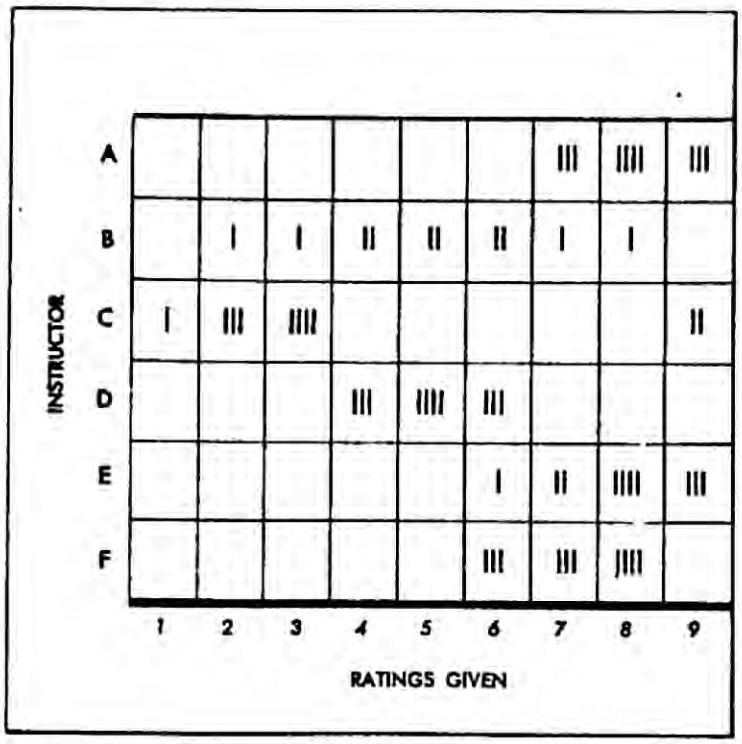


Figure 34. Ratings Assigned 60 Test Papers by Six Instructors

ently was affected by a halo error in the case of two papers.

A set of ratings made by one person can sometimes be revealing. An error of standards may be indicated if all his ratings tend to be high or low. If he has avoided using extreme ends of the scale he may be suspected of a central tendency. Parallel ratings of two traits may show a logical error. An error of halo would be reflected by having all of the traits being rated nearly the same for one individual; hence, the halo is difficult to identify unless general impressions have obviously been used to rate several individuals.

IMPROVING RATINGS

Ratings can be improved by using well-constructed scales, but greater improvement is possible through the training of raters. Satisfactory reliability can be achieved only when an observer has gained experience in rating and is familiar with all causes of unreliability. Observers should thoroughly understand the common rating errors, correct rating procedures, and the various rating techniques. The more an observer knows about causes of unreliability, the easier it is for him to avoid errors.

The following procedures help increase the reliability of ratings:

- Do not permit a long time lapse between the observation and the rating. Current observation is more accurate than memory.
- Whenever possible, use several observers and combine their ratings. Such a practice minimizes the common rating errors. The average opinion of a number of people is much more reliable than any single opinion. Whenever ratings are averaged, be sure that all observers are equally competent. Averaging the rating of an experienced observer with that of an inexperienced observer does not improve reliability, it merely spoils the one good rating.
- Make sure that all observers understand the use of each scale. Points on the scales should have a common meaning to all users.
- Make sure that all raters clearly understand the meaning of each quality, ability, or trait being rated. It is necessary to agree on more than words and definitions, since the same words sometimes call forth different mental pictures with different people.
- Do not allow the rating of one trait to influence that of other traits.
- Do not be influenced by friendships or animosities. Be completely impersonal. Rate only the specified traits.
- Use all steps in the rating scale, even the extremes, if they are deserved.
- Rate only specific, observable items of behavior.
- Make a rating only after allowing sufficient time to observe the person's performance.

CONSTRUCTING THE RATING DEVICE

The process for constructing a rating instrument involves certain general steps; these steps will naturally vary according to the type of scale being made. The following procedure has been established for building graphic scales, but it can also be used as a guide for other types of scales which teachers might construct.

Determine Objective and Purpose

The initial step is the same as that for constructing any other measuring instrument: determine the objective and carefully define it in terms of observable behavior. An objective may be to determine an officer's effectiveness in a particular assignment, to evaluate the level of achievement of a student in performing a particular task, or to predict the proficiency of a student in applying what he has learned. After the objective has

been clearly defined, determine how the rating is to be used. Determine not only what to evaluate (the objective), but also why the evaluation is to be made (the purpose).

Select Traits or Factors

This step requires careful consideration of the job which the man is now, or will be, doing. In the light of the objective and purpose of the rating, what traits or factors determine the success or failure of the person being rated?

Selected traits or factors must be critical, observable, distinguishable, specific, differentiating, and limited in number.

- Select only traits or factors that are critical or essential to the man's success in the performance of the job. If promptness is not a trait that must be considered to determine a degree of proficiency, do not include it. On the other hand, if it is essential it must be included to make the rating valid. The fact that you consider a trait highly important or desirable in a rating is no guarantee that it is essential.
- Select traits or factors that are observable by the rater. Ratings must be based on what the rater can see, rather than on his interpretation of the situation. Base the rating upon an eyewitness report, rather than upon circumstantial evidence.
- Select traits or factors that are distinguishable. If the traits are so closely related that a rating on one insures a similar rating on the other, logical error and loss of comprehensiveness will lower the validity of the rating.
- Select traits or factors that can be defined in terms which have the same meaning for all observers.
- Select traits or factors that are specific and definite, rather than vague or general in nature.
- After studying the traits that seem to meet the criteria, eliminate those which do not differentiate. If all people possess the trait to the same degree or level, it can serve no useful purpose in the rating scale.

The number of traits may vary from four to ten. Fewer than four rarely provide an adequate sampling—that is, there are nearly always at least four appropriate, critical factors in a human performance of any kind. More than ten traits usually tend to overlap. At any rate, the mind of the observer will be overburdened if he is expected to watch for too many factors. Accurate observations of a critical sampling are superior to sporadic observations of a bulky list of traits.

Define Traits

The traits or factors selected must be clearly and accurately defined in terms of OBSERVABLE BEHAVIOR which is pertinent to the situation. Definitions should show what the individual does rather than how well he does it. For example, voice (as used by a drill instructor) might be appropriately defined as "volume and clarity in giving commands." Such comments as "He uses his voice well," or "He is an able and effective communicator," are inadequate. The first gives no guidance as to what is to be considered under voice and the second is, in itself, an evaluation.

Determine Degrees of Success

The determination of the degrees of success or levels of performance should be made in the light of the purpose of the evaluation and the rater's ability to differentiate. If the purpose of the rating is to identify only three groups—poor, average, and good—there is no justification for using a five-point scale. If the nature of the evaluation is such that the rater can identify or distinguish between only two levels of performance, a scale of seven or more levels of attainment would be inappropriate. As a general rule, the number of levels of attainment should be suited to the purpose of the rating, and should be within the capability of the rater to evaluate.

Describe Degrees of Success

Each degree of success or level of performance in each trait or factor should be described in terms of observable behavior. These word pictures indicate how well the man performs. Quality of performance rather than frequency should be stressed.

Assign Weights

Determine how important each factor is and weight it accordingly. It is possible, but not likely, that all factors are of equal importance. For example, a rating system for two duty assignments, one administrative and the other technical, might look like this:

		Administrative	*Technical*
I	Job knowledge	15	10
II	Cooperation	20	10
III	Judgment	20	20
IV	Personal responsibility	20	10
V	Leadership	15	10
VI	Growth potential	5	35

The weight given each factor can be determined by pooling the opinions of several observers thoroughly familiar with the situation. These weights should be examined after the scale has been used. Then it will be possible to determine if the ratings actually differentiate between those who are effective on the job and those who are ineffective.

Validate

Validation is simply a method or procedure used to examine, review, and improve the rating instrument itself. In the validation of a rating scale, the following considerations are important.

- The study should be based on a significant number of cases, normally 50 to 100. With small groups, it may be necessary to use the scale several times before attempting to validate it.
- The instructor should compare the ratings of one individual made by several raters, as well as the ratings of several individuals made by a number of raters, in order to determine the reaction of the raters to the rating scale.
- Variations in ratings should be noted and the cause determined. The most common causes of variations are poor definition of traits, inadequate description of levels of performance, and improper weighting.

Validation of the rating scale is a continuous process. If the instructor does not analyze, critique, and improve the rating instrument, it will not serve its intended purpose. The following checklist should prove useful for this purpose.

CHECKLIST FOR THE RATING INSTRUMENT

Write the word *Yes* or *No* in the space that follows each item.

A. Construction

1. Are the objectives and purposes clearly defined? _____
2. Are the traits or factors selected essential in the performance of the job? _____
3. Are there enough traits to describe the performance without overburdening the rater? _____
4. Is each trait defined in terms of observable behavior? _____
5. Is the number of performance levels related to the objective and purpose and within the discriminative ability of the rater? _____
6. Is each level of performance described in terms of observable behavior? _____
7. Have the initial weights for each trait or factor been carefully determined by pooling the judgments of several persons familiar with the job? _____

B. Using the Rating Scale

1. Are ratings made as soon as possible after observation? _____
2. Is the final rating based on the rating of several observers? _____
3. Are the observers rating only those traits which they have had the opportunity to observe? _____
4. Are all steps of the rating scale — superior to unsatisfactory — used, if they are appropriate? _____
5. Is the rating scale thoroughly understood by the raters? _____
6. Are the ratings on one ability free of the influence of other abilities, or of a general impression? _____
7. Are the ratings free of the influence of acquaintanceship or friendship? _____
8. Have the raters been carefully trained by discussing the distribution of abilities; by analyzing scale design; and by cautioning against halo error, error of central tendency, error of standards, and logical error? _____

C. Studying the Scale

1. Has a definite program been set up for checking the success of the scale? _____
2. Has at least one person begun reliability studies? _____
3. Have plans been made for a careful, systematic study of performance on the job? _____
4. Has a study been set up to determine the true weights of the items? _____
5. Has a study been set up to determine whether all traits or factors of the scale effectively differentiate between successful and unsuccessful performance on the job? _____

SUMMARY

Since rating is, by definition, a subjective process, it is subject to the following types of errors: semantic, logical, central tendency, standards, and halo. Despite these inherent errors, the rating process is the most effective method available for the evaluation of a man's overall ability or the quality of his performance. As with tests and measurements, ratings may be either relative or absolute. Because of common rating errors, a rating may indicate the ability of the observer to rate rather than a difference between the people rated. In view of that possibility, frequent analyses of rating results are necessary. Instructors can further improve ratings by reducing or eliminating errors through careful consideration of the various steps in the construction of the rating scale and, most important of all, by thorough and continuous training of the raters.

CHAPTER 25

Constructing and Administering Examinations

This chapter presents basic information on how to evaluate student achievement with written examinations or tests. But neither teaching nor systematic evaluation should be started until the goals of teaching have been clearly defined. To give direction to his efforts, an instructor must have a clear understanding of his testing or evaluation goals.

TESTING GOALS

Why give a test to students? Three general categories of subject-matter testing are normally associated with teacher-student relations: pre-course, in-progress, and end-of-course examinations. Each can be designed to meet goals peculiar to its general category of testing.

Pre-Course Examination

A comprehensive examination may be given at the beginning of a course to determine the background knowledge of the class and the extent to which its members have already achieved the objectives of the course. Instruction during the course can then be altered to fit the level and range of the group, so as to achieve the required standards in the best manner possible. The pre-course examination can also be used to serve as an overview for the course as a whole.

An examination given at the beginning of a course can be constructed to identify individuals in the class who need special instruction. The special instruction may be remedial or corrective, or it may be advanced instruction to fit the needs or talents of certain individuals.

In-Progress Examination

Short daily or weekly examinations during a course are universally recommended by educators. For effective appraisal, it is desirable to have many samples of student achievement and growth. Frequent examinations provide the student with evidence of his own progress and also inform the instructor of the progress of the class and of individuals.

Periodic examinations and a final examination that samples all course areas and objectives, in combination with discussions and interviews, should give an adequate and dependable picture of student achievement. Students are often tense and nervous when they are not familiar with test programs. Experience has shown that students build self-confidence with frequent exposure to tests.

In-progress examinations should be designed to serve as diagnostic tools for both the instructor and the student. Through the use of thorough examinations, a clear picture of weaknesses and strengths develops. Both the student and the instructor then know how to direct their efforts more intelligently during other phases of the course. Competent analyses of in-progress examinations also enable the instructor to improve his instruction and his examinations for future classes.

Many instructors overlook the possibilities that can be realized by requiring students to analyze their own examinations during the course. Through such an analysis, students can discover for themselves the nature of their strengths and weaknesses. They may record their errors and indicate test or workbook material which requires further study. When in-progress examinations are used in this way, they become effective teaching devices in themselves.

End-of-Course Examination

Final examinations are frequently administered to determine the standing of students at the end of a course. Grades from these examinations should, therefore, reflect the status of each student in relation to other students and also to established absolute standards of achievement.

Although final examinations can be used to determine final standing, that should not be their sole purpose. Like in-progress examinations, end-of-course examinations should be designed to yield useful information about the instruction, as well as about final standings of students. Care and sound analyses of end-of-course examinations can indicate: (1) the degree to which the overall objectives of the instruction have been achieved; (2) the degree to which the examinations predict later job success; (3) trends in teaching effectiveness; and (4) needs for revisions in teaching techniques. The achievement of these four results would make testing worthwhile.

Whatever the purpose of an examination, certain basic steps in constructing and administering it must be followed to insure valid results.

ATTRIBUTES TO BE MEASURED

When examinations are being constructed, the specific changes in behavior that should result from learning are the most important consideration. Testing a student's memory of the nomenclature of electronic equipment (ability to list, recite, or identify) does not assess his ability to use that equipment or to solve its maintenance problems. Tests should measure the achievement of specific objectives at an appropriate learning level.

The objectives may contain any of the levels of learning described in Chapter 15 (or their equivalent in terminal behavior terms), but only three lend themselves to practical testing in the classroom. Whether objectives are stated in terms of levels of learning or in terms of terminal behavior, the evaluation requirements are the same. Only observable behavior can be measured or judged.

Knowledge

As a result of learning at the knowledge level, students should remember definitions, names of work tools, basic technical data, symbols, statements of rules, principles, or laws. It makes little difference to the evaluator whether lesson objectives are stated in terms of levels of learning or in terms of student skills gained from the learning process. In either case, proper testing measures the student's ability to *recall, recite, list,* or *identify* the essential elements of the subject-matter. Whether the student is asked to recall these elements from memory or merely to pick them out from related material should be predetermined in terms of the course as a whole.

Understanding

Learning to understand results in comprehension of how and why something operates or is true. The understanding level of learning includes such behavioral abilities as comparing, differentiating, contrasting, generalizing, explaining, and perhaps arriving at recommended solutions to problems. The student must be required to demonstrate one or more such abilities if he is to be evaluated properly at the understanding level of learning.

Ability to Apply Principles or Laws

Tests designed to measure learning achievement at this level are normally based upon situations which present the subject in a new context. The situations should be made in terms of the job for which the educational program is preparing the student. To determine achievement to this level of learning, the student must be asked to demonstrate his ability to solve complex problems, interpret the situations, or determine related causes and effects.

Ability to Perform Tasks

In certain courses, the major learning level is the ability of students to perform certain tasks and the best test requires the students to perform those tasks. Courses of this type are usually specific and often highly technical. In terms of evaluation requirements, the students must be asked to demonstrate their abilities to *perform an integrated sequence of related actions,* to *construct,* to *adjust,* to *repair,* or to *solve* something. For the evaluation to be most meaningful, the manner in which a successful student should perform must be clearly described; i.e., criteria should be stated for such factors as the time allowable, the tools to be provided, and the quality expected for an acceptable end-product.

DESIGNING THE TEST

In planning a test, the course, lesson, and testing objectives must be clearly identified. Usually subject-matter areas are subdivided into smaller segments, such as individual lessons. Lessons, in turn, have specific objectives which are subdivided into learning outcomes. Each objective and learning outcome specifies its own particular level of learning. Until the specific learning level is identified, the test is not likely to achieve a satisfactory degree of validity.

A course may be composed of several related subjects which, in combination, reflect the overall course objectives. To be valid, a test to measure achievement in one subject-matter area must exclude test items covering other subject-matter areas. Conversely, to be valid, a test to measure achievement of overall objectives must include a proportionate number of test items from each subject-matter area. The purpose of the test should be clear before the form of the items is decided.

Planning for Validity

A test-item worksheet (Fig. 35) is a useful device for planning the examination. The left column of the worksheet is used to list subject-matter areas. The other columns indicate all of the measurable learning levels. In cases where lesson objectives are expressed in terms of terminal behavior, these columns would indicate all the specific types of behavior which the student should be able to demonstrate; e.g., identify, recite, list, contrast, differentiate, explain, generalize, solve, adjust, construct, repair.

Subject-matter to be sampled	Level of Achievement		
	Knowledge	Understanding	Application
T-F test item uses	✓ item 1		
" " " advantages		✓ item 3	
" " " construction		✓ item 5	
MC test item uses	✓ item 2	✓ item 6	✓ item 7
" " " advantages		✓ item 4	
etc.			

Figure 35. Portion of a Test-Item Worksheet

Before writing or selecting items for the test, the instructor should devise a test-item worksheet based on the course or lesson objectives. First, he should list in the subject-matter column all of the essential material with which a successful student should be able to work. Opposite each entry he should make a check mark under the learning level that the fully successful student should achieve. In some cases, because of the complexity or importance of specific skills or tasks, more than one check mark may be made for a subject-matter area. Multiple entries may be at several levels of learning, depending on the objectives of the examination.

Using the completed worksheet as a guide, test items should now be prepared to match the requirements indicated by each check mark. If used properly, the worksheet helps the instructor: (1) to achieve a high degree of comprehensiveness; (2) to weigh each of the objectives according to its importance (thereby making the test a more representative sample); (3) to improve the validity of the evaluation (by measuring student achievement of the more critical objectives of instruction); (4) to meaningfully diagnose teaching effectiveness; and (5) to analyze individual student achievement effectively.

As the instructor selects a test item to meet the requirements of the worksheet, he inserts its number on the worksheet alongside the appropriate check mark. Thus, the worksheet also serves as a semipermanent record of the contents of the completed test.

To write or select test items properly, an understanding of the various kinds of items is necessary. Some items in every test should be so difficult that only the best student can answer them; some should be easy enough for everyone but the poorest student. The number of difficult items depends on the information desired. If it is only necessary to distinguish the satisfactory students from the unsatisfactory, the items should sample only the minimum essentials. On such tests, most students will get high scores. If it is necessary to determine the differences

among the better students, items should be used ranging from average to very difficult, with an appropriate number at each level. If it is necessary to rank all students, the examination should contain an approximately equal number of items at each level of difficulty, ranging from very easy to very difficult.

Forms of Test Items

Items for written tests take a variety of forms. No one form is best for all situations. Before choosing a particular form, the instructor should consider the advantages and disadvantages of each in relation to the purpose of the evaluation.

Test items can usually be divided into two large categories. The first category includes those items for which two or more alternatives are provided and the student is required to select a response from the alternatives. The familiar multiple-choice item illustrates this category. Because items of this kind require the student to select his response, they are referred to as selection items.

The second category includes those items which require the student to furnish his own response. The familiar essay item illustrates this category. Items which require the student to supply his own response are known as supply items.

SELECTION TEST ITEMS

When a student responds to the three basic forms of selection items—true-false, multiple-choice, and matching—he selects his response from two or more alternatives provided him.

Advantages

Selection test items have three major advantages. First, personal opinions, generalized impressions, and idiosyncracies of the scorer are removed from the scoring process. The student responses represent the only variables. The high degree of objectivity thus possible in scoring selection item tests can result in a relatively high degree of reliability in the test scores.

When selection items are used, tests can be scored by clerical assistants or by machines. Because such tests are unaffected by scorer bias, they have come to be known, somewhat erroneously, as objective tests.

The second major advantage of selection items is that they can test five to twenty times as many aspects of a course of study in a given time as items which require written essay responses. Since it is not usually possible to test more than a sample of a student's knowledge, understanding, or ability in any one course of study, selection items help to make the sample more comprehensive. Increases in comprehensiveness may be expected to improve the validity of the test and to provide greater opportunity for differentiating among students.

The third advantage of selection items is that they are especially well adapted to statistical item analysis. If the tabulations and computations are planned, the work can be handled by clerical assistants and made available for examination critiques with the students in a matter of hours.

True-False

This item-type, with all its variations, has a wide range of usage. It is well adapted to test knowledge of facts and details, especially when there are only two possible answers. It may also be used to determine the persistence of popular misconceptions or superstitions, where the suggestion of a correct response in a multiple-choice item would be too obvious. The chief disadvantage of this item is that the probability of guessing, in the simple types, is greater than in any other type of item. Some samples of different forms of this type follow.

Declarative statement

T F Forest fires cause a loss of ground water.

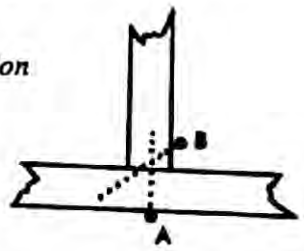
Cluster

The volume of a mass of gas

T F tends to increase as the temperature increases.
T F tends to increase as the pressure increases.
T F will be held constant by increasing pressure and decreasing temperature.
T F will be reduced to zero by increasing the pressure and decreasing the temperature.

Statement with illustration

T F Nail "A" will make a stronger joint than nail "B."



Double true-false

Directions: Indicate your answer in the space provided to the left of each statement, as

a. if the statement is true and the reason is correct for the statement.
b. if the statement is false and the reason is incorrect.

c. if the statement is true and the reason is incorrect.
d. if the statement is false and the reason is correct.

_____Statement: Aluminum is used in transportation.
Reason: Aluminum is light and strong.

_____Statement: Most items made of metal rust.
Reason: Many metals rust.

Other items of this general type—all designed to reduce guessing to a minimum—have also been devised. These include adding to the basic true-false choice the choices of "sometimes true-sometimes false"; "neither true nor false"; or, "the converse is true—the converse is false" and similar variations. In addition, this item can be made more difficult and discriminating by requiring the student to suggest what will make false statements true.

True-false items have probably been used and misused to a greater extent than any other selection item. Too often, instructors merely scan textual material, select sentences more or less at random, and make about half of them false by inserting negatives. They mistakenly believe they can justify their answers by merely referring students to pages in the text. When tests are constructed in this way, the principal attribute being measured is photographic memory. Such test construction has aroused antagonism toward selection tests in general and true-false items in particular. It has also decreased the validity of educational evaluations.

Some of the principles which should be followed in the construction of true-false items are listed below:

- Include only one idea in each statement.
- Do not make part of the statement true and another part false unless you are using the double true-false variation of this item.
- Avoid the unnecessary use of negatives. They tend to confuse the reader.
- Avoid involved statements. Keep wording and sentence structure as simple as possible. Make statements both definite and clear.
- Whenever possible, use terms which mean the same thing to all students. Use specific comparisons when quantitative description is not possible.
- As a rule, avoid absolutes such as "all," "every," "only," "no," and "never." Since unequivocally true or false statements are rare, statements containing absolutes are usually false. Similarly, avoid statements containing "some," "any," and "generally," which are most frequently true.
- Avoid patterns in the sequence of correct responses, because students can often identify the patterns. Instructors sometimes deliberately use patterns to make hand scoring easier. This is a poor practice.
- Make statements brief and about the same length. Some instructors unconsciously make true statements longer than false ones. Students are quick to take advantage of this tendency.

Multiple-Choice

This type of item may be used to determine student achievement, ranging from acquisition of facts to understanding, reasoning, and ability to apply what has been learned. It is appropriate to use when the problem: (1) has a built-in and unique solution, e.g., specific application of laws or principles; (2) may be clearly limited by the wording of the item so that the student must choose the *best* of several offered solutions rather than a universal solution; (3) is such that several options are plausible, or even scientifically accurate, but the student may be asked to identify the one *most pertinent;* (4) has several pertinent solutions and the student may be asked to identify the *most appropriate* solution. Some samples of different forms of this item follow.

STEM PRESENTED AS A QUESTION. This form is generally better than the incomplete stem in that it is simpler and more natural.

For what purpose is a plow used?
a. Dig the soil.
b. Break the soil.
c. Sow the seed.
d. Cultivate the seed.

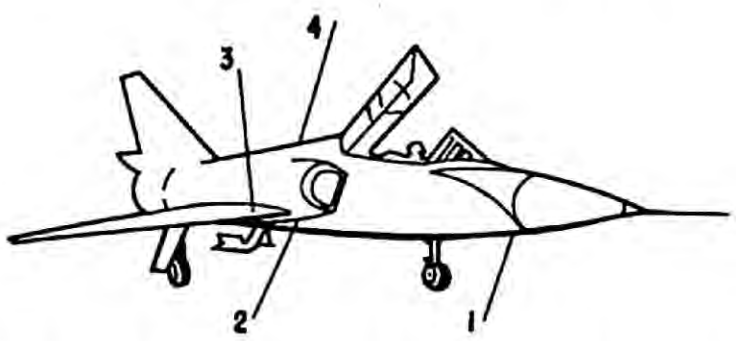
STEM AS AN INCOMPLETE STATEMENT. When using this form, care must be exercised to avoid ambiguity, giving clues, and unnecessarily complex or unrelated alternatives.

Tin is used
a. as a coating on iron.
b. to make tin cans.
c. on tin roofing.
d. to make tinfoil.

MULTIPLE RESPONSE REQUIRED. Students are instructed to mark all the correct answers.

Why are summers hot?
a. We are near the sun.
b. Days are longer than nights.
c. Sun shines about straight down on us.
d. Earth's axis slants more in the summer.

STEM SUPPLEMENTED BY AN ILLUSTRATION. Useful for measuring ability to read instruments, identify objects, use principles in hypothetical application to appropriate instruments, etc.



To refuel an F–106, where is the fuel nozzle inserted?
a. 1.
b. 2.
c. 3.
d. 4.

"NONE OF THE ABOVE" OR "ALL OF THE ABOVE" AS ALTERNATIVES. No sample is given for this form. May be used when the correct alternative seems to give itself away in a set of ordinary alternatives. To be effective, these alternatives must sometimes be the correct response.

THE NEGATIVE VARIETY. Always emphasize the negative word.

Which is NOT a kind of iron?
a. Scrap.
b. Wrought.
c. Cast.
d. Steel.

ASSOCIATION TYPE. Useful if a limited number of associations are to be made. Matching items serve better if a large number of related associations are to be made.

Which of the following does NOT belong with the other three?
a. Copper.
b. Brass.
c. Iron.
d. Nickel.

DEFINITION TYPE. Two varieties are shown. The form illustrated by the second item is normally more difficult to respond to, as well as to prepare.

The process by which water is lost from the cells of a plant by evaporation into the intercellular spaces, and the escape of the vapor through the stomata is known as
a. respiration.
b. osmosis.
c. imbibition.
d. transpiration.

or

Transpiration is
a. the process by which two miscible liquids or gases or solids in solution become equally mixed.
b. the process by which water is soaked up by a plant.
c. the collapse and construction of the protoplasm of a cell, due to the passing of the water out of the cell.
d. the process by which water is lost from the cells of a plant by evaporation into the intercellular spaces, and the escape of the vapor through the stomata.

In general, the form with the alternatives as answers to a question is preferable to the form which uses an incomplete statement as the stem. It is more easily phrased and is more natural for the student to read. Less likely to contain ambiguities, it usually results in more homogeneity among the alternatives and gives fewer clues to the correct response.

When multiple-choice items are used, four or five alternatives are generally provided. It is usually difficult to construct more than five plausible responses (responses which appear to be correct to one who has not mastered the subject matter). If there are less than four alternatives, the probability of guessing the correct response is considerably increased.

Students are not supposed to guess the correct alternative; they should select it only if they know it is correct. It is, therefore, ethical to mislead the unsuccessful student into selecting an incorrect alternative. An effective and valid means of diverting him from the correct response is to use errors commonly made by students as distracting alternatives.

Items intended to measure the knowledge level of learning should have but one correct alternative; all other alternatives should be clearly incorrect. When items are to measure achievement at a higher level of learning, some or all of the alternatives should be acceptable responses—but one should be clearly better than the others. In either case, the instructions given the student should direct him to select the best alternative.

Some of the principles which should be followed in the construction of multiple-choice items are listed below:

- Put everything that pertains to all alternatives in the stem of the item. This helps to avoid repetitious alternatives and saves time.
- Word the stem in such a way that it does not give away the correct response. Especially avoid

the use of synonyms for the correct response in the stem.

- Keep all alternatives of approximately equal length. Research on teacher-made tests reveals that, in general, correct alternatives are longer than incorrect ones.
- Design items which call for knowledge essential to the job rather than abstract background knowledge or unimportant facts.
- State each item in the working language of the student and the job. Failure to do so can result in decreased validity of the test, since the ability to work with the language will be measured as well as subject-matter knowledge or achievement.
- Generally avoid using "a" or "an" at the end of the stem. They may give away the correct choice. Every alternative should fit grammatically with the stem of the item.
- Make each item independent of every other item in the test. Do not permit any item to reveal the correct answer to another item or permit the solution to any item to depend upon knowing the correct solution to another item. If items are allowed to be interdependent it becomes impossible to pinpoint specific deficiencies in either students or instruction.
- Include sketches, diagrams, or pictures when they can present a situation more vividly than words. They generally speed the testing process, add interest, and help to avoid reading difficulties and technical language. A common criticism of written tests is the emphasis on the reading ability of the student. The validity of the examination is decreased when this ability is not an objective of the course or test.
- When a negative is used, emphasize the negative word or phrase. The student who is pressed for time may identify a wrong response simply because, in his haste, he has overlooked a negative form. To whatever extent this occurs, the validity of the examination is decreased.
- When alternatives are numbers, they should generally be listed in ascending or descending order of magnitude.
- All the alternatives should be plausible to the student who has not achieved the required level of learning of the subject-matter being tested.
- Catch questions, unimportant details, ambiguities, and leading questions should be avoided, for they do not contribute to effective evaluation in any way. Instead, they tend to confuse and to antagonize the student. If the objectives of instruction and the purpose of evaluation are kept clearly in mind, they will not be used.

Matching

This type of item, with its several variations, has many of the advantages of the multiple-choice item and is particularly good for measuring the achievement of a number of closely related concepts or facts. The matching item is, in reality, a collection of related multiple-choice items. Matching is useful for testing ability (1) to classify materials into categories (knowledge level of learning), (2) to arrange materials in a certain sequence (either knowledge or understanding level of learning, depending on construction), or (3) to make refined interpretations of subject-matter (understanding or application level of learning). Matching reduces the probability of guessing correct responses—as compared to a series of multiple-choice items covering the same material—especially if alternatives may be used more than once. The testing time can also be used more efficiently. Samples of different forms of this item follow.

EQUAL COLUMNS. When using this form, always provide for some items in the response column to be used more than once, or not at all, to preclude guessing by elimination.

Directions: In the blank before each word in the left-hand column, write the letter corresponding to the name of the author of the work. Each name may be used more than once; some names may not be used at all.

____1.	Huckleberry Finn.	a. Samuel Clemens.
____2.	The Deerslayer.	b. James F. Cooper.
____3.	The Legend of Sleepy Hollow.	c. Joel Harris.
____4.	The Murder in the Rue Morgue.	d. Bret Harte.
____5.	Innocents Abroad.	e. Washington Irving.
____6.	The Outcasts of Poker Flat.	f. Edgar Allen Poe.
____7.	The Raven.	g. Sidney Porter.

UNEQUAL COLUMNS. Generally preferable to equal columns.

Directions: Write, in the parenthesis before each statement, the number of the location to which the statement applies. Each location may be used once, more than once, or not at all.

( ) 1.	The eastern end of this island is located directly south from the easternmost part of the United States.	1. Bermuda 2. Cuba 3. Haiti 4. Jamaica 5. Nicarauga

( ) 2. Would be crossed in a direct flight from Key West to the Panama Canal.
( ) 3. Etc. to a maximum of nine statements.

INFERENCE MATCHING. The item illustrated would probably measure learning to the understanding level.

Directions: Which of the following characteristics of a good test are implied or referred to in the statements below? Fill in the space on your answer sheet corresponding to the letter of the term which you believe is implied or referred to by the speaker. Each of the characteristics may be used once, more than once, or not at all.

a. Differentiation.
b. Validity.
c. Objectivity.
d. Comprehensiveness.
1. "Well, I've finally finished making this test and it contains items at all levels of difficulty."
2. "After grading this test, the students still don't really know the subject matter."
3. "Thirty test items cover this entire unit?"
4. "I wonder if this test will really tell me what the students know about the subject-matter?"
5. "Be sure you follow the key because it is the only fair judge to all students."
6. Etc.

CAUSE AND EFFECT MATCHING. Good for measuring learning to the understanding level.

Directions: Listed below are certain facts followed by several statements. Fill in the space *on your answer sheet* corresponding to the letter (a, b, or c) which represents the best statement of the relationship between each statement and the fact which precedes it.

a. The statement is the cause of the fact.
b. The statement indicates a result of the fact.
c. The statement is not related to the fact.

Fact: A flash of light occurs.
Statements:
1. A roar of thunder can be heard.
2. Electricity passed between clouds and the earth.

Fact: Metals, generally speaking, expand when heated.
Statements:
3. Etc.

CODED ALTERNATIVES FOR SCIENTIFIC REASONING. This type of matching item can be expected to differentiate well between better students. Items of this type normally measure achievement at least to the understanding level.

Directions: Below are some hypotheses and methods of testing them. *On your answer sheet*, fill in the space corresponding to

a. if the item directly helps to prove the hypothesis true.
b. if the item indirectly helps to prove the hypothesis true.
c. if the item directly helps to prove the hypothesis false.
d. if the item indirectly helps to prove the hypothesis false.
e. if the item is unrelated to proof or disproof of the hypothesis.

Hypothesis: Thunder causes rain.
1. Observations show that, during a rain storm, it always begins to rain immediately after a clap of thunder.
2. Etc.

Hypothesis: High temperatures for a few day cause rain.
3. Heated water in a pan evaporates.
4. Etc.

CODED ALTERNATIVES FOR INTERPRETATION. Good for high differentiation between more successful students. Useful for measurement at the application level in some subject-matter areas.

Directions: An experiment is described below. Assume that the facts which are given and the results are correct. Following the description are several statements suggested as interpretations of the experiment. Use the following code letters to indicate your judgment of the suggested interpretation—place the appropriate letter to the left of each item in the space provided.

a. Reasonable interpretation of the results obtained.
b. Might possibly be true but insufficient facts are given.
c. Cannot be true — contradicted by results.

The Experiment: Some white starch was treated with brown iodine. This was done 10 times and each time a blue color formed. Later some white starch was mixed with saliva. The mixture was left for a time and then treated with the same brown iodine solution. This was done 10 times and each time *no* blue color was formed. (The first item is answered as an example)

a X. The starch was changed to sugar by the action of the saliva.
____1. Saliva digested the starch.
____2. Saliva acted upon the iodine.
____3. Saliva produced a change in the starch.
____4. Starch mixed with iodine solution did not turn blue.
____5. Etc.

As previously stated, the matching item may be considered as a combination of related multiple-choice items. In a given period of time, more samples of a student's abilities can be measured by using the matching item than by using equivalent multiple-choice items. Thus, when appropriate subject matter is being tested, the matching item is often more efficient than the multiple-choice item.

Some of the principles which should be followed in the construction of matching items are listed below.

- Give specific and complete instructions. Do not make the student guess what is required of him.
- Test only essential information; never test unimportant detail.

• Use closely related materials throughout an item. If students can divide the alternatives into distinct groups, the item is reduced to several multiple-choice items with few alternatives and the possibility of guessing is distinctly increased.

• Make all alternatives plausible responses to each element in the first column, wherever possible, to minimize guessing by elimination.

• Use the working language of the job or the student, wherever possible. By reducing language barriers, both the validity and reliability of the test will be improved.

• Arrange the alternatives in some sensible order. An alphabetical arrangement is common.

• If alternatives are not to be used more than once, provide three or four extra ones to reduce guessing.

SUPPLY TEST ITEMS

A supply item requires the student to furnish the response himself; he is not given alternative responses from which to choose. The basic forms of supply items are completion, short-answer, and essay items.

Many instructors have the mistaken idea that supply items are easy to construct. Any test item, regardless of its form, takes much care, thought, and competence to construct if it is to be a useful evaluation instrument.

When recall of information, ability to express ideas, or original thinking are to be measured, supply items have a distinct advantage over selection items. The ability to solve problems and to think creatively are seldom worthwhile end products in themselves; it is usually necessary to communicate the solutions or ideas to others, frequently in writing. When development of the ability to write clearly is a legitimate objective of a course, supply items may be used effectively. Test items which call for a written discussion, such as the essay form, also give the student an opportunity to express himself—something students often like to do. More importantly, however, it is known that studying for supply-item tests causes students to retain more of the subject-matter for a longer time.

Problems arise, however, in attempting to evaluate the responses to supply items. It is difficult to construct a supply item for which comparable scores will be given by several equally competent instructors. This difficulty in attaining objectivity in scoring often leads to reduced test reliability.

It is not usually possible to leave the scoring to clerical assistants when supply items are used. Competence in the area tested is usually required. As a rule, the instructor himself must score student responses. Considerably more time is required to score such a test than is required to score a selection item test.

Another disadvantage arises from the fact that students think and read more rapidly than they write. Consequently, less material can be covered by tests made up of supply items than by those made up of selection items, assuming that the same amount of testing time is allowed for each. Because answering supply items takes more time, a test made up of such items is often less comprehensive.

Completion

This form of supply item is well adapted for testing student ability to make verbal associations of the *who, what, when, where,* and *why* types. However, because of the difficulty in constructing items for which there is but one correct response, the scoring of completion items is normally less objective then for selection items. Even when a single response has been determined to be the correct one, responses not anticipated frequently deserve part or whole credit. For this reason, as is suggested later in this chapter, the instructor should make a complete scoring key (for any supply item) at the same time that he prepares the basic item.

Samples of different forms of this type item follow.

INCOMPLETE STATEMENT FORM. This type is more difficult for the student than the direct-question form of short-answer item. The instructor must constantly be on guard to avoid ambiguous incomplete statements, such as "Columbus was born in _____," which could be answered with a city, year, country, etc.

The cotton gin was invented by_____.

or

Columbus was born in the year of_____.

or

A pilot can determine compass heading by correcting for variation and _____.

SENTENCE OR PARAGRAPH COMPLETION. Omit only *key* words or phrases. Avoid copying from textbooks.

The (1)_____ of a sound varies (2)_____ as the square of the distance from the source. 1._____ 2._____

or

In 1795, Napoleon was given command of a small army in (1)_____. 1._____
The wonderful genius of the young leader made the (2)_____ campaign the decisive factor. By rapid movements he separated (3)_____ and (4) _____ forces. In eleven days he forced (5)_____ to conclude peace. 2._____ 3._____ 4._____ 5._____

Completion items require that the student recall one or more words omitted from a statement. When the correct word or words are supplied in the proper blank, the statement is complete and true. The advantages of the completion item include the following: (1) it requires the student to recall at least a part of the idea expressed in the statement; (2) the possibility of guessing is largely eliminated; and (3) it is time-saving when compared with essay items.

Some of the principles which should be followed in constructing completion items are listed below.

- Generally speaking, use only one blank in each sentence. Multiple blanks in a sentence can quickly lead to ambiguity and, therefore, to decreased validity and reliability.
- The statement should usually be worded so that the blank appears at or near the end. When this is done, the student normally has all the required information before he reaches the blank and can fill it in without having to regress. Thus, greater clarity is achieved and time is saved.
- There should be only one correct or best response for each blank. In the interest of scoring objectivity and test reliability, both the student and the instructor should have a clear understanding of the criteria for acceptable responses.
- As in selection items, statements should be worded differently than they are in texts or lectures. Failure to do so will preclude testing at any level of learning higher than the knowledge level, regardless of item form or subject matter.
- Blanks should all be of the same length. A clue is given when blanks are adjusted to the length of the response anticipated. Directions for a test containing completion items should tell the student (1) that length of blanks is uniform and, therefore, not related to length or nature of required response, and (2) whether one blank always calls for one word or if short phrases may sometimes be required.
- For convenience and accuracy in scoring, a separate series of blanks should be provided in a vertical column on the test page. Students should then be told in test directions that their responses should be recorded in this column rather than in blanks within the item itself.

Short-Answer

This form of supply category test item is generally considered to be an intermediate form between the completion and essay varieties. Short-answer items may be used to test ability to recall facts, basic concepts, and principles.

The advantages and disadvantages of the short-answer item are essentially the same as those for the completion items. However, the short-answer item often tests more fully, since the idea recalled must be put in a more complete form. Some samples of different forms of this item follow.

DIRECT-QUESTION TYPE. This is usually easier for the average student than a completion item, since it helps eliminate ambiguous elements.

What are the two main gases found in the air? _____and _____

or

Who was the first president of the U.S.A.? _____

IDENTIFICATION OR ASSOCIATION SERIES. Adaptable to informal classroom testing.

After each city, write the name of the state in which it is located.

Detroit _____ New Orleans _____
Chicago _____ San Antonio _____
Seattle _____ Los Angeles _____

SHORT EXPLANATION VARIETY. Useful in obtaining maximum comprehensiveness with a minimum of guessing.

Explain, in one sentence or phrase, the most significant connection each of the following people had with Abraham Lincoln:

Stephen A. Douglas _____
Chester A. Arthur _____
Ulysses S. Grant _____
Etc.

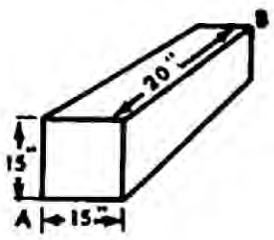
LIST VARIETY. Especially useful for informal classroom testing.

List at least four significant reasons why safety practices are important.

a. _____
b. _____
c. _____
d. _____
e. _____

PICTORIAL VARIETY. The use of pictures or diagrams often add clarity, speed the testing process, and make testing more interesting and valid.

Directions: Study the drawing at the right and write your answer to each question in the appropriate blank.



____1. What is the horizontal distance from point A to point B?

____2. What is the volume of the polyhedron?

____3. Etc.

As might be concluded from the preceding examples, the specific form of the test item is limited only by the imagination of the instructor and by the learning objectives with which he works. Some principles to be followed in the construction of short-answer test items are listed below.

- Be specific. Let the student know exactly what you expect. If this is not done, the test results are likely to be both unreliable and invalid.
- Each required short answer should involve but one idea, concept, or fact. If more is involved, meaningful interpretation of responses becomes difficult or even impossible.
- Let the student know how completely he should respond. This can usually be accomplished by the wording of the item. Sometimes it is effective to provide a limited amount of space in which the student may respond. The amount of space should not be a clue to the correct response; it should serve only as a guide to the desired length of response.

Essay

Any attempt to differentiate sharply between short-answer and essay items would be a compromise at best. Fortunately, such a distinction is not necessary. The essay item may be described as one which calls for a more or less extensive discussion by the student. The difference between the two forms is perhaps more noticeable in the length of responses than in the wording of the items themselves.

The essay is probably the weakest form of supply item for measuring simple recall (knowledge level of learning). It should be used only when students are expected to think reflectively or creatively, to organize knowledge in the solution of a problem, and to express their solution in writing. On the other hand, the essay item is the best of all item types for causing students to learn better as a result of studying for tests.

The essay item can be used to advantage in gathering material for new selection items. For example, an instructor might use an essay item to test knowledge of the principles of jet propulsion. From the answers obtained, he could design several good alternatives to use in a multiple-choice item. Short daily quizzes can thus help in accumulating items for a final examination composed of selection items.

The major disadvantage of essay items is found in the scoring. For this reason, as suggested later in this chapter, a complete scoring key should be made for each essay item when it is first prepared.

Types of Responses

Essay items may be designed and classified in various ways. One classification is made according to the type of response the student is expected to make. An example of each of the six major kinds of essay items, according to this classification, follows.

Comparison

Compare the range of operation of jet aircraft and propeller-driven aircraft with regard to fuel.

Decision

Which of two methods or organization is better in the following situation? (The instructor describes a specific situation.) Why?

Causes, Effects, or Relationships

Why do cirrus rather than cumulus clouds form under the following atmospheric conditions? (The instructor describes a set of atmospheric conditions.)

Explanation

Explain the principles of airfoil lift.

Summary

In about fifty words, summarize the functions of management.

Illustration

Illustrate the peculiarities of high-speed aerodynamics.

One of the difficulties in constructing essay items is that the process appears too easy. As a matter of fact, essay items and selection items of high quality are probably equally difficult to construct.

Constructing Essay Items

Before an essay item is written, two things must be known: (1) the background and training of the students, and (2) the objectives to be

measured. Clear instructions must be given about the kind and length of response desired. Essay items should be phrased to require a specific mental process. They should be balanced in difficulty, if they are of equal importance. No choice of items should be offered since relative achievement of students could not be accurately judged from the results obtained. Some additional principles which should be followed in constructing essay items are listed below.

- Use the essay form of supply item only for functions for which it is best adapted; i.e., to measure achievement of subject matter to the understanding or application levels of learning.
- State essay items clearly so that students will know exactly what type of discussion is required. It is a mistake to make essay items vague in an effort to test the student's ingenuity. If the items are skillfully devised, they will give the students ample opportunity to show ingenuity and creativeness. Well-constructed essay test items should mean essentially the same thing to all students who have achieved the desired level of learning. Revise or eliminate all items with a double meaning.
- Whenever possible, increase the number of test items and reduce the amount of discussion required for each. This will not only make scoring easier, it will probably increase the comprehensiveness of the test as a whole.
- Suggest a time limit for each item, indicate the desired length of response, or otherwise limit responses to a size compatible with testing objectives.
- Inform the students prior to the test (normally as part of the instructions for the test) what weight each item will have on the final score. Every student should have a clear understanding of all the criteria which are to be used in the scoring process.
- Avoid basing the solution of one problem on the response to another. If items are linked in this way, a student may miss an entire series of test items instead of only one in a series. The interpretation of results in such a situation would be difficult, if not impossible.

PROBLEM-SITUATION TEST ITEMS

The most common types of test items have been discussed under the headings of selection and supply items. The problem-situation item may either give the student alternatives from which to select or require him to supply the answer.

Advantages

A problem-situation test item poses a realistic problem for the student and asks him to find his own solution. In Air Force instruction, the problem situations used should be those which Air Force personnel might normally encounter in line of duty. Some items might require only that students recall and select facts or apply basic principles. Others might require more reflective thinking. A problem-situation test may measure at least the following abilities: to classify data, to interpret data accurately, to identify relationships, to apply scientific principles and laws of logic to new situations, and to test conclusions.

Everyone continually meets difficulties or perplexing situations for which there are no ready "book answers." Depending upon the difficulty and the situation, the natural reaction is to search, to inquire, to look for solutions suggested by others, and to give critical consideration to the conditions before one arrives at a satisfactory solution. When school problems approximate real-life situations, students are better prepared to adjust themselves to new situations that lie ahead. The problem-situation test is an attempt to bring the student face-to-face with reality.

The following advantages characterize the problem-situation item when it is properly constructed: (1) it is an effective device for obtaining evidence of the degree of understanding; (2) it can be constructed to test and measure the student's ability to reason, either inductively or deductively, and (3) it tests the student's skill in the application of principles and measures his ability to apply previously learned principles to a new situation. In other words, it may be used effectively to measure the degree of transfer.

Types of Problem-Situations

Samples of the various forms of this item follow.

APPLICATION OF GENERAL PRINCIPLES TO A SPECIFIC SITUATION. Two forms are shown for the problem portion of this item. When essay items are used, a major problem may arise because equally competent instructors differ in scoring the responses. This difficulty might be overcome by (1) more clearly limiting the responses

required, (2) preparing a complete scoring key, or (3) putting the problem in multiple-choice rather than essay form.

Situation

Captain Jones is a management analyst at Amboy Air Force Base. You are comptroller. Five months ago the maintenance squadron commander requested a study of his maintenance control system. You gave Captain Jones the assignment. He is young and aggressive and, although he had no maintenance experience, you felt he could handle the job. A recent check on his progress showed the following developments.

1. He had not completed any studies but reported varying degrees of progress on seven different studies, with "three more in the planning stages." Of the seven, two were held up because of a deadlock between Captain Jones and the officers in charge of the areas in which he was making the studies. The two officers in charge stated that he did not understand maintenance problems and that his recommendations were faulty. The other five studies were apparently stagnant.
2. Captain Jones had established requirements for nine temporary reports from maintenance squadron activities to provide him with data in various maintenance areas. The requests for these reports had been initiated at different times.

Problems

1. In what respect did Captain Jones err most seriously?
2. In the present situation, how can the two studies which have been held up because of nonconcurrence be best completed?

When essay items are used and students are allowed freedom in phasing their solutions, a major problem arises because equally competent instructors differ in scoring the responses. This difficulty might be overcome if the form of the item is changed. The item can, for example, be put in the multiple-choice form:

1. In the light of the situation described above, where in the process of analysis did Captain Jones show the greatest weakness?
   a. Planning the analysis.
   b. Establishing reports.
   c. Interpreting deviations from standards.
   d. Selling his final product.
2. In the situation described above, what action should be taken concerning studies which were held up by nonconcurrence?
   a. Captain Jones should be transferred to another area in the comptroller organization where he will not have direct contact with other offices.
   b. The analyses should be withdrawn and the officers permitted to "cool off" before another analysis is requested.
   c. The officers concerned (the maintenance officer and the comptroller) should sit down and discuss their differences of opinion.
   d. If the reports show a factual soundness, they should be forwarded to the Deputy for Materiel without concurrence.

MEMO OUTLINE. The following essay item represents an attempt to present both a realistic situation and to guide the student's responses.

MEMO PAD

Fred L. Jones, Brigadier General

1 March 196X

TO: Comptroller

Joe,

Recently I spent some time at Industrious AFB with the base commander. Among other things, he showed me a copy of his "Base Financial Plan," which he said his comptroller had developed.

Please prepare for me, in complete detail, a written explanation of a base financial plan, as follows:

a. What is it?
b. How is it prepared?
c. How is it used?
d. What records are needed to prepare such a plan?
e. What steps and methods are used in developing the plan?
f. What benefit could be derived from the plan?
g. How would you go about initiating one here?

FLJ

INTERPRETATION OF NUMERICAL DATA. The use of information which the student will be required to work with on the job will add realism to both the situation and the problem.

Situation

You are the Director of Materiel of a C–124 wing. Your duties require you to make estimates of supplies needed for operation in the immediate future. The following planning data is available:

Assigned aircraft	45
Engine hours between overhaul	1,000
Sortie rate per month	68
Estimated average length of sortie (in hours)	12
Gallons of fuel per airplane per hour	400

Problems

1. Using only the quantities given in the situation, what is your estimate of monthly gasoline consumption rate in gallons?

a. 2,560,000
b. 4,800,000
c. 6,912,000
d. 7,730,000

2. Using only the quantities given in the situation, what would be your estimate of the number of engine overhauls required per month:

a. 12

b. 18
c. 24
d. 31

Constructing Problem-Situation Items

A problem-situation item invariably has two major parts, but these two parts are not always readily discernible. The first major part—the situation—always sets the stage. The situation must be carefully designed to provide an adequate basis for the solution. Charts, maps, sketches, or diagrams should be added if they will increase clarity or realism. The second major part—the problem—may be phrased in either selection or supply form.

Certain principles should be followed in preparing the problem-situation item.

- Make both the situation and the problem realistic. Whenever possible, an actual situation should be presented.
- Make both the situation and the problem specific. Allow no confusion regarding details or requirements.
- Limit problems so that they might be responded to in the allotted time.
- In the interest of economy and efficiency, several problems should be constructed to exploit as many aspects of a single situation as possible.
- Unimportant details may sometimes be added to determine the student's ability to select the important facts.
- The situation should be one not previously presented to the student. It should, however, require the use of the principles and ideas presented in the course.
- The situation may be either simple or complex, depending upon the learning and testing objectives.

EFFECTIVE ITEM WRITING

Writing effective test items is one of the instructor's most difficult tasks. Besides requiring considerable time and effort, this task demands a mastery of his subject, an ability to write clearly, and an ability to visualize joblike situations for use in developing problems. Because effective items are difficult to secure, a semipermanent record of items which have been used is desirable. The record of the item, along with the analysis compiled about the item, can be entered on test item records (explained and illustrated in Chapter 27). When sufficient item cards are assembled, a test item pool is created. As long as precautions are taken to safeguard the security of items in the pool, the existence of the pool lightens the instructor's burden of continuously preparing new items.

Principles to Follow

Regardless of item type or form, the following principles should be followed in writing new items or in reviewing existing items.

- Each item should test a concept or idea that is important for the student to know, understand, or be able to apply.
- Each item must be stated so that everyone who is competent in the subject-matter area would agree on the correct response.
- Each item should be stated in the working language of the student.
- The wording of the item should be simple, direct, and free of ambiguity. The wording, should be edited for brevity. Unnecessary words merely delay the student.
- Sketches, diagrams, or pictures should be included when they are necessary for the student to visualize the problem correctly, or when they will add realism.
- The item as a whole should present a problem which demands knowledge of the job or course. No item which can be responded to on the basis of general knowledge should be included in an achievement test.
- When a negative item is used, the negative element must be emphasized in some way.
- Items containing double negatives invariably cause confusion. If a word such as "not" or "false" appears in the stem, avoid using another negative word in the stem or in any of the alternatives.
- Each item should be independent of every other item in the test. Do not allow any item to reveal the correct response to another item, nor permit the solution to any item to depend upon knowing the correct solution to another.

Multiple-Choice Items

STEMS. In preparing the stem of a multiple-choice item or in reviewing an old one, the following general principles should be kept in mind.

- The stem of the item should clearly present the central problem or idea. The function of the stem is to set the stage for the alternatives which follow.

• The stem should contain only material relevant to its solution (unless the selection of what is relevant is part of the problem).
• The stem should be worded in such a way that it does not give away the correct response. Avoid clue words or phrases.
• Place everything that pertains to all alternatives in the stem of the item.
• Avoid catch questions, unimportant details, ambiguities, and leading questions.

ALTERNATIVES. In preparing or reviewing the alternatives to a multiple-choice item, the following principles are important to remember:
• The alternatives in a multiple-choice test item are as important as the stem. They should be formulated with care; incorrectness should not be the only criterion for the distracting alternatives. Some distractors which can be used are (1) a response which is related to the situation and which sounds plausible to the untutored, but which is incorrect; (2) a common misconception; (3) a statement which in itself is true but does not satisfy the requirements of the problem; or (4) a statement which is either too broad or too narrow for the requirements of the problem.
• The alternatives should not contain clue words. Students who are experienced in test-taking can usually detect that statements containing words like "all," "always," "never," etc., are generalizations so broad that they are likely to be false. Similarly, statements containing limiting words, such as "usually," or "sometimes," are more likely to be true.
• The instructor must avoid making the correct response conspicuous by wording it so much more carefully that it becomes longer than the other alternatives. All alternatives should be relatively equal in length.
• The correct responses should be placed in random positions; avoid any consistent pattern within a single test or in a series of tests.

ASSEMBLING THE TEST

The first page, or cover page, of each test should include all data required to identify the test. This information should be printed on the first page or the students should fill in blanks. The name and location of the school, name of the course, section number, date, and student code number are often included.

A complete set of instructions for each student should specify what text and other tools may be used during the examination and the time to be allowed for parts or for the total examination. The instructions should include a statement of the number of items in the test and should indicate clearly the manner in which the student should respond. It is often a good plan to give a sample item with the correct response. The instructions should also tell whether to proceed individually from part to part or from page to page, or whether to wait for a signal or further instructions. Students should also be informed of the procedure to follow when they have completed the test. If reliable testing data is to be compiled for administrative purposes, testing instructions should be kept uniform from class to class.

Test items should be placed on the page so that each item stands out clearly from the others. For example, true-false items two lines long should be single-spaced, but two spaces should be left between items. A space should separate the stem of multiple-choice items and the list of alternatives. The alternatives should appear in a single column beneath the stem and should be indented beyond the paragraph indention.

If tests are to be machine-scored, precautions must be taken to see that the items can be used with IBM machine-scored answer sheets. Special IBM answer sheets can be designed in a variety of ways. Stock answer sheets can be used for true-false items, for multiple-choice items with 5 or less alternatives, and for matching items with 15 or less alternatives.

As nearly as can be anticipated, items should be arranged in order of difficulty within groups. Items of known difficulty which have been used before are readily arranged in order of difficulty. Students are put at ease when they find relatively easy items in the early portion of a test. The resulting development of self-confidence and the improvement in morale are enough to justify an arrangement of items from easy to difficult.

When limited time is allowed for testing, a test should be sufficiently short for most students to complete it. When many of the students are not able to complete a test, much of its efficiency is sacrificed and student morale is likely to suffer. On the other hand, it is rarely desirable that all students complete the test before the end of the allotted time. In that event, a large portion of the group must wait for the remainder to finish.

If students are allowed to leave as they complete a test, they distract and confuse those who are still working. When all things are taken into account, the time required for approximately 80 percent of the class to complete the examination is generally considered to be the optimum length of time for administration.

ADMINISTERING THE TEST

Although the decision as to when to administer the test does not always rest with the instructor, he is often allowed to establish the time. The instructor should arrange for tests to be administered in the morning when students are fresh and alert, rather than in the afternoon when they are tired and less likely to be at their best. The selection of a place in which to administer the test is equally important for reliable testing results. In a quiet, well-lighted, well-ventilated room with a comfortable temperature, the student is more likely to perform at his best. Ample working space should also be provided. This is particularly important when separate answer sheets are used, and when the students are expected to make computations on scratch paper. If students are uncomfortable or if they are distracted by physical surroundings, their scores can be expected to suffer. Also, since some students are affected more than others, scores will be less dependable.

The instructor should arrive at the examination room well in advance of the class to make sure that he has on hand the materials to be used in the examination. Some instructors prefer to have test papers at the seats before the students arrive. Extra tests, answer sheets, and pencils should be available in case they are needed. When administering the test, the instructor should be clear and concise in his pretest instructions to gain the confidence of the students. With confidence in the instructor, students work more efficiently without being nervous or tense. The test will then present a more accurate picture of their understanding of the area being evaluated.

Whether or not the instructor wins the confidence of the students depends largely upon personality—his own and that of the individual students—and upon the teaching situation. The instructor should do all he can to encourage the students and put them at ease.

Although carefully written directions for taking the test should be a part of the test, the instructor may wish to give oral directions as well. Before the examination begins, students should be invited to ask questions concerning procedures and should be told that no questions will be answered after the test begins. Any errors, misprints, omissions, or other defects in the test should be explained beforehand.

If the test has time limits, these should be announced and observed. Students should be told whether they are free to turn in papers and leave the room during the period, or whether they are to remain seated until all materials are collected. A planned procedure must be followed throughout the examination.

SCORING SUPPLY ITEMS

The procedure used in scoring should be explained to all students at the time they take the test. Students should know the relative weight of each question or problem, and of its separate parts. Only in this way can they know how to budget their time and effort.

Scoring of examinations made up of supply items presents serious difficulties. Obviously, if test results are to be reliable, the ratings assigned to a paper must be comparable when scored by several competent instructors. If one instructor scores a test paper "Superior" and another scores the same paper "Good," the grade expresses the opinion of the instructor rather than the proficiency of the student.

To make the scoring of supply items as objective and reliable as possible, the instructor should arrange for each paper to be scored by more than one person. Supply items require a great deal of time to grade and, being highly subjective, are difficult to evaluate. The instructor may find himself assigning the best grades to students who use his own phraseology.

The principles for incorporating objectivity into the scoring processes are the same for all three forms of supply items. Since the essay form is the most difficult one to make objective, it is the only one of the three forms which is discussed here.

Preparing a Key

To minimize subjectivity as much as possible in scoring essay examinations, write outlines of model answers. The weight to be given to each topic in the outline is determined, and the papers

PILOT PREFLIGHT PROCEDURES

T–33 Aircraft

You are the pilot of a T–33 about to make a VFR flight from Maxwell Air Force Base, Alabama, to Amarillo Air Force Base, Texas. Takeoff time is 1400Z. File your Form 175; obtain maps, charts, and personal equipment; and arrive at the aircraft at 1320Z. From this point on, what will be your actions prior to takeoff? State your actions in each of the following steps:

Weights		
15	I.	Before exterior inspection
44	II.	Exterior inspection
4	III.	Interior inspection
30	IV.	Starting engine procedure
8	V.	Tower clearance and taxi instructions
50	VI.	Before taxiing
8	VII.	Taxi
12	VIII.	Before takeoff
30	IX.	Lineup check

Figure 36. Sample Essay Test Problem

are scored by this criterion. This outline, or key, for an essay test, as for any other test, is basically an answer sheet. The answer to each question should be written to include all important details. A sample essay test item is shown in Figure 36. A sample key for scoring this item is shown in Figure 37.

Preparing a Score Sheet

Once the key, or acceptable solution, has been devised, a score sheet is drafted to guide the person grading the papers and to provide for a detailed record. A portion of such a score sheet is shown in Figure 38.

It is well to have the students put code numbers rather than names on the answer sheets. If the instructor knows whose paper he is grading, he is likely to be biased. After the scoring has been completed, the papers can be identified.

Part of the responses of Student 12 (see Fig. 38) to the problem in Figure 36 is shown in Figure 39. Note that the scorer has identified the parts of the response which have a direct bearing on the items in the key. As these items are identified and circled, the scorer should record in the block on the sheet the score that represents the proportion of the total weight that he believes the student deserves. Whenever the student does not refer to an item listed in the scoring key or

PILOT PREFLIGHT PROCEDURE
FOR T–33 AIRCRAFT

Total weight: 201 points

I. *Before Exterior Inspection* (15 points)
- A. Canopy jettison and seat ejection system 4
- B. AF Form AFTO 781 3
- C. Required publications 2
- D. Throttle off 2
- E. Check wing flaps down 2
- F. Personal equipment 2
- Points 15

II. *Exterior Inspection* (44 points)
- A. Right forward fuselage 1
- B. Nosewheel well 2
- C. Right air intake 1
- P. Left forward fuselage 1
- Points 44

III. *Interior Inspection* (4 points)
- A. Aft cockpit check (solo flights) 2
- B. Front cockpit (all flights) 2
- Points 4

IV. *Starting Engine Procedure* (30 points)
- A. Fuselage tank switch 2
- B. Starter switch start 2
- J. Battery switch 2
- Points 30

V. *Tower Clearance and Taxi Instruction* (8 points)
- A. Taxi direction 2
- B. Runway number 2
- C. Wind velocity 2
- D. Altimeter setting 2
- Points 8

VI. *Before Taxi* (50 points)
- A. J–8 attitude indicator 3
- B. Flight instrument power switch 3
- T. Wheel chocks 2
- Points 50

VII. *Taxi* (8 points)
- A. Leading edge and wing tank transfer pumps 4
- B. Flight instruments 2
- C. Navigation equipment 2
- Points 8

VIII. *Before Takeoff* (12 points)
- A. Pitot heat 2
- B. Tip tank jettison switch 2
- C. Tip tank fuel switch 4
- D. Fuel deicer switch 2
- E. Canopy 2
- Points 12

IX. *Lineup Check* (30 points)
- A. Directional indicator 2
- H. Advance power full open (check 100 rpm). Adjust throttle friction to hold throttle 4
- Points 30

Figure 37. Sample Scoring Key for Essay Test Problem

Score Sheet for Problem: Pilot Preflight Procedure, T-33 Aircraft

Total weight : 201 points

Student code number	I. Before exterior inspection (15 points)						II. Exterior inspection (44 points)			
	A. Canopy jettison and seat ejection system	B. AF Form AFTO 781	C. Required publications	D. Throttle off	E. Check wing flaps down	F. Personal equipment	A. Right forward fuselage	B. Nosewheel well	C. Right air intake	
12	4	3	2	2	2	2				
13	2	2	1	1	2	1				
14	4		2	1	2	2				
15	3	3	1	2	2	1				
16	2	3	1	2	1	2				
Total	15	11	7	8	9	8				

Figure 38. Sample Score Sheet

when his response is completely inadequate, no entry is made.

In Figure 38, the score sheet has been partially completed. The scorer has given Student 12 full credit for each of the items under "Before Exterior Inspection." If the scorer had felt that only partial credit should have been allowed for certain parts of the problem, he would have

Pilot Preflight Procedure:
T-33 Aircraft

My first step would be to check the canopy jettison and seat ejection system to see that it is in a safe condition. I would check the status in the Form 781 and then check the aircraft to insure that the required publications are aboard. My next step would be to see that the throttle is off and that the wing flaps are down. After checking my personal equipment I would . . . . . .

Figure 39. Part of Student's Response

entered smaller scores in certain blocks, as he did for Student 13.

All papers should be checked for one part of a problem at a time. The number of points assigned each student for the first part of the first problem should be entered in the block on the score sheet provided for the purpose. Each paper is then scored for the second part, and the number of points assigned each response is entered on the score sheet. Each of the other parts is scored in the same manner. When all test papers have been scored, the scores for all parts are added to get the raw score for the entire first problem. This score is entered in a column on the right of the form (not shown in Fig. 38).

The instructor should provide another row at the bottom of the score sheet for the sums of the separate columns and label this "Total," as shown in Figure 38. The value of the total for each column is the total number of points scored by all students on that part. If this value is divided by the total possible score on the part, multiplied by the number of students, the instructor can arrive at an index of his effectiveness in teaching each part. Thus, in Figure 38, the "Canopy jettison and seat ejection system" column totals 15 points, but the total possible score is 20 (4 points $\times$ 5 students $=$ 20). Fifteen divided by 20 is 75 percent. The instructor, then, can assume that his instruction was only 75 percent effective in teaching the canopy jettison and seat ejection system. Similarly, he can assume 74-percent effectiveness in his instruction on AF Form AFTO 781. These may or may not be acceptable degrees of effectiveness, depending upon the importance of each part to the students' overall understanding of T–33 preflight procedures. This kind of analysis can be made for subject-matter areas and groups of items, as well as for separate items.

SCORING SELECTION ITEMS

When items are of the selection type, students should be informed in advance what procedure is to be followed in scoring, as this knowledge can considerably affect their attitude when taking the test. For example, if students are told that the number of correct responses will be used as a score, they are encouraged to hazard a guess. On the other hand, if they are in-

formed that the number of wrong responses will be multiplied by three and subtracted from the number of right responses, each student will probably weigh carefully his chances of selecting the right response when he is not sure. Many students will probably omit all items about which they do not feel sure. Some consideration surely should be given to the sort of problem-solving attitude to be fostered, but each student should be allowed to exercise his own judgment as to whether or not to guess.

When speed in solving the problem is to be measured, the use of a correction-for-guessing formula may be worthwhile. Research has generally found that corrected scores are slightly more valid than scores based only on the number of correct responses. It is often felt, however, that the slight increase in validity obtained when a correction formula is used does not justify the time and effort required in scoring and the greater chance of making errors. If students are instructed to answer all items and if the test is designed in such a way that about 80 percent of the class has time to finish it, the use of a correction formula probably does not appreciably change the relative standing of the students or the validity of the test.

A scoring procedure or formula should not be arbitrarily selected. It should reflect what is desired from the test. No one has yet devised a formula that compensates for the test constructor's incompetence or laziness. A correction formula can estimate certain kinds of guessing, but it does not make a poor test good.

Number of Correct Responses Used for Score

The simplest procedure to use when scoring selection tests is merely to total the number of correct responses for each student. Each student's score may then be used to indicate his relative standing in the group. A score sheet, identical in form to the one illustrated for essay tests (Fig. 38), can be used. If advisable, certain items may be given more weight than others. In any case, each student's test score is the number of points accumulated.

ADVANTAGES. With selection tests, the use of total number of correct responses (or total number of points accumulated) has the following advantages over adjusting the scores:

- It is quick. Each score can be obtained in a minimum time. In fact, it is not uncommon for students to exchange papers and score them as the instructor reads the correct responses. Papers are returned, and an analysis is made of the results. This method provides an opportunity for immediate reteaching and clarification.
- The chance of making errors is held to a minimum. Merely to count the number of correct responses is a straightforward and simple task. Adjustment procedures invariably call for some computations. Adjustments can be made automatically, however, if the test is machine-scored. Once the machine is set up for scoring, an adjusted score can be obtained as accurately as the number of correct responses.
- Students are able to understand the method and, as a rule, consider it just.

DISADVANTAGES. The use of only the number of correct responses is subject to the following weaknesses:

- The possibility of guessing the correct answer reduces both the efficiency of the test and the range of the distribution of scores. In a true-false test, for example, an individual who knows nothing but guesses at all items should answer half of them correctly. With this assumption, the useful range of scores on a 100-item test with two alternatives is from 50 to 100. In other words, the first half of the test period might be considered to be spent in chance guessing and the second half in obtaining a measure of the student's ability and knowledge. Also, the true-false test does not differentiate as well as it might, and an appreciable portion of the test may be considered a sheer waste of time.

In a multiple-choice test with four alternatives for each item, zero knowledge of the 100 items may be presumed to correspond with 25 items correct, and the first quarter of the testing time is spent in "coming up with zero." In general, if a test has N items and K alternatives to each item, the useful range of test scores is from N/K to N instead of from zero to N.

- Students who deliberately guess have an undeserved advantage over those who attempt only those items they feel qualified to answer.
- Guessing is encouraged. Students develop a practice of making a sheer guess when they are not sure of themselves. They cannot lose by making wrong guesses.

The disadvantages in using the number of correct responses as the test score sometimes out-

weigh the advantages. This is particularly true when the process is simplified by machine-scoring. Before a decision can be made as to whether to adjust the score or not, it is necessary to examine the assumptions underlying the common procedures for adjusting scores.

Correction for Guessing

This procedure is often used when the test administrator wishes to determine the number of items which each student knew. Essentially, the number of items the student guessed correctly is subtracted from the number of items which the student had correct.

It is never possible for the scorer to know exactly how many items each student guessed correctly; nevertheless, a satisfactory estimate can be based on these assumptions: (1) that a student can identify the correct response to an item either by knowing it or by guessing it; (2) that wrong responses are obtained exclusively by guessing, that is, a wrong response means lack of knowledge and consequent guessing; and (3) that all alternatives to each item are equally attractive or unattractive to a student who does not know the correct alternative, and that he guesses as many incorrectly as correctly.

To make all alternatives equally attractive or unattractive requires skill in constructing the test and revising it.

The assumption that wrong responses are always obtained by guessing is probably the least acceptable one. The student who selects a wrong response is not always uninformed; he may be misinformed. If he is uninformed, he has no knowledge of the item. If he is misinformed, he has incorrect information. For example, a student with no previous training in military radio communication would probably be uninformed as to the meaning of the abbreviation IFF. The student who thought that was an abbreviation of "induced field force" would be misinformed.

It is important that those who use the correction-for-guessing formulas understand that they are based on at least these three assumptions. Obviously these assumptions are not always wholly true.

The formula generally used to adjust scores for guessing is

$$\text{Corrected score} = R - \frac{W}{K - 1}$$

In this formula, R is the number of items the student answered correctly; W is the number of items he answered incorrectly; and K is the number of alternatives to each item.

For example, suppose that Smith took a 100-item true-false test. He checked 70 of the items correctly; 20, incorrectly; and he omitted the remaining 10 items. Smith's corrected test score would be—

$$70 - \frac{20}{2 - 1} = 70 - 20 = 50$$

Smith's test score of 50 represents the number of items he probably knew. This confusion is logical. He selected 20 wrong items. If it is assumed that this incorrect selection was the result of guessing, he must also have guessed 20 items correctly—one correct guess for each incorrect guess. The 20 items guessed correctly should be subtracted from the 70 correct items. An important point is that the subtracted quantity is an estimate of the number of items guessed correctly; it is not the number of incorrect items. The two quantities happen to be the same in the true-false test.

The correction-for-guessing procedure cannot possibly indicate which items were guessed correctly; it can only estimate how many items were guessed correctly.

As a second illustration of the procedure, suppose that a 100-item multiple-choice test has four alternatives to each item. The number of right and wrong responses of three students is shown below:

	Number right	*Number wrong*
Student A	79	21
Student B	76	9
Student C	74	0

If each student's test score is the number of items he had correct, then these three students would rank in the order A, B, C. It should be noted, however, that Student A has attempted all 100 items. Student B attempted 85 items, and Student C attempted only 74. Furthermore, Student C identified the correct response to every item he attempted. Student B missed 9 items; Student A, 21 items. The distributions make it appear that Student A guessed at items when he did not know the answer. Student C, on the other hand, appears not to have attempted any

item of which he was not sure. If this is the case, it may be that Student C really knew the answers to more of the items than either Student A or Student B.

When the correction formula is applied, the three students have the following scores:

Student A, 72
Student B, 73
Student C, 74

It now appears that Student C knew the correct responses to more items than did either A or B. Thus the rank order of the three students is reversed.

An important fact is that the quantity subtracted $\frac{W}{K-1}$ from the number of right responses is an estimate of the number guessed correctly. In the multiple-choice test just described, the ratio of correct to incorrect guesses made by an uninformed student is 1 to 3. Since there are four alternatives to each item, a student should have one correct guess for three wrong guesses. Since Student A has 21 wrong responses (and the assumption is made that these are wrong guesses), he should have one-third as many right guesses; that is, 7 of his 79 right responses were correct guesses, and he knew the answer to only 72 items.[1] The actual computation of his corrected score would be—

$$\text{Corrected score} = R - \frac{W}{K-1}$$

$$79 - \frac{21}{4-1} = 79 - \frac{21}{3} = 79 - 7 = = 72.$$

With the use of a correction procedure, such as the one described here, all the items with the same number of alternatives should be grouped. Suppose, for example, that a test consists of the following items: 30 true-false, 25 three-alternative multiple-choice, and 20 four-alternative multiple-choice. The three forms should be grouped separately in the test, and each form should be scored separately on each paper. Grouping the items not only helps the instructor in giving directions to the students and in scoring the tests, but also facilitates student response. The items may be arranged in any order within the three groups, preferably according to increasing difficulty.

[1] Using the same formula, compute the scores of Students B and C.

When the number of alternatives to items is large, say five or more, the correction factor $\frac{W}{K-1}$ is very small. For this reason, it is generally felt that correction procedures are not justified with five or more alternatives, and they are seldom used with matching items.

Penalizing for Guessing

Sometimes test administrators wish to discourage students from guessing. To overcorrect for guessing or to penalize wrong responses, they use the following formula:

$$\text{Overcorrected score} = R - (T \times W).$$

R is the number of right responses, and W is the number of wrong responses. The new term T is a value which the test administrator may assign to fit his purpose. For example, if the instructor prefers that the students attempt only those items about which they are confident, he may use a value of 4 for T. Suppose that a certain student had 75 correct items and 12 incorrect items in a selection-type test. This student's test score (when computed according to this formula) would be—

$$75 - (4 \times 12) = 75 - 48 = 27.$$

If he is being penalized for guessing, the student will probably weigh carefully his chances of selecting the right response. The odds are not in his favor. In frequently administered short tests, the penalizing of guessing is a useful means of identifying misinformation. In the illustration just given, the instructor may be sure that, if a large number of his students answered certain items incorrectly, they did so in the belief that they were correct. In such cases the instructor should examine the source of misinformation.

SUMMARY

A primary reason for testing is to improve instruction and, thereby, to increase learning. The grades which result from testing are, at best, a secondary testing objective. Pre-course examinations may be used to determine the educational background of students for grouping purposes or for modifying teaching approaches. Such examinations are also an effective means of providing students with an overview of the course. In-progress examinations give the instructor a posi-

tive indication of what and how well his students are learning. In addition, repeated testing makes students more confident in the testing situation. Such examinations, when used as a review instrument, are teaching devices in themselves. The results of testing and review may be used to identify teaching strengths and areas for improvement. End-of-course examinations, in addition to helping to determine the final standing of students, provide further insights for teaching improvement.

When examinations are being constructed, the desired specific changes in behavior (learning objectives) should be the most important consideration. For purposes of subsequent measurement, these changes in behavior may be defined in terms of both subject-matter content and the level of learning (or skill) that a successful student should be able to demonstrate. Only observable behavior may be judged or measured. Identifying, reciting, or listing are the most common observable behaviors associated with learning at the knowledge level. The behavioral abilities which result from learning include comparing, differentiating, contrasting, generalizing, explaining, and perhaps solving. At the application level of learning, observable behavior to be demonstrated by successful students includes solving complex problems, interpreting situations, determining related causes and effects, performing an integrated sequence of related actions, constructing, adjusting, and repairing.

To be valid, a test to measure achievement in one subject-matter area must exclude test items from other areas. Conversely, a test to measure the achievement of overall course objectives must include test items from all subject-matter areas. A test-item worksheet will help insure comprehensiveness and validity.

Two broad categories of test items are selection and supply. The selection category includes true-false, multiple-choice, and matching items, all of which provide alternatives from which the student must choose. The supply category includes completion, short-answer, and essay items, all of which require the student to supply whatever information is requested. Selection items enjoy the advantages of high objectivity in scoring, the capability of measuring the learning of a large number of facts, ideas, or principles in a relatively short time, and ease in arriving at statistical analysis. When properly constructed, they can measure learning at any level. Supply items have a distinct advantage over selection items when recall of information, ability to express ideas, or original thinking are to be measured. The preparation for supply type test requires thorough study, which, in turn, is also an aid to learning and retention. When properly constructed, supply items can measure learning at any level.

The problem-situation variety of either supply or selection test-items can measure learning at the highest levels. It can aid in differentiating among students of high achievement and in estimating the degree of transfer of learning achieved by students.

The actual writing of test items is one of the instructor's most difficult tasks. He must understand the basic concepts involved.

When assembling items into an examination, a complete set of instructions for the student should be included. He should know exactly what is expected of him, the relative value of test items, and the time limits. Normally, the items should be arranged in order of difficulty (starting with the easiest) and grouped according to both subject-matter and item type.

The instructor should understand the effects of physical facilities, temperature, humidity, lighting, time allowed, and time-of-day on the reliability of test results. Similarly, he should understand the function of oral instructions preceding a test. If test results are to be reliable, there must be consistency in the circumstances surrounding each testing session.

A test may be valid, reliable, and comprehensive, but if it is not scored properly, individual scores are useless. To increase objectivity, model answers and a scoring key should be used to score a test with supply-type items. One of three basic procedures can be used to score a test with selection items. Whatever the method of scoring, students should be specifically told about the method at the time the test is administered. Obviously, if a good test is to be used effectively, scoring is a vitally important procedure.

CHAPTER 26

Assigning Grades

The numerical scores obtained from tests are relatively meaningless for evaluation purposes. The fact that a student received a rating of 246 for a performance, a score of 68 on an examination, or accumulated 143 points during a course means nothing until these scores are converted into grades which have common meaning to those who are to use them for selection, placement, and guidance.

This chapter is concerned with the conversion of numerical scores into meaningful grades. Various methods of grading and their comparable effectiveness are considered first. A few mathematical computations are included in this discussion. The second part of the chapter shows the actual computations by which the grading methods are applied to the final scores of 150 students in an Air Force clerical school.

GRADING SYSTEMS

The many different methods of grading fall into two broad systems—absolute and relative. In an absolute grading system, the grade represents a position on a fixed scale or background. Such a system assumes that a grade can be assigned to represent a true position in terms of a common, fixed scale and that those who interpret the grade identify the same position on the absolute scale. For example, the letter grades used in many public schools and colleges are frequently based on the assumption that the letters represent certain fixed degrees of proficiency on a fixed scale, and that this degree is interpreted uniformly by all who use it. Thus, it is conceivable that all members of a certain class could receive "A" grades, provided they all demonstrated proficiency at that absolute level.

In a relative grading system the grade reveals only the individual's relative standing within a group. Such a system makes no attempt to fix an individual's position against an absolute scale. For example, when a student's rank order in a class is reported, the grading system is relative. If relative grades are used, it is always desirable to describe the group on which the grades are based. Otherwise, such grades lack significance. Whenever possible, grades should be recorded in both absolute and relative terms. This plan makes grades easier to interpret because it conveys more information.

INTERPRETATION OF GRADES

There is no best method of grading. Of the numerous methods, each has advantages and disadvantages. The grading methods designed for specific situations are not appropriate for general use. Every institution should weigh the advantages and disadvantages of all methods and either select the method (or combination of methods) that best fits its own needs and objectives or else devise another method. Whatever the decision, the method should be revised frequently to meet changes in the curriculum and to make interpretation easier.

Raw Score

The raw score is considered an absolute grading method since it is based on a fixed scale such as the number of correct responses possible in any given evaluation instrument. While raw scores in themselves are sometimes used as grading devices, their value is doubtful. They are, however, the basis for other grading methods. The raw score can be defined as the number of items an-

swered correctly on a test, or the numerical sum of a rating scale.

Percentage Grades

Percentage grading methods have been used more than any other single method. A percentage grade is usually obtained by first dividing the total raw score by the maximum number of points possible, and then by multiplying the result by 100. For example, suppose the maximum number of points which can be accumulated during a certain course is 224. A student who accumulates 168 points would receive a grade of 75 percent.

$$\frac{168}{224} \times 100 = 75\%$$

Percentage grades may be based on points accumulated during a course, on scores received on a single test, or on ratings of a performance.

Percentage grades imply an absolute scale with values ranging from zero to 100. The fact that neither zero nor 100 are fixed, meaningful reference points should be apparent. A student who answers no test item correctly in a test on the principles of military management probably knows something about the subject, and the student who answers 100 percent of the items correctly does not know everything about the subject. Values between these two points do not imply the percentage of total knowledge that they are sometimes assumed to have.

Percentage grades are obviously unstable. Whether the test questions are easy or hard materially affects the grades received by students. Instructors sometimes find that the percentage grade of all the students in their class is below a previously established minimum. In that case, instructors may find it expedient to add a certain percentage arbitrarily or to recompute all grades in a different manner.

Percentage grades convey little or no information about a student's ability. The fact that a student accumulated 75 percent of the maximum number of points possible or correctly answered 75 percent of the items on some test reveals nothing significant. However, the relative standing of the individual provides much more useful information.

Rank-Order Grades

To use rank order, which is a relative method of grading, the instructor lists all individuals in the group in the order of proficiency, from most proficient to least proficient. Relative positions may be determined from numerical test scores, ratings, or combinations of several such evaluations. Under the rank-order method, the grade is usually reported as a fraction. The numerator of the fraction is the individual's position in the group, and the denominator is the number of persons in the group. For example, a student who ranks 86th in a class of 150 students would receive a rank order of 86/150. When ties for a certain position occur, the tying students are usually given the median rank within their particular tying group. To illustrate, if the top four students in a class of 150 had the same score, each of them would be given the rank order of 2.5/150. In this case the numerator of 2.5 is, of course, the median rank for positions 1,2,3, and 4.

Rank-order grades are easy to compute and their interpretation is straightforward. A major weakness in the method is that the grades do not give an accurate indication of relative abilities, but only of relative positions. Whereas numerical differences between successive rank-order grades are constant, ability differences are not. For example, the numerical difference between 2/112 and 3/112 is the same as the difference between 45/112 and 46/112. For this reason, there is a tendency to infer that there is as much difference in proficiency between the persons who ranked 2d and 3d as between those who ranked 45th and 46th. This assumption is probably not true.

A second weakness of rank-order grading is that no differentiation is made between successive individuals, particularly near the middle of the group. It may be possible to rank in true order of ability a group of eight or ten persons, but to make such differentiations among all members of a larger group would hardly be possible. It may be possible to observe a distinct difference between the persons with rank-order grades of 2/112 and 3/112, but not between those with rank-order grades of 45/112 and 46/112.

Centile-Rank Grades

Grading by centile rank is one of the most popular variations of the rank-order grading method. The principal improvement provided by this method is that the grades received in several classes of different size can be compared directly.

In this method, the ranks are reversed from those in the rank-order method and are converted to percentages. In other words, persons near the lower end of the distribution receive the low centile ranks (around 1), and those near the top of the distribution receive the high centile ranks (around 100). An individual's centile-rank is the percentage of the total group of students who are equal to or below him in the distribution.

As in rank-order grading, it is customary to assign to tying students a centile-rank grade which corresponds to the centile-rank of the person theoretically at the middle of the tying group. Because of the usual imperfections in educational measuring instruments, centile-rank grades should be reported as whole numbers only; the decimal portions are not significant.

As compared with the rank-order grading method, the centile-rank method allows for a better comparison and a greater ease in interpretation of grades, because the base is 100. However, the centile-rank method has certain disadvantages in common with the rank-order method. In the first place, there is a tendency to interpret centile-rank grades as representing relative ability when they represent only relative position. Some instructors are inclined to think that differences in ability are proportionate to differences in centile ranks. The difference in ability between two persons 10 centiles apart is not the same at different positions on the scale. There probably is more difference between the ability of persons at the 95th and 85th centiles than between those at the 60th and 50th centiles.

Centile-Group Grades

It is a fairly common practice to establish certain centile rank-cutting scores which divide a class into groups. These groups are frequently designated by some descriptive term or symbol. For example, the persons in the top 20 percent of the class may be identified as "Superior"; those between the top 20 percent and the middle of the class, as "Above Average"; the next 40 percent, as "Satisfactory"; and the bottom 10 percent, "Unsatisfactory." The percentage of the total class placed in each of these categories may be decided arbitrarily, or it may be varied to meet certain needs, or the class may be divided into groups of equal size, such as thirds, fourths, tenths, or some other fraction. The groups identified by the process may be labeled in a variety of ways: with adjectives, as in the example just given; with letters of the alphabet (A, B, C, D, F); or with numbers (5, 4, 3, 2, 1). A number is frequently used when the class is divided into equal fractional parts in which case the grade may be reported as a fraction, similar to a rank-order grade. For example, the centile-group grade $\frac{2}{10}$ would be interpreted to mean that the individual ranked within the second tenth from the top of the class. The centile-group grade ¼ would mean that the individual ranked in the top quarter of the class.

Centile-group grading methods of the sort described are not based on what is known about the distribution of abilities among people; instead they represent a convenient procedure for reporting relative position. The differences in ability between successive groups are not constant. For example, the difference in ability between the average students in the first and second quarter of a group is not the same as the difference in ability between the average students in the second and third quarters.

Centile-group grading retains some of the better features of the centile-rank method, and it may eliminate at least one of its faults; since there are fewer categories, fewer students are placed in the wrong category. On the other hand, those who do get placed in the wrong category are displaced farther from their true position.

Standard Scores

The distribution (the series or set) of scores made by 200 students on an achievement test is shown in Figure 40. Certain features of the distribution should be noted: (1) scores are massed near the center, (2) comparatively few scores are found near the extremes, and (3) the number of scores tend to decrease gradually as the extremes are approached.

Whenever the members of any large, unselected group are effectively measured for a certain ability, the distribution falls into this same general pattern. As a matter of fact, the distribution of most physical traits has this general shape also.

The case illustrated in Figure 40 shows slight dips and peaks in the outline of the distribution. With an increase in the number of persons in this distribution, the dips and peaks would tend

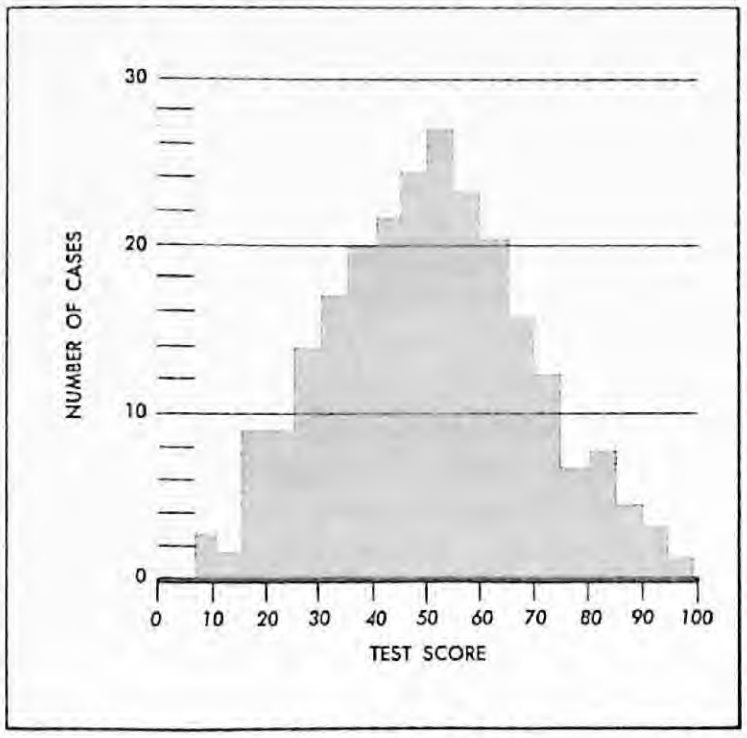


Figure 40. Test Scores of 200 Students

to smooth out. If the increase represents a large number of people (millions), the distribution would follow the pattern shown in Figure 41.

The distribution in Figure 41 shows the same characteristic massing at the center and the gradual decrease in the number of cases as the extremes are approached. In addition, the minor

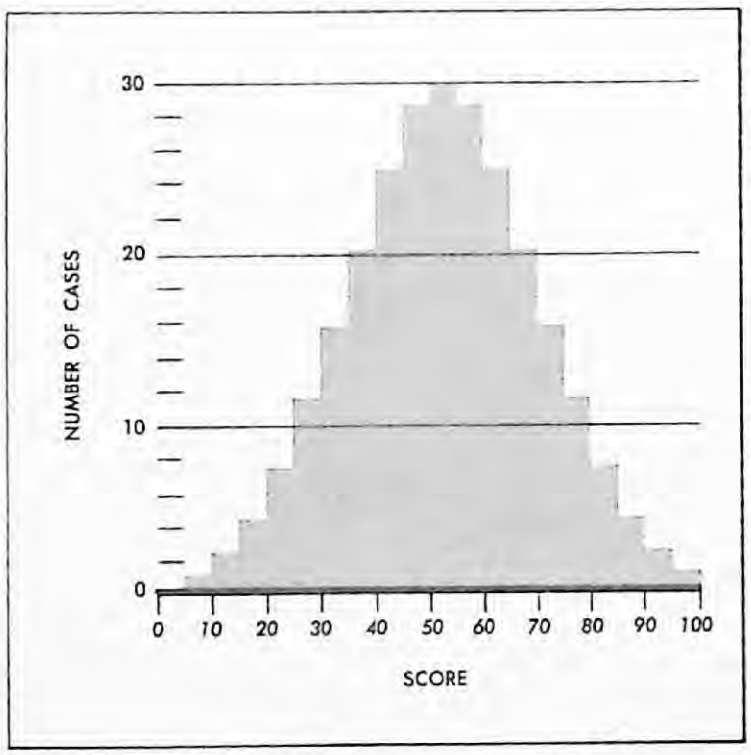


Figure 41. Distribution of Trait Among Millions of People

peaks and dips have disappeared, and the shape is symmetrical.

The distribution in Figure 41 has steps along its top edge. These steps were caused by the process of grouping used when the measurements were made. No measuring instrument is capable of infinitely fine differentiations. Heights of people, for example, are usually measured to the nearest quarter or eighth of an inch. When persons are weighed, the results are usually reported to the nearest quarter or half pound, often merely to the nearest pound. Test scores are usually reported in units. In all measurements, categories must be imposed. The fineness of these categories depends on the measuring instruments and on the intended use of the results.

If infinitely fine differentiations could be made with the measuring instruments, and if an infinite number of people could be tested, distributions would usually form a smooth, symmetric curve which is called the *normal probability curve*. Even though this smooth curve cannot be achieved in practice, the true distribution of most abilities among the total population tends to approach this shape. The normal probability curve has been analyzed mathematically in great detail.

As pointed out with percentage grades, no point on the scale has any real significance. This weakness has its source in the test scores themselves. The fact that zero test items are correct, or that all items are correct, or that 70 percent of the items are correct has no real meaning.

CENTRAL TENDENCY. There must be a significant reference point on the scale. One reference point that is generally considered significant is the central point or score around which the scores tend to cluster. This characteristic clustering is called the *central tendency* of the scores. Three measures of central tendency are commonly used in educational statistics: the mean, the median, and the mode. The *mean,* which is simply the arithmetical average of a series of test scores, is generally considered the most meaningful reference point. The *median* is defined as the point or score in a frequency distribution on either side of which lie 50 percent of the cases. The *mode* is the score which occurs most often in a frequency distribution. It is, then, the most popular score. When two or more scores have equally high frequencies, the distributions are said to be bimodal or multi-modal.

Although a measure of central tendency is descriptive, it alone is inadequate to portray a distribution. Two sets of scores may have the same mean but differ greatly in their spread. In describing the distribution of intelligence for a given class of students, for example, it would not be enough to give only the average I.Q. of the class. An instructor finds it equally important to know the amount of the individual differences in intelligence within the class. He would like to know whether the class is made up exclusively of students of average and near-average intelligence or whether it contains a large proportion of very bright and very dull students. He wants a measure of variability. He might refer to this variability as variation, dispersion, spread, or scatter.

VARIABILITY. Variability is measured in a number of ways in educational statistics. Two common measures of variability are the range and the standard deviation. These are absolute numerical measures in terms of raw score units. The *range,* of course, is merely the highest score minus the lowest score. The *standard deviation* is a unit of measure of the spread of the scores about the mean. It is used to identify a score in relation to the mean. The standard deviation of a distribution is usually about one-fourth to one-sixth of the total range of scores. In a normal distribution, about 68 percent of the cases fall within one standard deviation above and below the mean, with half (34 percent) of the cases on each side.

Both a measure of central tendency and a measure of variability are combined in the standard score. The two specific measures used are the mean and the standard deviation.

In nonstandardized grading methods, two common errors occur: those made because of differences in the difficulty of the tests, and those made because of differences in the variability of scores obtained on the tests. Figure 42 shows differences in average, or mean, scores made on two different tests by classes of students who are actually equal in ability. Figure 43 shows differences in the variability of scores made on two different tests. While the average grade is the same for Tests C and D, the spread of the grades for Test D is much larger.

The best means of correcting these two sources of errors would, of course, be to construct tests that would be of equal difficulty and variability. Unfortunately, such construction is not always possible, desirable, or even worthwhile. A more practical solution, then, is to correct the differences among tests by converting all raw scores on tests to some form of standard score. In combining scores made on many tests, standard scores eliminate differences in difficulty by making the mean the reference point, and in this way equating the means of all distributions. Other scores are then measured in terms of their standard deviation distances above or below the mean.

Differences in variability are important because they influence averages. When grades from distributions with different variability are averaged, the average is determined largely by the distribution with the greater variability. A simplified example will serve to explain this principle. Suppose that all students in a class receive 40 for a performance rating (no variability). At the same time their written examination grades range from 25 to 50. If these two sets of grades are averaged, the final grade will depend entirely

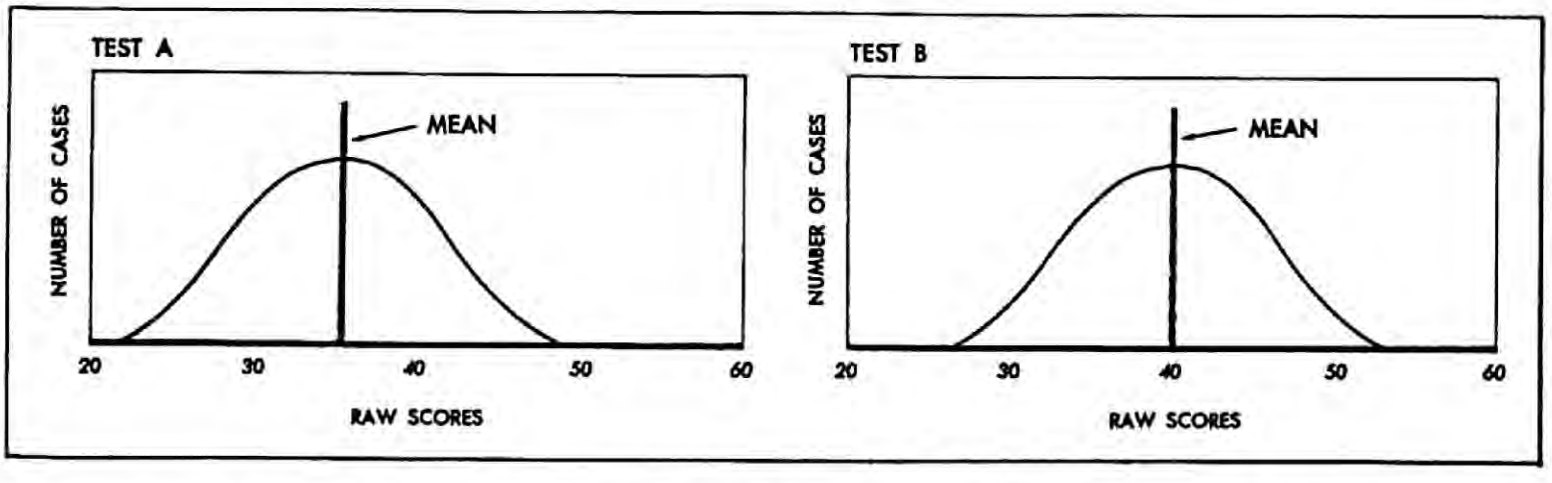


Figure 42. Means Obtained by Two Classes of Equal Ability When Tests Varied in Difficulty

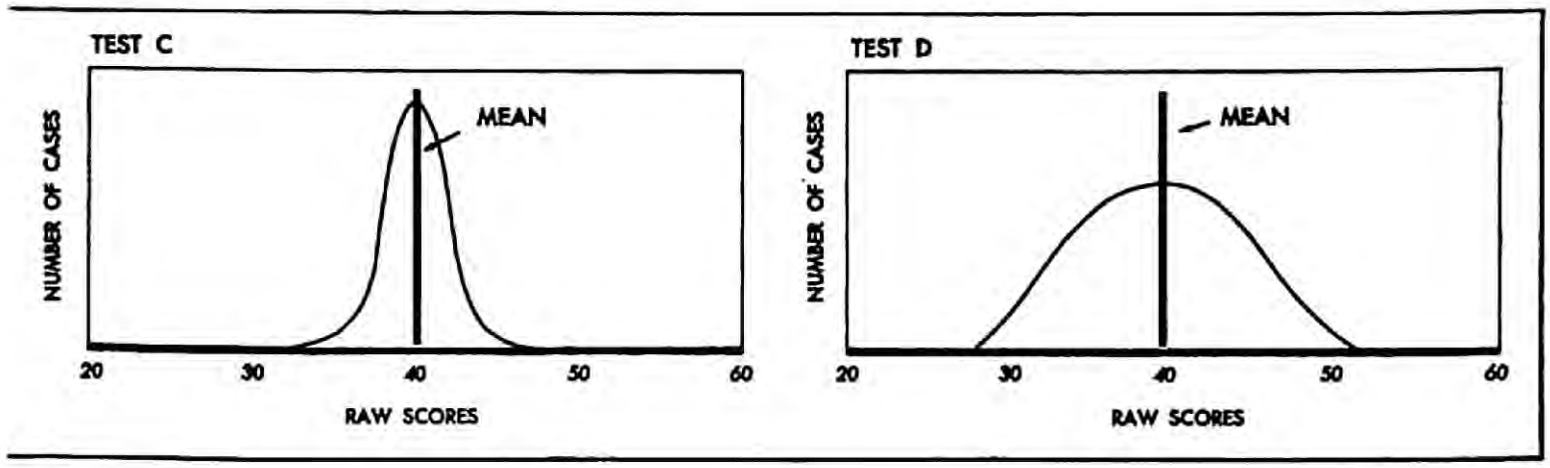


Figure 43. Distribution of Scores Obtained by Two Classes When Tests Differed in Variability but Mean was the Same

on the grade obtained on the written examination. No matter how the performance grade is weighted, this is still true. While the case is an extreme one, the principle holds true in some degree whenever there are differences in variability. When grades are averaged, they automatically weight themselves in accordance with the variability of their distributions.

If grades need to be weighted, as is commonly done, they should first be converted by a method which retains their differences in variability. This must be done before the effect of their weighting can meaningfully be evaluated.

Just as the difficulty of a test is shown by the size of its mean score, the variability is shown by the size of the standard deviation. This measure of variability is computed by adding all the squared differences between each test score and the average test score, dividing by the number of scores, and then taking the square root. (Formulas for computing the mean and the standard deviation are given later in the chapter, under "Computing Scores.")

Once the mean and standard deviation have been obtained, it is a simple matter to convert test scores to standard scores. Standard scores are reported with zero as the standard score for the mean; the other scores are reported in terms of the number of their standard deviations above or below the mean. A plus sign indicates deviation above the mean; a minus sign, deviation below the mean. In actual practice standard scores are rarely used. Scales are based on the scale for the standard scores, but improvements are usually incorporated. Test scores are usually converted to the improved scale without the intermediate step of the standard score.

T-Scores

In most distributions, about half of the grades would be negative if standard scores were used, and almost all grades would contain decimals. Both of these features are generally considered undesirable.

As the extremes of a distribution are approached, the number of cases decreases. In fact, it can be shown mathematically that, in a large representative group, only once in a million times will an individual score be more than five standard deviations from the mean. Thus, an instructor of an ordinary class would not expect to have a student with a standard score of a -5 or less, or one with a standard score of $+5$ or more.

To avoid decimal values and negative numbers, a method known as T-scoring is frequently used. The scale of the T-score is the same as that of the standard score except that its zero is five standard deviations below the mean, and its unit is one-tenth of a standard deviation. Corresponding standard scores and T-scores are shown in Figure 44.

Since the T-score of 50 is zero on the scale of standard scores, and since the T-score unit is one-tenth of a standard deviation, it is a simple matter to convert mentally from one scale to the other, if the relationship shown in Figure 44 is kept in mind. For example, a person who is one standard deviation above the mean and has a standard score of $+1$ would have a T-score of 60. A person with a standard score of -2 would

have a T-score of 30; one with standard score of —0.8, a T-score of 42; and one with a standard score of 3.6, a T-score of 86. A formula for computing T-scores is given later in the chapter under "Computing Grades."

The range of T-scores in any class depends to some extent on the size of the class. For groups of about 20, the range may be expected to be from about 30 to 70, with about half the class falling between 45 and 55. For a group of 100, T-scores may be expected to range from about 25 to 75, with about half falling between 44 and 56. In larger groups (200 to 500), T-scores may be expected to have a range from about 20 to 80, with half of them between 43 and 57.

A T-score of 50 identifies the mean of the distribution. Each 10 T-score units above or below 50 represents one standard deviation. Because T-scores may range from zero to 100, (although they will seldom exceed the limits of 20–80) with an average of 50, there is a tendency to regard them as centile-rank grades. This is a serious error. The centile score and the corresponding T-score are not necessarily the same at more than one point in any distribution (Fig. 45). Usually that point is close to 50.

The unit of the T-score is of constant size throughout the range of abilities represented on the horizontal axis. Units of centile rank are not constant. The size of the unit changes continually throughout the scale. Therefore, the real, or absolute, difference in ability between persons at the 55th and 58th centile rank is less than that between those at the 95th and 98th centile ranks, yet the difference in centile rank is 3 in both cases.

When educational evaluations have been competently made, differences on T-scores are proportional to the measured differences in abilities. The difference in ability between a person with a T-score of 55 and one with a T-score of 58 is the same as that between persons with T-scores of 95 and 98.

When a T-score is known, centile rank (based on the normal probability curve) may be obtained readily. A rough approximation of centile rank from T-score may be made by using Figure 45. (Confirm the scores which are compared below.)

T-score	*Centile rank*
75	99+
70	98
60	84
55	69
35	7

By reversing the process, T-scores may be obtained from centile ranks. In fact, one of the methods for converting test results and course points to T-scores first converts the raw scores to centile ranks, and then converts centile ranks to T-scores. An arrangement like Figure 45 may be used for this conversion. Confirm the scores in the following list, in which T-scores correspond to centile ranks.

Centile rank	*T-score*
95	67
90	63
70	55
40	47
25	43
2	30

For either of the above conversions (T-scores to centile ranks or centile ranks to T-scores), tables from texts in statistics are more accurate than Figure 45. The use of these tables is, however, beyond the scope of this text.

The T-scope method is only one of the many grading methods based on standard scores and the normal probability curve. Actually, a great many variations of converted standard scores are in use. The instructor should understand the details of the method being used before he attempts

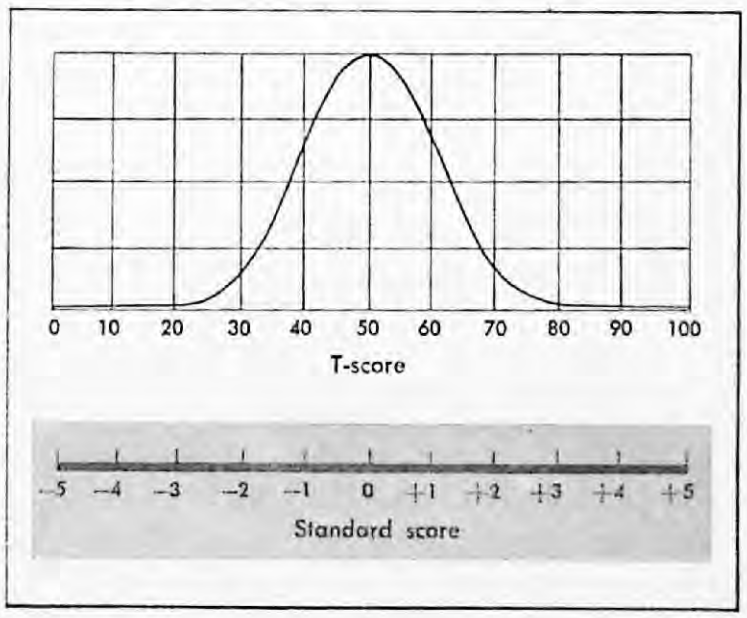


Figure 44. Position of T-Scores and Standard Scores in Normal Probability Curve

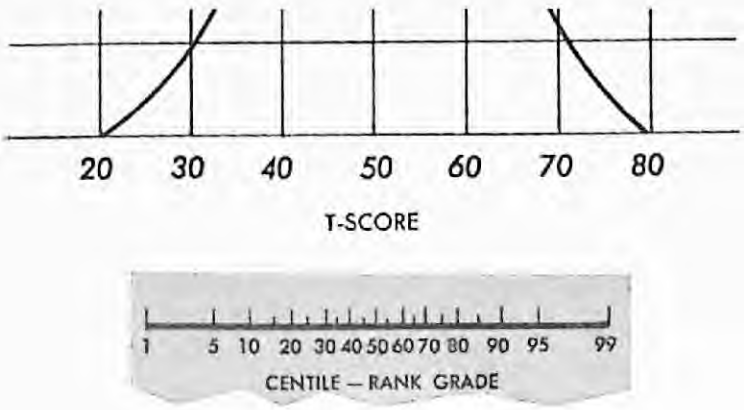


Figure 45. Corresponding T-Scores and Centile Ranks Related to Normal Probability Curve

interpretations. The T-score method assigns the value 50 to the mean of the distribution and 10 to its standard deviation. Another popular converted standard scoring method assigns the value 100 to the mean and 20 to the standard deviation. A third method, used primarily for certain nationwide testing programs, assigns the value 500 to the mean and 100 to the standard deviation. The number of possible variations to the system is, of course, infinite.

Converted Standard Scores within ATC

Of the many possible variations, the Air Training Command makes extensive use of a converted standard scoring method called the ATC Standard Scoring System. This method of grading can be used by any agency having a need for it.

The scale of the ATC Standard Scoring System ranges from 70 to 100 with a mean of 85 and a unit of one-fifth of a standard deviation. Such a scale assumes that the entire range of scores in any frequency distribution will be encompassed by six standard deviations—three above and three below the mean. It can be statistically determined that this assumption is true over 99% of the time; the error introduced, therefore, is not large. Corresponding conventional standard scores and ATC Standard Scores are shown in Figure 46.

It is easy to convert from one scale to another if the relationship depicted in Figure 46 is understood. Five units of the ATC Standard Score are equal to one unit of conventional standard score. Thus, a conventional standard score of +1 would be equal to an ATC Standard Score of 90; a conventional standard score of +1.4 would be equal to an ATC Standard Score of 92; a conventional standard score of −2.8 would be equal to an ATC Standard Score of 71; and so on. A convenient method for estimating ATC Standard Scores from centile grades, the method normally used in ATC, is discussed later.

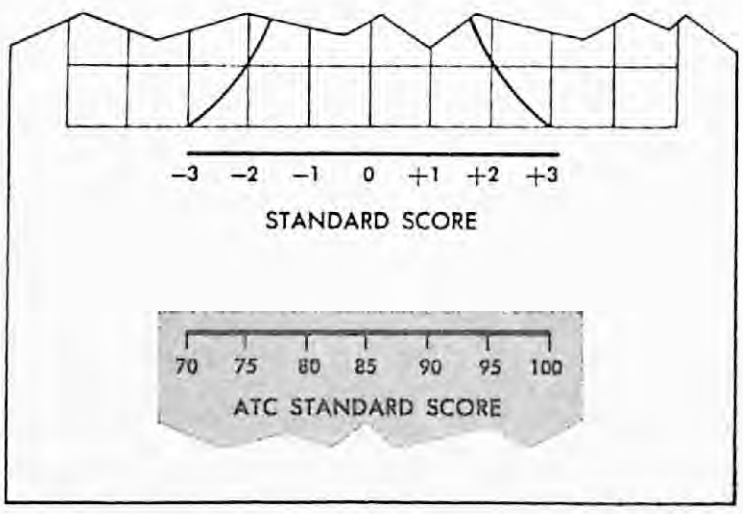


Figure 46. Corresponding Conventional Standard Scores and ATC Standard Scores Related to Normal Probability Curve

Grading on the Curve in Groups

The normal probability curve, shown in Figure 47, has been divided into ten parts at intervals of one-half standard deviation. The percentage of the total area under each of the ten

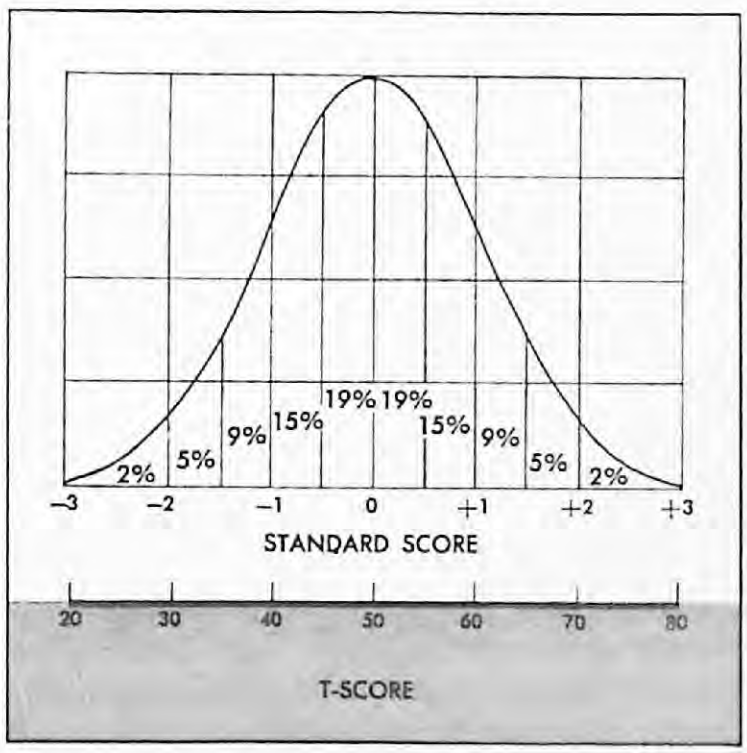


Figure 47. Percentage of Cases Falling in Certain Portions of Normal Probability Curve

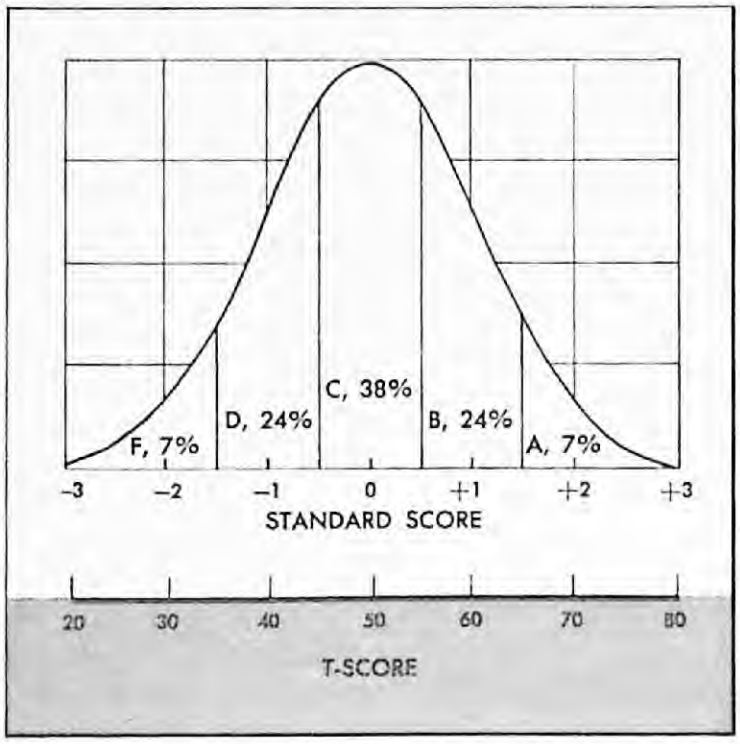


Figure 48. A System of Grading on the Curve

portions of the curve is shown. The divisions may be made and the portions combined in a variety of ways, when one is grading on the curve. A method frequently used combines these portions into five categories, with dividing lines at standard scores of −1.5, −0.5, +0.5 and +1.5. (Corresponding T-scores would be 35, 45, 55, and 65, respectively.) The resultant portions and percentages are shown in Figure 48. Students in the five groups are often assigned letter grades A, B, C, D, and F, as shown. Sometimes they are identified by the numbers 1 through 5 (in either order), or by such terms as Very Superior, Superior, Average, Fair, and Poor. Under certain conditions, the five groups may represent equal steps on a scale of ability.

Students in the different categories are sometimes identified by T-scores. Students with T-scores of 65 and above could be assigned A grades, those with T-scores from 55 to 65 could be assigned B grades, and so on. As already indicated in the discussion of centile-group grades, students are sometimes grouped by the use of centiles or percentages. For example, the top 7 percent of the class may be assigned an A grade; the next 24 percent, a B grade, and so on.

Other methods of grading in groups on the basis of the normal probability curve will probably occur to the reader.

Grading Methods Compared

To compare grading methods, suppose that two students in a class of 90 received the scores shown in Table 2 in five subjects. The raw scores

TABLE 2. — *Raw scores made by two students in five subjects.*

Subject	*Students*	
	Frank Brown	*John Doe*
A. Practice teaching	156	186
B. Curriculum construction	16	6
C. Special laboratories	30	25
D. Evaluation	11	2
E. Writing	129	130
Average score	68	70

tell nothing whatever about the real proficiency of either of these students in the five subjects. It is only possible to draw conclusions about their comparative standings. Inspection reveals that Frank Brown excels John Doe in three of the five subjects, but there is no way of knowing the quality of the difference. If the scores of the two students are averaged, John Doe has the higher average. It might, therefore, be inferred that John Doe is the better student, if the five subjects are equally important.

In Table 3, Brown's and Doe's rank-order grades are shown. These rank-order grades give

TABLE 3. — *Rank-order scores made by the same two students in the five subjects.*

Subject	*Students*	
	Frank Brown	*John Doe*
A. Practice teaching	45/90	9/90
B. Curriculum construction	11/90	86/90
C. Special laboratories	47/90	79/90
D. Evaluation	16/90	89/90
E. Writing	43/90	42/90
Average Score	32/90	61/90

more information than the raw scores alone. Differences in rank order, however, are not proportional to differences in ability. There is a tendency to infer such a relationship. Furthermore, although Frank Brown ranked above John Doe in writing, such fine discriminations are not warranted near the center of so large a group.

The scores of Brown and Doe were converted to the centile-rank grades shown in Table 4.

TABLE 4. — *Centile-rank scores made by the same two students in the five subjects.*

Subject	Students	
	Frank Brown	John Doe
A. Practice teaching	50	90
B. Curriculum construction	88	4
C. Special laboratories	48	12
D. Evaluation	82	1
E. Writing	52	53
Average score	64	32

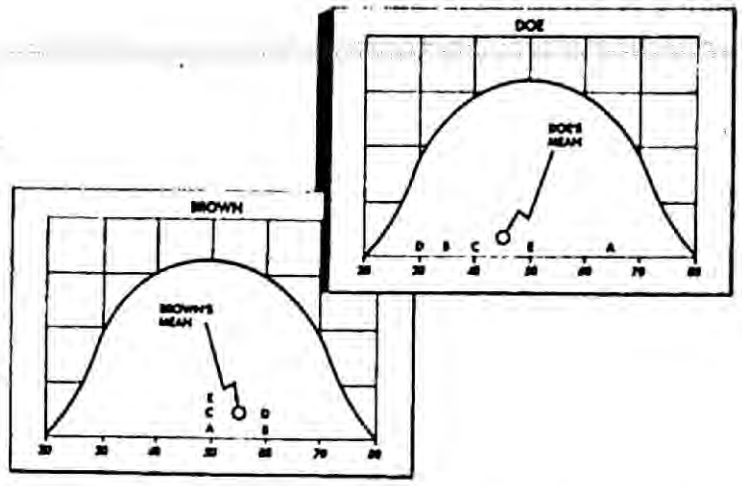


Figure 49. Relative Standings of Two Students in Five Subjects

In general, the situation is the same as with the rank-order grades. Again, the apparent difference in abilities of the two students in writing is not genuine.

The mean and standard deviation of the distribution of the 90 scores in each of the five subjects were computed and are recorded in Table 5. When these values were compared with

TABLE 5. — *T-Score grades made by the same two students in the five subjects.*

Subject	Mean score	Standard deviation	T-score	
			Frank Brown	John Doe
A. Practice teaching	156	20	50	65
B. Curriculum construction	12	4	60	35
C. Special laboratories	30	5	50	40
D. Evaluation	8	3	60	30
E. Writing	130	36	50	50
Average score	—	—	54	44

the scores of Brown and Doe, their T-score grades for each of the five subjects were obtained. If the normal probability curve and the scales shown in Figure 45 are kept in mind, a clear picture of the proficiency of each student relative to that of other students is obtained. Figure 49 shows the relationships that the interpreter should keep in mind.

Frank Brown is average, or well above average, in all five subjects. John Doe, on the other hand, is above average in only one subject, and clearly below average in three subjects. Furthermore, Brown's mean T-score is well above the average of the total group, whereas Doe's mean T-score is clearly below average.

One of the advantages of grades based on standard scores is that they may be averaged fairly. Averages based on other grading methods are open to question. For example, Doe had a higher course average, based on original raw scores, yet he is clearly a poorer student.

When grades in several subjects are to be weighted and then expressed as a single, composite grade, the grades should be based on standard scores. (The instructor can then be sure that each subject has been truly weighted in accordance with the weighting factor.) For example, if scores in each subject are first converted to T-scores, and each set of T-score grades is multiplied by the weighting factor, then each student's sum may be used as a measure of his relative position in the class. This approach to weighting subjects is shown in Table 6 for Brown and Doe.

T-scores may be weighted, but the original raw scores and accumulated points should not be weighted. Weighting original raw scores may only make weightings less reliable, as in the case of Brown and Doe.

COMPUTING GRADES

This section is concerned with several grading methods described in the first part of the chapter. The basic data are the final school grades made by 150 students in Air Force clerical schools.

TABLE 6. — *Weighted scores made by the same two students in the five subjects.*

	Weight factor (percent)	Frank Brown		John Doe	
		T-score	Weighted score	T-score	Weighted score
A. Practice teaching	35	50	18.50	65	22.75
B. Curriculum construction	10	60	6.00	85	8.50
C. Special laboratories	10	50	5.00	40	4.00
D. Evaluation	25	60	15.00	30	7.50
E. Writing	20	50	10.00	50	10.00
			54.50		47.75

Whatever grading method is to be used, a frequency distribution of scores should be established first. The scores may be the result of a single administration of the test or they may have been accumulated over a period of time.

The frequency distribution of the scores made by the 150 students in Air Force clerical schools (Fig. 50) was constructed as follows:

Step 1. In Column 1, the scores obtained by the group were listed from the highest to lowest.

Step 2. In Column 2, tally marks were entered for each score.

Step 3. In Column 3, the number of tally marks for each of the scores was recorded. Because this column tells how frequently each score occurred, it is known as the "frequency column (f)." The total of this column should be the total number of persons in the group.

This frequency distribution (Columns 1 and 3) is used in computing grades in the remainder of this chapter.

Rank-Order Grades

Rank-order grades are best computed from the basic frequency distribution shown in Figure 50. Figure 51 shows the rank-order which would be assigned to all 150 students. Two tied for the highest rank in the class. If evaluation instruments had the capability of making finer differentiations between the two students, one would have ranked first and the other, second. Since it is not possible to differentiate between them on the basis of information available, they should both receive the same rank-order grade.

In cases of a tie, it is customary to assign all members the median rank of that tying group. The two highest would therefore be assigned the rank-order grade of 1.5/150. Since 7 students tied for the ranks 3 through 9, each would receive the rank-order grade of 6/150.

To find a rank-order grade of tying students, the instructor should follow this procedure: (1) note the lowest and highest ranks of those in the tying group, and (2) average these two ranks. For example, 25 students received scores higher than 43, and 12 students received 43.

1	2	3
School score	Tally marks	Number of students (f)
47	II	2
46	𝍸 II	7
45	𝍸 III	8
44	𝍸 III	8
43	𝍸 𝍸 II	12
42	𝍸 𝍸 I	11
41	𝍸 𝍸 𝍸	15
40	𝍸 𝍸 II	12
39	𝍸 III	8
38	𝍸 𝍸 II	12
37	𝍸 𝍸 II	12
36	𝍸 𝍸	10
35	𝍸 II	7
34	I	1
33	𝍸 II	7
32	𝍸 I	6
31	IIII	4
30	II	2
29	IIII	4
28	I	1
27	I	1
Sum		150

Figure 50. Tabulation of a Frequency Distribution

1	2	3
School score	Number of students (f)	Rank-order grade
47	2	1.5/150
46	7	6/150
45	8	13.5/150
44	8	21.5/150
43	12	31.5/150
42	11	43/150
41	15	56/150
40	12	69.5/150
39	8	79.5/150
38	12	89.5/150
37	12	101.5/150
36	10	112.5/150
35	7	121/150
34	1	125/150
33	7	129/150
32	6	135.5/150
31	4	140.5/150
30	2	143.5/150
29	4	146.5/150
28	1	149/150
27	1	150/150

Figure 51. Computation of Rank-Order Grades

The highest person in the group receiving 43 would therefore have a rank of 26; the lowest, 37. The rank-order grade for each of these 12 students is computed as follows:

$$\frac{\frac{1}{2}\ (26 + 37)}{150} = \frac{\frac{1}{2}\ (63)}{150} \text{ or } \frac{31.5}{150}.$$

In computing rank-order grades, the following formula may be used.

$$\text{Rank-order grade} = \frac{\frac{1}{2}\ (T + B)}{N}.$$

Where T is the rank of the student at the top of the tying group; B, the rank of the student at the bottom of the tying group; and N, the total number in the class.

The formula may be used to obtain the rank-order grade for the eight students with the score of 44:

$$\text{Rank-order grade} = \frac{\frac{1}{2}\ (18 + 25)}{150}$$

$$\frac{\frac{1}{2}\ (43)}{150} = \frac{21.5}{150}$$

Centile-Rank Grades

Centile-rank grades are computed from a frequency distribution in much the same way as are rank-order grades. The main difference is that centile-rank grades are computed from the lower end of the scale.

Probably the easiest method of converting a frequency distribution into centile-rank grades is by the use of the basic distribution of student scores. These steps can be followed:

Step 1. Construct a cumulative frequency column (Column 3 in Fig. 52), which shows the number of students below the score given. For

1	2	3	4	5
School score	Number of students (f)	Number of students below each score	Column 3 + half the number at this score	Centile-rank grade
47	2	148	149.0	99
46	7	141	144.5	96
45	8	133	137.0	91
44	8	125	129.0	86
43	12	113	119.0	79
42	11	102	107.5	72
41	15	87	94.5	63
40	12	75	81.0	54
39	8	67	71.0	47
38	12	55	61.0	41
37	12	43	49.0	33
36	10	33	38.0	25
35	7	26	29.5	20
34	1	25	25.5	17
33	7	18	21.5	14
32	6	12	15.0	10
31	4	8	10.0	7
30	2	6	7.0	5
29	4	2	4.0	3
28	1	1	1.5	1
27	1	0	0.5	0

Figure 52. Computation of Centile-Rank Grades

example, no one scored below 27. Therefore, the entry in Column 3 for 27 is zero. Since one student had a score lower than 28, the entry in Column 3 for 28 is 1. Since two students scored below 29, the entry in Column 3 for 29 is 2. This process is continued to the top score. Obviously, the top entry in Column 3 is 148. The cumulative frequency for the top centile-rank can be checked against the total number in the distribution.

Step 2. Construct a column (Column 4, Fig. 52) which shows the number of students below a particular score, plus one-half the number of students obtaining that score. Entries for Column 4 may be obtained by adding ½ the number in Column 2 to the entry in Column 3. For example, in Figure 52, the entry in Column 4 for the score 36 is 38 because—

$$\tfrac{1}{2}\ (10) + 33 = 38.0.$$

For the score 41, the entry is 94.5 because—

$$\tfrac{1}{2}\ (15) + 87 = 94.5.$$

Step 3. It is now a simple matter to compute the percent of the total group which lies below the middle of each of the scores. To do this, divide each entry in Column 4 by the total number of students, and then multiply by 100. For example, for a score of 36 the centile-rank would be 25, obtained as follows:

$$\frac{38}{150} \times 100 = 25.$$

In other words, the ten students with a score of 36 receive a centile-rank grade of 25; they are at the 25th centile. The 15 students who had a score of 41 receive centile-rank grades of 63 since—

$$\frac{94.5}{150} \times 100 = 63.$$

Step 4. The above arithmetical procedures can be expressed by the following formula:

$$\text{Centile Rank} = \frac{Y + f/2}{N} \times 100$$

Where Y is the number of students below a particular score; f, the number of students receiving that same particular score; and N is the total number of students in the class. Usually the decimal portions of centile-rank grades are not considered important. Consequently, centile-rank is usually reported to the nearest whole percent.

Centile-Group Grades

Many methods of centile-group grading are used, and the instructor may invent one to suit his needs. Whatever groups are used, some of the dividing lines are almost sure to fall so that they will separate the members of a group who have the same score. In such a situation, it is necessary to decide on which side of the group the line should be placed. All students with the same score should receive the same grade.

A basic distribution of scores may be grouped in several ways (Fig. 53). In the first method (A), the class is divided into four groups. The top 20 percent of the class is labeled Superior; the next 30 percent, Above Average; the next 40 percent, Satisfactory; and the bottom 10 percent, Unsatisfactory. Since 20 percent of 150 is 30, a count from the top of the distribution should include 30 students. The 30th student from the top is among the 12 students who received a score of 43. If the dividing line is placed just above this group, only 25 are within the top 20 percent. If the dividing line is placed so as to include the whole group with a score of 43, then 37 students would be within the top 20 percent. Since 25 is closer to 30 than 37 is, the dividing line is placed between the scores 43 and 44. Obviously the position of this dividing line will vary with instructors; and for the individual instructor, it is likely to vary according to his mood and his general impressions. In Method A, subjectivity is involved even more in identifying the low 10 percent. Since 10 percent of 150 is 15, a count from the bottom of the distribution should include 15 persons. This dividing line falls at the middle of the group which received a score of 32. An arbitrary decision is necessary.

Method B is similar to Method A with these exceptions: five groups are used, the percentages are intended to be symmetric, and letters instead of adjectives are used to identify the groups. In Method C, the class is divided into ten approximately equal groups. Method D divides the class into quarters.

Standard Scores

ARITHMETIC MEAN. The arithmetic mean of a set of scores can be found by totaling them and by dividing the sum by the number of scores. For example, the mean of 103, 101, 98, and 98 is 100.

School score (raw score)	Number of students (f)	Percentage groupings			
		A 20%, 30%, 40%, and 10%	B 10%, 20%, 40%, 20%, and 10%	C Tenths	D Quarters
47	2	High 20% (Superior)	High 10% (A)	1	1
46	7				
45	8				
44	8		Next 20% (B)	2	
43	12	Next 30% (Above Average)		3	
42	11				2
41	15		Next 40% (C)	4	
40	12			5	
39	8	Next 40% (Satisfactory)		6	3
38	12				
37	12			7	
36	10		Next 20% (D)	8	
35	7			9	4
34	1				
33	7				
32	6			10	
31	4	Low 10% (Unsatisfactory)	Low 10% (F)		
30	2				
29	4				
28	1				
27	1				

Figure 53. Computation of Several Centile-Group Grades with Different Percentage Groupings

$$\frac{103 + 101 + 98 + 98}{4} = \frac{400}{4} = 100$$

The method of computing the mean might be further illustrated by considering grades obtained from the class of 150 students (Fig. 54). The numbers in column f tell how many students obtained each raw score. The mean is computed in the following steps:

Step 1. Arrange the raw scores of the test in numerical order from highest to lowest without repeating identical scores. (Call this column X.)

Step 2. In a column opposite each score list the number of students who made that score. (Call this the f, or frequency column.) Total this column to determine N, the number of students in the class.

Step 3. Multiply each score by the number of students who made that score (fX column). Since the figure shows that two persons obtained a score of 47, this score should appear twice in the list of scores. To save space, 94 (47 multiplied by 2) can be entered in column fX opposite 47. The next entry is 46 times 7, or 322. The column is completed in this manner.

Test score X	Frequency f	fX	Deviation d	d^2	fd^2	Standard Score $\frac{d}{s}$	T-score
47	2	94	8.1	65.6	131.2	1.76	68
46	7	322	7.1	50.4	352.8	1.54	65
45	8	360	6.1	37.2	297.6	1.32	63
44	8	352	5.1	26.0	208.0	1.10	61
43	12	516	4.1	16.8	201.6	.89	59
42	11	462	3.1	9.6	105.6	.67	57
41	15	615	2.1	4.4	66.0	.45	55
40	12	480	1.1	1.2	14.4	.23	52
39	8	312	.1	.0	.0	.02	50
38	12	456	−.9	.8	9.6	−.19	48
37	12	444	−1.9	3.6	43.2	−.41	46
36	10	360	−2.9	8.4	84.0	−.63	44
35	7	245	−3.9	15.2	106.4	−.85	42
34	1	34	−4.9	24.0	24.0	−1.07	39
33	7	231	−5.9	34.8	243.6	−1.28	37
32	6	192	−6.9	47.6	285.6	−1.50	35
31	4	124	−7.9	62.4	249.6	−1.72	33
30	2	60	−8.9	79.2	158.4	−1.93	31
29	4	116	−9.9	98.0	392.0	−2.15	29
28	1	28	−10.9	118.8	118.8	−2.37	26
27	1	27	−11.9	141.6	141.6	−2.59	24
	150	5,830			3234.0		

$$\text{Mean} = M = \frac{\Sigma fX}{N} = \frac{5,830}{150} = 38.9$$

$$\text{Standard deviation} = s = \sqrt{\frac{\Sigma fd^2}{N}} = \sqrt{\frac{3234.0}{150}}$$

$$= \sqrt{21.6} = 4.6$$

Figure 54. Computation of Mean, Standard Deviation, Standard Scores, and T-Scores

Step 4. Find the sum of column fX. This is the sum of all 150 scores obtained on the test. In the example, the sum is 5,830.

Step 5. Divide the sum of scores (5,830) by the number of scores (150) to obtain the mean. The result is usually reported to the nearest tenth.

$$\frac{5,830}{150} = 38.867 \text{ or } 38.9$$

The mean can be computed by the following formula:

$$M = \frac{\Sigma fX}{N}$$

Where M is the mean; Σ (the Greek letter, sigma), the "summation of"; f, the frequency; X, a test score; and N, the number of scores.

STANDARD DEVIATION. The same frequency distribution of grades is used here to show how to find the standard deviation of any distribution. The following method is used.

Step 1. Determine how much each test score deviates from the mean. (Call this column d.) This figure can be obtained by subtracting the mean from the test score. For example, 47 — 38.9 = 8.1, the deviation of highest score; and 27 — 38.9 = −11.9, the deviation of lowest score. Note that the deviation of all scores below the mean is negative.

Step 2. Square the deviation. (Call this column d^2.) If 8.1 (the deviation of the test score 47) is multiplied by itself (i.e., squared), the product is 65.6. The column is completed in this manner.

Step 3. Multiply the frequency of each score by the deviation squared for that particular score. (Call this column fd^2.) Just as the test score is multiplied by the frequency in finding the mean, the square of the deviation is multiplied by the frequency to find the standard deviation.

Step 4. "Standard deviation" may be defined as the square root of the average of the squares of the deviations from the mean of the distribution. Compute the standard deviation of this distribution by using the following formula:

$$s = \sqrt{\frac{\Sigma fd^2}{N}}$$

Where s is the standard deviation; Σ, the "summation of"; f, the frequency; d, the deviation of a score from the mean; and N, the number of scores. The total of column fd^2 is 3,234.0. This total divided by the number of scores in the distribution (150) results in 21.6. The square root of 21.6 is 4.6. Therefore, the standard deviation for this distribution is 4.6. (The standard deviation is usually reported to the nearest tenth.)

STANDARD SCORE. Now it is a simple matter to find the standard score corresponding to any given raw test score. Standard scores (SS) are defined as scores expressed in terms of their standard deviation distances from the mean. This definition may be expressed in terms of the following formula:

$$\text{Standard score} = SS = \frac{X - M}{s} \text{ or } \frac{d,}{s}$$

where X is the test score, M is the mean, and s is the standard deviation.

The basic formula can be reduced to $\frac{d}{s}$, as d is the amount each raw score deviates from the mean and is the same as $X - M$.

To calculate the standard score ($\frac{d}{s}$ column), divide the amount each score deviates from the mean (d column) by the standard deviation. For example, the test score 47 expressed as a standard score may be found as follows:

$$SS = \frac{X - M}{s} = \frac{47 - 38.9}{4.6} = \frac{8.1}{4.6} = 1.76.$$

T-Scores

Standard scores can be converted to T-scores, which have a mean of 50 and a standard deviation of 10. (Note: T-scores are usually reported to the nearest whole number.) This conversion is expressed in the following formula:

$$\text{T-Score} = 10\left(\frac{d}{s}\right) + 50$$

For example, the test score 47 expressed as a T-score would be found in the following manner—

$$\text{T-Score} = 10\left(\frac{d}{s}\right) + 50 = 10\left(\frac{8.1}{4.6}\right) + 50 =$$

$$10\ (1.76) + 50 = 17.6 + 50 = 68.$$

In actual practice, the labor of computing standard deviation and standard and T-scores is reduced considerably by using a slide rule or calculating machine. The instructor will find many short cuts and checks as he becomes more familiar with the process. A few of these short cuts will now be considered.

Assumed Mean Method of Computing T-Scores

One difficulty often encountered in the preceding method is the fact that deviations (*d*) are not whole numbers. When the mean is not a whole number, this can be avoided by using the assumed mean method (Fig. 55).

Step 1. Select the test score which appears to be a logical mean. Any raw score will work since this method involves a correction factor. For the purpose of illustration, the score 40 will be the assumed mean. In the *d* column, assign zero to this score and complete the column. (Note that the deviations below the assumed mean are negative.)

Step 2. Find the values of *fd*. Since the table shows that two students with the score of 47 had deviations of 7, the entry in the *fd* column would be 14 (2 multiplied by 7). The column is completed in this manner.

Step 3. Find the algebraic sum of the *fd* column. Add all positive numbers; add all negative numbers; subtract and assign the sign of the larger ($+201 - 371 = -170$).

Step 4. Determine the correction by dividing this sum by the total number of students and apply it to the assumed mean:

$$\left(\frac{-170}{150} = -1.13\right).$$

$$40 - 1.13 = 38.87 \text{ (true mean)}$$

Test score X		*f*	*d*	*fd*	*fd²*	*T*	*(Rounded off)*
47		2	7	14	98	67.6	68
46		7	6	42	252	65.4	65
45		8	5	40	200	63.3	63
44		8	4	32	128	61.0	61
43		12	3	36	108	58.9	59
42		11	2	22	44	56.8	57
41		15	1	15	15	54.6	55
40	(assumed mean)	12	0	0	0	52.4	52
39		8	−1	−8	8	50.2	50
38		12	−2	−24	48	48.0	48
37		12	−3	−36	108	45.9	46
36		10	−4	−40	160	43.7	44
35		7	−5	−35	175	41.6	42
34		1	−6	−6	36	39.4	39
33		7	−7	−49	343	37.2	37
32		6	−8	−48	384	35.0	35
31		4	−9	−36	324	32.9	33
30		2	−10	−20	200	30.7	31
29		4	−11	−44	484	28.5	29
28		1	−12	−12	144	26.4	26
27		1	−13	−13	169	24.2	24
		150		−170	3428		

$$\frac{-170}{150} = -1.13 \quad 40 - 1.13 = 38.87 \text{ (true mean)}$$

$$\text{Standard deviation} = \sqrt{\frac{3428}{150}} = \sqrt{22.85 - 1.2769} = \sqrt{21.57} = 4.6$$

$$\sqrt{\frac{\Sigma fd^2}{N}}$$

Figure 55. Computation of T-Scores Using Assumed Mean Method

Step 5. Complete the fd^2 column by multiplying d times fd. In the first case, this would be 7 multiplied by 14. The figures below the assumed mean now become positive. (Algebraically, a negative value multiplied by a negative value becomes a positive value.) Divide the sum of the fd^2 column by the total number of students ($3{,}428 \div 150 = 22.85$).

Step 6. A correction must now be applied to this figure before the square root can be extracted to determine the standard deviation. This correction is computed by squaring the correction found in step 4 above: $-1.13 \times -1.13 = 1.28$. Subtract this new correction factor ($22.85 - 1.28 = 21.57$); and then extract the square root ($\sqrt{21.57} = 4.6$).

Step 7. This method permits the computation of T-scores without first determining the standard score. This is made possible by using the combined formulas for standard score and T-score conversion which were discussed earlier.

$$\text{Standard score} = \frac{X - M}{s}$$

$$\text{T-score} = 10 \text{ (standard score)} + 50$$

$$\text{Combined: } 10\,\frac{X - M}{s} + 50 = \text{T-score, or}$$

$$\frac{10}{s}(X - M) + 50 = \text{T-score}$$

Using this formula, the T-score for the lowest raw score is computed:

$$\frac{10}{4.6}(27 - 38.87) + 50 = 24.2$$

In the progression to the next raw score, the T-score is increased by the constant $\frac{10}{4.6}$, written 2.17.

$$\frac{10}{4.6}\ (28 - 38.87) + 50 = 26.36\ \ (26.4).$$

Each succeeding T-score is determined by adding the constant (2.17) to the preceding T-score. Thus, the raw score of 29 gives a T-score of 28.5 (26.4 + 2.17 = 28.57, or the round sum, 29).

SHORT METHOD OF COMPUTING STANDARD DEVIATION. This method is based on the relation of standard deviations with centile-rank (see Fig. 45). Two key points are the 5th and 95th centiles. Statistically, these are found to be 3.4 standard deviations apart (1.7 above and 1.7 below the mean) in a normal distribution.

Step 1. Average the raw scores of the top 10 percent (15 students) of the distribution to determine the raw score at the 95th centile, applying this to the distribution (see Fig. 54). (Note: Only six students of the eight with raw scores of 45 were used.)

$$\frac{2(47) + 7(46) + 6(45)}{15}$$

$$= 45.7 \text{ (raw score of 95th centile).}$$

Step 2. Likewise, average the raw scores for the bottom 10 percent (15 students) to determine the raw score equivalent to the 5th centile. 1(27) + 1(28) + 4(29) + 2(30) + 4(31) + 3(32) = 30.0 (raw score of 5th centile). (Note: Only three of the six students with a raw score of 32 were used.)

Step 3. The formula is applied as follows:

$$\text{Standard Deviation} = \frac{\text{95th centile raw score} - \text{5th centile raw score}}{3.4} =$$

$$\frac{45.7 - 30.0}{3.4} = \frac{15.7}{3.4} = 4.6$$

LINEAR CONVERSION OF RAW SCORES TO T-SCORES. Since there is the constant relationship between the raw scores and the computed T-scores for any distribution (as shown in the assumed mean method of computing T-scores), this relationship can be represented by a linear graph. With such a graph, raw scores are then easily converted directly to their T-scores. The data necessary for this method are the mean and standard deviation for the distribution.

From the grades made by the 150 students in the Air Force clerical schools, the mean is found to be 38.9 with a standard deviation of 4.6. The graph (Fig. 56) is prepared as follows:

Step 1. Label the T-scores on the horizontal axis of the conversion graph.

Step 2. Enter the raw scores of the distribution on the vertical axis of the conversion graphs (the lowest raw score is entered at the bottom of the vertical axis). All possible scores from the lowest to the highest must be entered, even though no students actually receive some of the scores listed.

Step 3. On the vertical axis, mark with a short line the point corresponding to the mean of the raw scores (38.9).

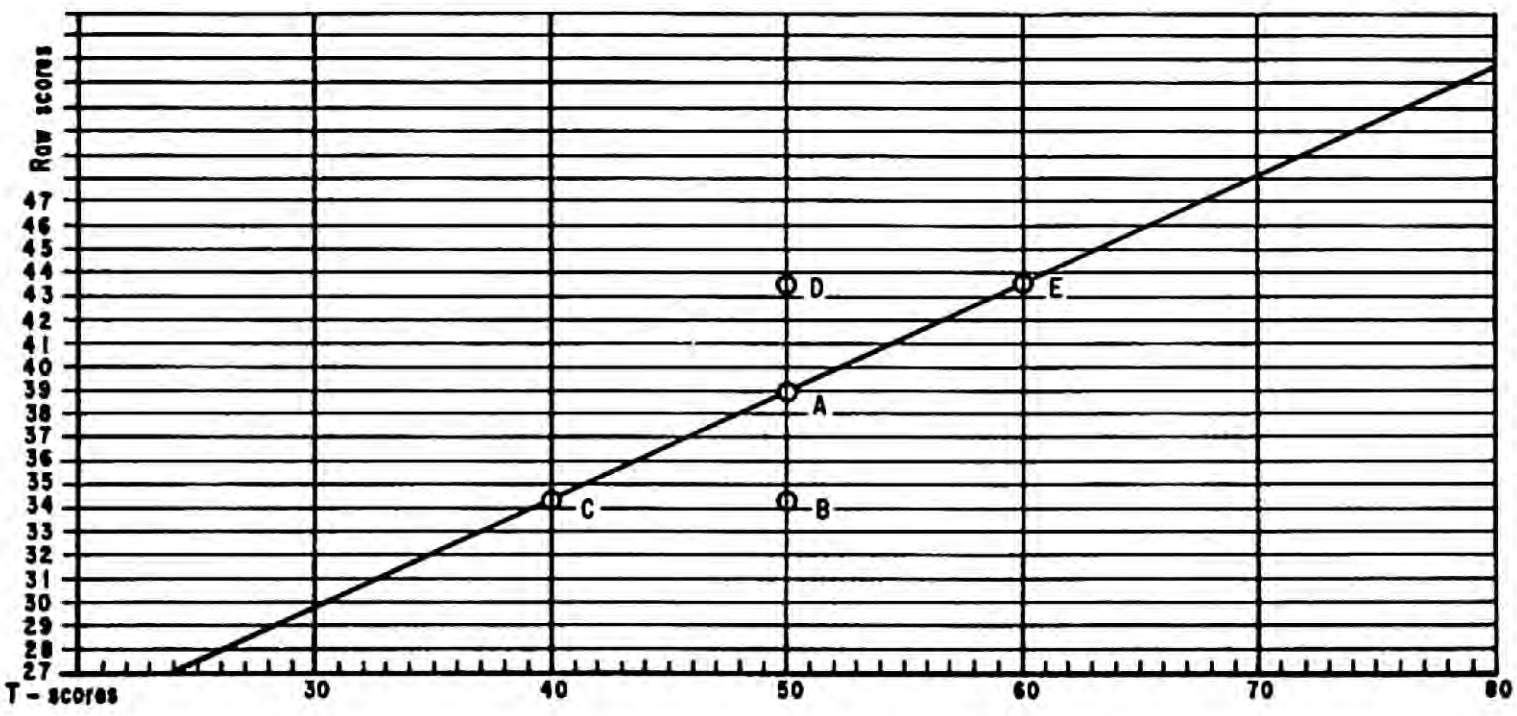


Figure 56. Linear Conversion Graph — Raw Scores to T-Scores

Step 4. Draw a horizontal line from this point to the right until it intersects with the vertical line corresponding to a T-score of 50. (Label the point of intersection of these two lines with an "A".)

Step 5. Starting at point "A," count down the numbers of spaces equal to the standard deviation (4.6) of the raw scores. (Label this point "B".)

Step 6. Starting at point "B," count to the left ten spaces (one standard deviation) corresponding to the T-score 40. (Label this point "C".)

Step 7. Using a straight edge, connect points "A" and "C", and extend this line in both directions across the entire graph.

Step 8. To check the accuracy of this line further, determine point "D" by counting up one standard deviation (4.6) from the mean (point "A"). Then count to the right one standard deviation (to T-score line representing 60) and mark point "E." This point will fall on the line drawn through points "C" and "A," if the construction is accurate.

Step 9. Use the line drawn in step 7 as a basis for converting raw scores to T-scores.

1. Find the point on the vertical axis of the graph corresponding to the raw score desired (37).
2. Follow a horizontal line from this point to the right until it intersects the line drawn in step 7.
3. Directly below this point of intersection on the horizontal axis the T-score equivalent of the raw score will be found (46).

ATC Standard Scores

As noted earlier in this chapter, conventional standard scores can be converted to ATC standard scores with an assigned mean of 85 and each standard deviation with an assigned value of 5. Formulas can be developed for making these conversions, but, in actual practice, ATC standard scores are usually estimated from centile grades. In making these estimations, ATC uses a form similar to the one shown in Figure 57. The instructor will note the similarities between this form and the table shown in Figure 52. For purposes of illustration, however, complete accomplishment of the form shown in Figure 57 is explained in detail since this form or a similar one is widely used in ATC.

Step 1. First enter the appropriate information in the spaces provided in the heading of the form.

Step 2. Indicate by a check mark (√) the proper raw score or percent column as indicated by the range of scores.

Step 3. If the same examination has been given previously, determine the distribution of raw scores for previous exams. Enter the information in the column headed PREVIOUS CLASSES and the identifying data for the classes involved in that portion of the heading titled CLASS. (In this example, it has been assumed that the 150 clerks represent one "class." Therefore, the word NONE would be entered in the space for CLASS.)

Step 4. Determine the distribution of raw scores for the present class (the 150 clerks) and enter this information in the column titled PRESENT CLASS.

Step 5. Determine the overall distribution of raw scores (present class plus previous classes) and enter this information in the column titled TOTAL. (In this example, the TOTAL column will, of course, be the same as the PRESENT CLASS column.)

Step 6. Starting with the lowest raw score, determine the number of raw scores and enter this information in the column titled CASES BELOW GIVEN SCORE. The number of cases below the lowest rate score will, obviously, always be zero. The number of cases below the second lowest raw score will be the number of cases shown in the TOTAL column for the lowest raw score. The number of cases below the third lowest raw score will be the number of cases below the second lowest raw score made plus the number of cases in the TOTAL column for the second lowest raw score. The number of cases below each raw score is obtained in a similar manner. The number of cases below the highest raw score plus the number of cases for the highest raw score should always be equal to the total number of cases involved (in this problem, 150).

Step 7. Again, starting with the lowest raw score, determine the number of cases below each score plus one-half the number of cases for each score and enter the sum in the column titled CASES BELOW PLUS ½ ON SCORE.

Step 8. Determine a centile grade for each raw score. To do this, first divide 100 by the total number of raw scores involved (both previous and current) to obtain a constant. In this problem, 100 divided by 150 equals a constant of .67. Then multiply this constant by each figure in the column titled CASES BELOW PLUS ½ ON SCORE and enter the results, correct to two decimal

ATC Standard Score Conversion Table

Base or Center: Lackland AFB	Course: ----------	Class: None
Subject: Clerical Duties	Exam Form Nr.: --------	Date Administered: ----------

Raw Score or Percent			Frequency Tabulation: Previous Classes	Frequency Tabulation: Present Class (---)	Total	Cases Below Given Score	Cases Below + ½ on score	Centile Grade	ATC Standard Score
50	75	100							
49	74	99							
48	73	98				150			
47	72	97		II	2	148	149	99.83	100
46	71	96		𝍸 II	7	141	144.5	96.82	94
45	70	95		𝍸 III	8	133	137	91.79	92
44	69	94		𝍸 III	8	125	129	86.43	91
43	68	93		𝍸 𝍸 II	12	113	119	79.73	89
42	67	92		𝍸 𝍸 I	11	102	107.5	72.03	88
41	66	91		𝍸 𝍸 𝍸	15	87	94.5	63.32	87
40	65	90		𝍸 𝍸 II	12	75	81	54.27	86
39	64	89		𝍸 III	8	67	71	47.57	85
38	63	88		𝍸 𝍸 II	12	55	61	40.87	84
37	62	87		𝍸 𝍸 II	12	43	49	32.83	83
36	61	86		𝍸 𝍸	10	33	38	25.46	82
35	60	85		𝍸 II	7	26	29.5	19.77	81
34	59	84		I	1	25	25.5	17.09	80
33	58	83		𝍸 II	7	18	21.5	14.41	80
32	57	82		𝍸 I	6	12	15	10.05	79
31	56	81		𝍸	4	8	10	6.70	78
30	55	80		II	2	6	7	4.69	77
29	54	79		𝍸	4	2	4	2.68	75
28	53	78		I	1	1	1.5	1.01	73
27	52	77		I	1	0	.5	.34	71
26	51	76							
25	50	75							
24	49	74							
23	48	73							
22	47	72	100 =	.67 (constant)					
21	46	71	150						
20	45	70							
19	44	69							
18	43	68							
17	42	67							
16	41	66							
15	40	65							
14	39	64							
13	38	63							
12	37	62							
11	36	61							
10	35	60							
9	34	59							
8	33	58							
7	32	57							
6	31	56							
5	30	55							
4	29	54							
3	28	53							
2	27	52							
1	26	51							
0	25	50							
				TOTAL					

Figure 57. ATC Standard Score Conversion Table

TABLE 7.—*Table for Converting Centile Grades to ATC Standard Scores.*

Centile Grades	*Corresponding ATC Standard Score*
99.81 to 100.00	100
99.65 to 99.80	99
99.38 to 99.64	98
98.93 to 99.37	97
98.21 to 98.92	96
97.13 to 98.20	95
95.54 to 97.12	94
93.32 to 95.53	93
90.32 to 93.31	92
86.43 to 90.31	91
81.59 to 86.42	90
75.80 to 81.58	89
69.15 to 75.79	88
61.79 to 69.14	87
53.98 to 61.78	86
46.02 to 53.97	85
38.21 to 46.01	84
30.85 to 38.20	83
24.20 to 30.84	82
18.41 to 24.19	81
13.57 to 18.40	80
9.68 to 13.56	79
6.68 to 9.67	78
4.46 to 6.67	77
2.87 to 4.45	76
1.79 to 2.86	75
1.07 to 1.78	74
.62 to 1.06	73
.35 to .61	72
.19 to .34	71
0 to .18	70

places, in the CENTILE GRADE column opposite the appropriate raw score. These arithmetical computations are, in effect, applications of the formula for determining centile-ranks given previously.

Step 9. Determine the ATC standard score equivalent for each raw score by referring to Table 7. To do this, locate the centile grade range or interval in the table which includes each of the above computed centile grades and enter the corresponding ATC standard score opposite the appropriate raw score.

Figure 58 has been included in the text to show a comparison of several grading methods. If the relationships shown in this figure are kept in mind, it is a simple matter to convert from one of these methods of grading to another.

SUMMARY

There is no best grading method; each method has advantages which must be weighed. The selection of any method depends on the purposes which the grades are expected to serve. Absolute methods include raw scores and percentage grades; relative grading methods include rank-order grades, centile grades, standard scores, and T-scores (converted form of standard scores). Any grading method is effective only to the degree that its users are able to compute grades accurately and interpret them meaningfully.

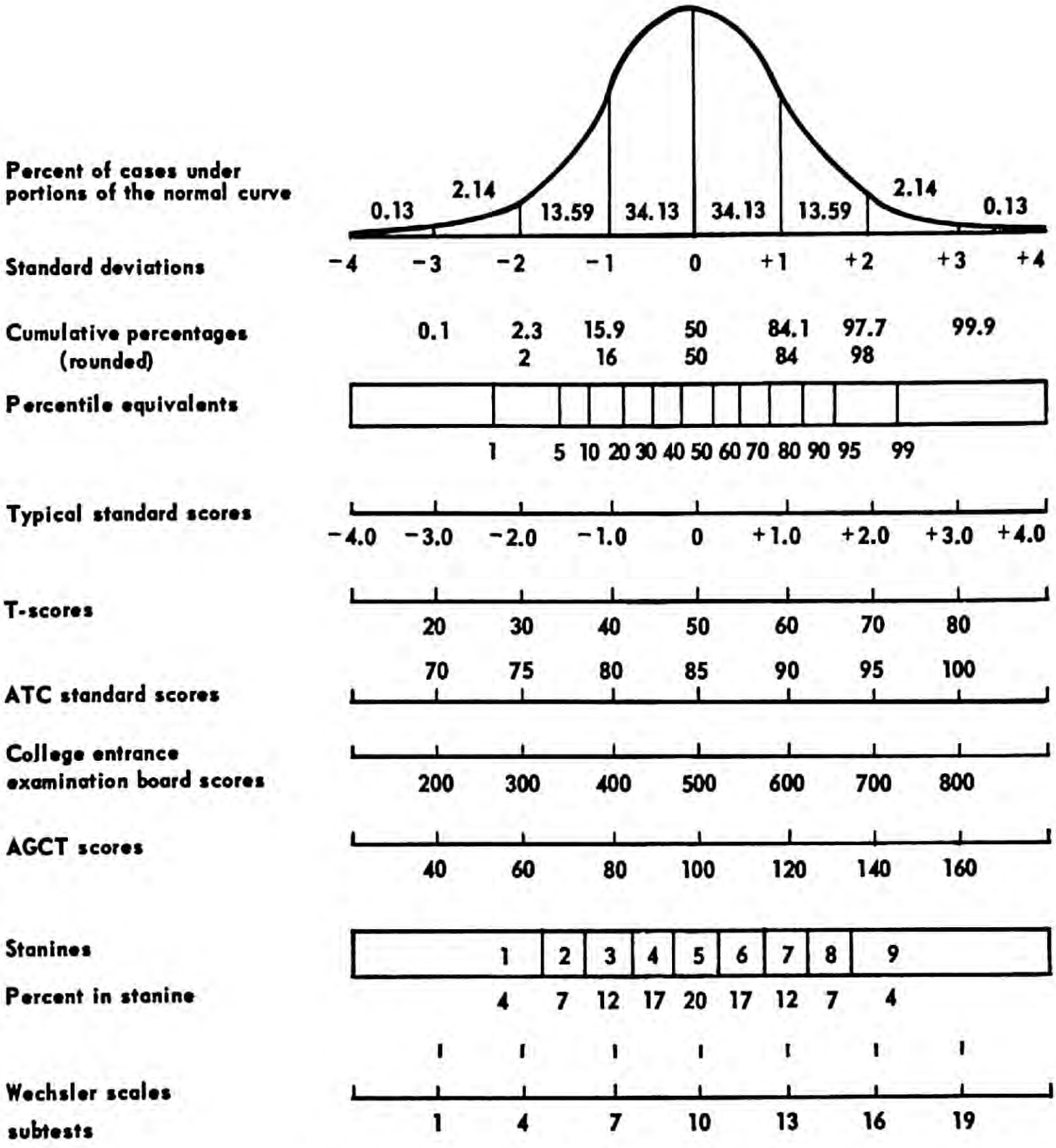


Figure 58. Comparison of Grading Methods

CHAPTER 27

Appraising Test Usefulness

The administration of a test should not be considered an end in itself. When an instructor prepares a test, he makes it as effective as he can. Once the test has been administered to the individual, the responses, stems, and the test as a whole offer data not only for measuring student achievements and analyzing the effectiveness of instruction but also for measuring the usefulness of the test itself and for improving future tests.

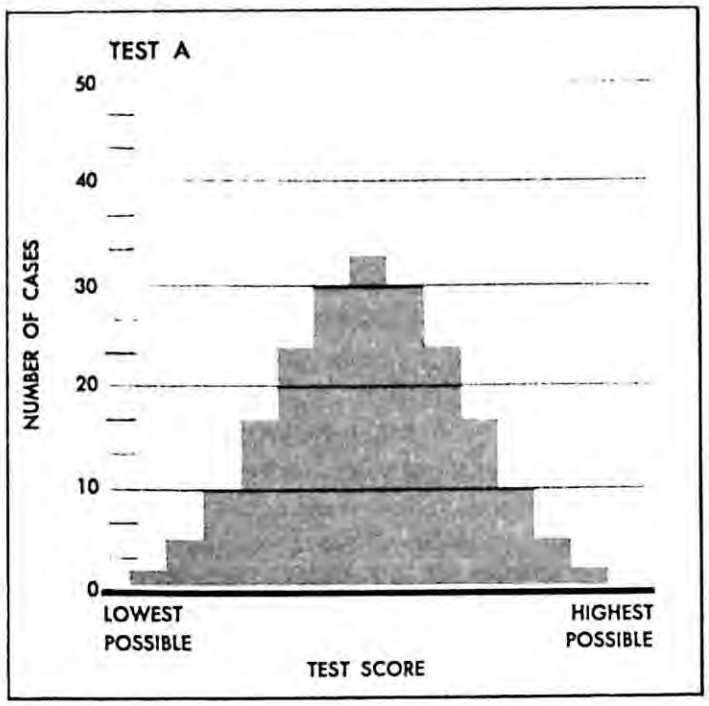
This chapter considers six important phases in evaluating the worth of a test: (1) efficiency of the total test; (2) ease index of separate items; (3) differentiating ability of separate items; (4) analysis of incorrect responses; (5) validity of the total test; and (6) reliability of the total test. Suggestions are made for conducting examination critiques with students and for maintaining pools of test items.

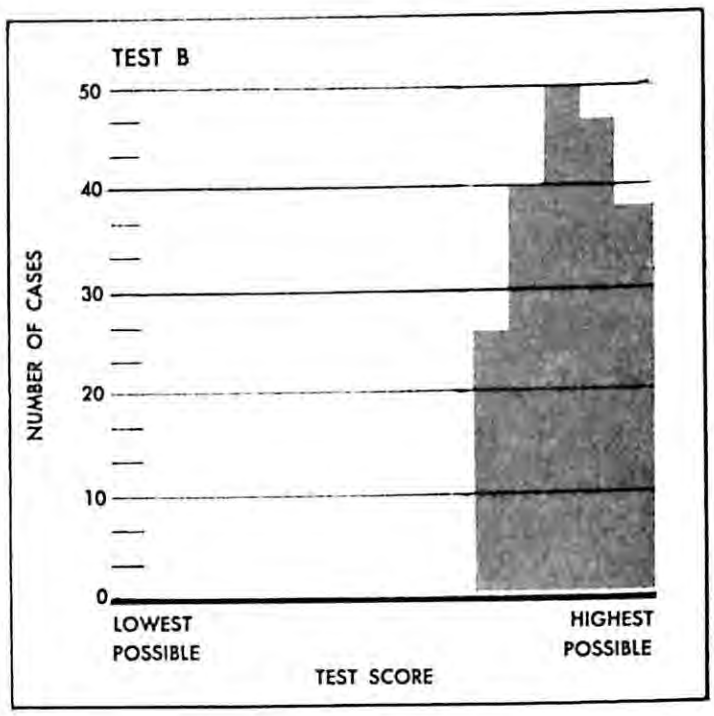
EFFICIENCY OF TOTAL TEST

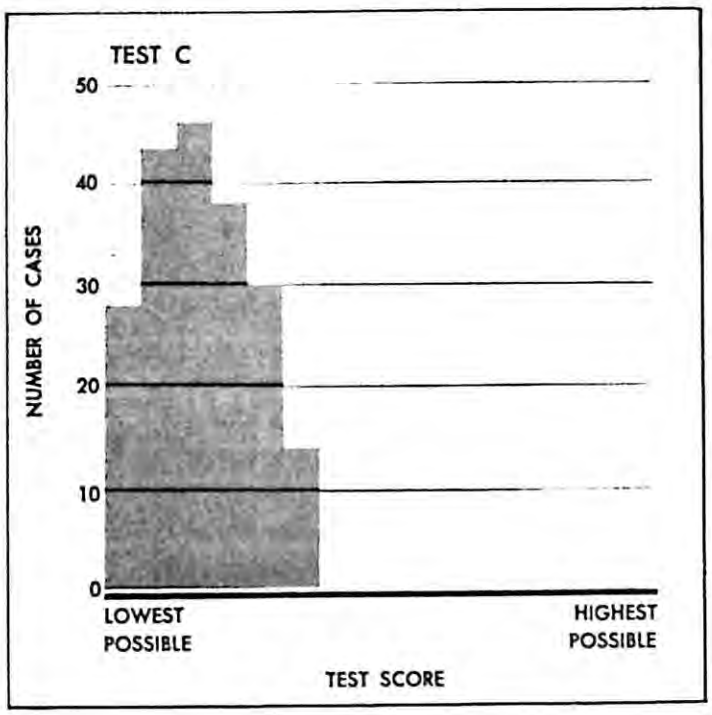
Students have different abilities and levels of achievement. The range and distribution of their abilities should be reflected in the test scores. If the instruction has been effective and if the test is efficient, a few scores will be very low and a few very high, but most of them will be massed around the middle of the scale. (However, there are instances when a student must answer all items in a test correctly to assume his future duties.) For most purposes, the distribution of student scores on a test (1) should resemble the normal probability curve with most of the scores near the mean and relatively few at the extremes, and (2) should fill the scale of possible test scores from almost the lowest score to almost the highest. The scores for Test A in Figure 59 meet both these conditions. In practice, distributions as perfect as this cannot be anticipated.

The more nearly a distribution of scores meets these two requirements, the more efficient the test will be for most purposes. Marked deviations in distribution can usually be accounted for by one of the following reasons:

- Scores are clustered at the high end of the scale. Test B in Figure 59 illustrates a distribution of this type, which shows that the test was easy for the group as a whole. Perhaps the items tested simple material which had been drilled repeatedly. Or perhaps the scoring was lenient, or high scores were assigned arbitrarily. Occasionally, the actual range of scores may be confined to the upper 10 or 20 percent of the scale. Whatever the cause of a distribution of this sort, the testing time has not been used with maximum efficiency. Such a distribution is justified only when all students are to be given an opportunity to demonstrate that they have achieved many relatively simple and basic objectives, and that there is no reason for distinguishing among the students.
- Scores are clustered at the low end of the scale. Test C in Figure 59 illustrates such a distribution, which indicates that the test was difficult for the group as a whole. Several factors may account for this situation: (1) the instruction may have been inadequate; (2) the test may have covered obscure material which was not explained clearly; (3) the test items may have been worded vaguely and ambiguously; or (4) the test may have been too long for the time allowed, and the students failed to complete many items.
- Scores are clustered near the center of the scale. Test D in Figure 59 illustrates a distribu-







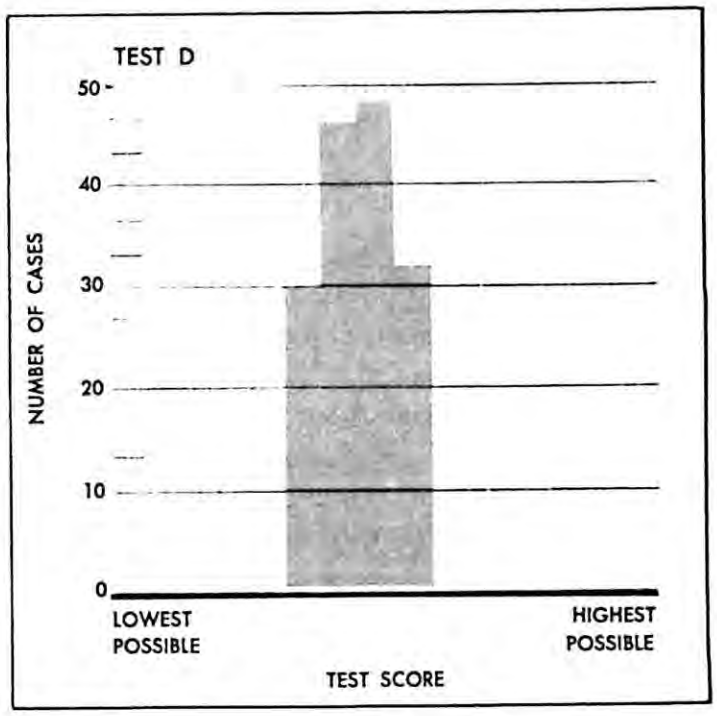


Figure 59. Scores of 200 Students on Four Tests

tion of this sort. Such a distribution shows that the test as a whole lacks variety. Perhaps the course material was focused on a small area, or the test itself was not comprehensive enough. Possibly the test did not have items that taxed the abilities of the best students, as well as items that allowed the poorer students to demonstrate their achievement.

In distributions resembling B, C or D of Figure 59 are obtained, the test should be revised to meet the objectives of the course and the level of the group, before it is administered again.

After a test has been administered, test scores should be tabulated. From the tabulation, a frequency distribution can be made. If the frequency distribution is presented graphically, it is usually easier to analyze the efficiency of the test. The procedure for constructing a frequency distribution is discussed in Chapter 26.

EASE INDEX OF SEPARATE ITEMS

The ease index of a test as a whole is the composite of the ease of the individual test items.

When mention is made of the ease index or the ease level of a test or of a particular test item, it means merely how easy that test or item was for the group taking the test. Since the ease of an item is also a measure of its difficulty, it is sometimes called the difficulty index. The distribution of test scores can be adjusted by changing the ease of items, or by eliminating some items and selecting others on the basis of their difficulty. If the difficulty level of items has been adjusted properly, the average score of the group falls between 60 and 70 percent of the maximum possible score, and scores cover nearly the whole possible range, from almost zero to almost perfect.

Arranging Items According to Difficulty

If a group were to be tested on individual ability to climb hills, it would be necessary to know how steep a hill each member could climb. The test would naturally be made on a hill of gradually increasing steepness. Some members would drop out on the gradual slopes. Others would progress easily beyond the gradual slopes, but would drop out, one by one, as they reached the steeper slopes. The last person to drop out would be the one who could climb the steepest grade.

If the hill were steep near the bottom, many and perhaps all contestants would fail at the beginning. This would provide little information, except that the first portion of the course was too steep. Nothing significant could be determined about relative abilities, since none of those tested reached a part of the course where the differences in their ability would become apparent.

Items on a test should be arranged in order from easy to difficult. This plan has the following advantages: (1) students' scores spread out and show many differentiations in ability; (2) the instructor reasonably assumes that a student could not have answered the items beyond the point at which he began to miss them consistently; and (3) students build up confidence during the early part of the test in which the items are relatively easy.

If items are not arranged in order of increasing difficulty, students may spend an undue amount of time on difficult items near the beginning of the test and neglect later items which they could have answered correctly.

When tests are made up of two or more forms of items (for example, true-false or multiple-choice), all items in the same form should be grouped together. Within each group, however, items should be arranged in order of increasing difficulty. If it is necessary to group items according to subject matter, the items should also be arranged in order of increasing difficulty within these groups.

Before an item is used, its ease index should be estimated; it should be placed in the test according to this estimate. After the item has been used in a test, an ease index can be computed. With this information, the instructor has meaningful guidance as to where this item should be placed in future tests.

Simple Formula for Ease Index

The simplest procedure for determining the ease index of an item is to divide the number of persons who answered the item correctly by the total number of persons who took the test. Multiply this quotient by 100 to convert the result to a percentage figure. The formula for computing the simple ease index (E.I.) of an item is:

$$\text{E.I.} = \frac{R}{N} \times 100$$

Where R is the number responding correctly, and N is the number taking the test. If everyone answered the item correctly, the numerator and denominator of the fraction would be the same, and the ease index would be 100 percent. If no one in the group answered the item correctly, the numerator would be 0, and the ease index would also be 0. Consequently, the range of the ease index is from 0 to 100 percent. As can be seen, the higher the percentage, the easier the item; i.e., an item with an ease index of 80 percent is easier than an item with an ease index of 35 percent.

TABLE 8.—*Distribution of correct and incorrect responses made by 150 airmen on a multiple-choice item in the Clerical Aptitude Test**.

Groups according to total test score	*Number of responses*		*Total number of students*
	Incorrect or omitted	*Correct*	
High third (above 65)	22	28	50
Mid-third (61-65)	38	12	50
Low third (36-60)	43	7	50
Total	103	47	150

* The item that was used to illustrate the computation of an ease index is used throughout.

The responses made by the 150 airmen to an item in the clerical aptitude test shown in Table 8 are used to illustrate a few simple techniques of item analysis. On the basis of 47 correct answers, the ease index (E.I.) of this item would be computed as follows:

$$\text{E.I.} = \frac{47}{150} \times 100 = 0.31 \times 100 = 31\%$$

The procedure applies to either selection or supply items. For an item in an essay test, the numerator may be the number of persons who achieve a certain level in their responses; the denominator, the number of persons taking the test.

Formula Adjusted for Students Not Attempting Item

The procedure just given for finding the ease index assumes that the entire group of students had an opportunity to answer the item. If it is assumed that all omissions were the result of a lack of knowledge, the procedure can be defended. Omissions in the early portion of a test are usually caused by lack of knowledge, but items near the end of a test may have been omitted merely because the students did not reach them. If the items are arranged in order of difficulty, students who did not reach certain items near the end of the test probably did not know the correct solutions. In this situation, the simple procedure is defensible.

If items are not arranged in order of difficulty, there is no way of knowing how many of those who did not reach the item would have answered it correctly. In this case, it is often assumed that the proportion of students who knew the correct response to an item is the same for those who did not reach it as for those who did reach it. If this assumption is justified, the denominator should be the number of students who tried the item rather than the total number taking the test. In other words, the denominator should be the number taking the test minus the number who did not reach the item. The formula for computing the adjusted ease index is written as follows:

$$\text{E.I.} = \frac{R}{N - n_r} \times 100$$

Where R is the number responding correctly, N is the number taking the test, and n_r is the number of persons who did not reach the item.

For selection items the instructor can determine the number of persons who did not reach a given item (n_r in the formula). The test papers of all students who omitted the item are examined. If the student attempted later items, he is considered to have reached the item. The number of students who omitted this item and did not attempt subsequent items on the test is assumed to be the number of students who did not reach the item. (It is usually open to question whether a student reached the item immediately following the last item he attempted.)

For example, 47 airmen answered the item in the aptitude test correctly; 63 answered the item incorrectly; the remaining 40 omitted the item. Of the 40 airmen who omitted the item, 13 did not attempt later items. Therefore the denominator of the fraction should be 150 — 13, or 137. The adjusted ease index of this item would be:

$$\text{E.I.} = \frac{47}{150 - 13} \times 100 = \frac{47}{137} \times 100 = 0.34 \times 100 = 34\%$$

Formula Further Corrected for Guessing

With selection items, the number of persons who respond correctly may be greater than the number of persons who actually know the answer. Some may guess the item correctly. Consequently, the index may make the item appear easier than it is. If the ease index is to reflect the proportion of the class who knows the correct response, perhaps the numerator should be corrected for guessing. Since 63 airmen answered the item incorrectly and since this was a four-alternative multiple-choice item, it may be estimated that 16 (about one-fourth) of the airmen who selected the correct alternative guessed it correctly. With selection items, in order to correct for guessing, it may be worthwhile to add a correction factor to the formula for adjusted ease index. The formula for adjusted and corrected ease index is:

$$\text{E.I.} = \frac{R - \left(\frac{W}{K - 1}\right)}{N - n_r} \times 100$$

Where R is the number of students who checked the item correctly, W is the number of students who checked the item incorrectly, K is the number of alternatives in the item, N is the number of students who took the test, and n_r is the number of students who did not reach the item.

For the item being considered, a four-alternative multiple-choice item, values are as follows:

47 responded correctly, 63 responded incorrectly, 27 omitted the item but answered subsequent items, and 13 omitted the item and did not answer subsequent items.

The adjusted and corrected ease index for this item would be:

$$\text{E.I.} = \frac{47 - \left(\frac{63}{4-1}\right)}{150 - 13} \times 100 =$$

$$\frac{47 - \left(\frac{63}{3}\right)}{137} \times 100 = \frac{47 - 21}{137} \times 100 =$$

$$\frac{26}{137} \times 100 = 0.19 \times 100 = 19\%$$

For comparison, the simple ease index for this same item is:

$$\text{E.I.} = \frac{47}{150} \times 100 = 0.31 \times 100 = 31\%$$

The instructor must recognize that the doubly corrected formula for ease index is measuring ease of the item for only those students who reach it and not for the group as a whole. For instance, if the last item of a 150-item test was reached by only five students out of 100, and if all five answered the item correctly, the ease index would be 100 percent so long as this item retains the same position in the test.

$$\text{E.I.} = \frac{5 - \left(\frac{0}{4-1}\right)}{100 - 95} \times 100 =$$

$$\frac{5}{5} \times 100 = 100\%$$

If very few students complete a test of this nature in the time allowed, the ease index for the items occurring late in the test could be misleading. It is important for the test constructor to know all the facts about the item and the specific formula which was used.

Interpreting Ease Index

The ease index is only a statistical factor. It should not be used by itself to judge the worth of an item. Rather it should be used in conjunction with other data, as explained in the next paragraph. All statistical data (including the ease index) used in comparisons must be based on equivalent groups; for example, an item having an ease index of 85 percent with an advanced group of students might well have an ease index of 45 to 60 percent with a group of basic students.

The type of ease index selected for use should be the one judged most suitable for the course materials, school objectives, testing objectives, and type of test items used.

Conclusions Governing Interpretation of Ease Index

Each of the three methods for determining ease index for an item has certain merits and certain disadvantages. In general, the first and easiest procedure is satisfactory for essay, as well as for selection category, test items. The last and most difficult method is best for true-false and multiple-choice items with few alternatives, especially if items are not arranged according to known order of difficulty. The method of determining the ease index should be the same, if the items are to be compared. The three methods which were just demonstrated yield different values for the ease index of the same item.

An effective test should include items representing a considerable range of difficulty, but most of the items should be of about average difficulty (ease index of about 60 to 70 percent). If the instructor has a pool of test items, he can select items from it to cover the range of abilities in the class in such a way that the distribution of test scores fills the scale and approximates a normal curve.

DIFFERENTIATING ABILITY OF SEPARATE ITEMS

Whenever an item is answered correctly by some students and not by others, it divides the class into two groups. This question arises: In what other way are the two groups different? The really effective instructor wants to know not only those of his students who answer an item correctly but also the kind of student who has the ability to answer it correctly.

One means of analyzing an item is to determine the total test standing of the students who answer the item correctly. If the students who answer the item correctly are predominantly those with high total test scores, the item is adding to the effectiveness of the test as a whole. It is contributing positively toward the differentiating ability of the test.

If students who answer the item correctly are about equally divided between those with high total test scores and those with low scores, the

item contributes little or nothing to the differentiation of the test as a whole. In fact, it may detract from the efficiency of the test by unfairly adding to the scores of some students and subtracting from others. The possibility should not be overlooked that the quality of instruction rather than a poor test item could be the reason for little differentiation.

In general, the group that responds correctly to any item should be composed principally of students who have high total test scores. This incidence of scores is particularly necessary, if the test is designed to cover material which is closely related. In this situation the test should have high consistency within itself. An item which can be used to separate students who achieve high total test scores from those who do not is said to have differentiation ability. For purposes of analysis and comparison, this ability can be represented by an index number.

Computing Differentiation Index

The differentiation index obtained by the process suggested here measures the ability of an item to differentiate between students with high scores on the total test and those with low scores.

There are numerous formulas for computing the differentiation index. The formula selected must be the one that best fits the needs of the user. One method of computing the differentiation index is to divide the test papers into groups based upon the over-all test scores. If three groups are used to compute the differentiation index of 150 students, for example, the best 50 test papers are placed in the high group, the next 50 are in the middle group, and the poorest 50 papers in the low group. The number of students in each group who responded correctly to the item are then counted. For the clerical aptitude test, 50 airmen were in each third of the class. In the high third, 28 airmen answered the item correctly; in the middle third, 12; in the bottom third, only 7 (Table 9).

The number of persons in the low third who answered the item correctly is subtracted from the number of persons in the high third who also answered it correctly. This difference is then divided by one-third the total number of students in the group. (This represents the total number of students divided by the number of groups used. In this case, three groups were used, therefore N is divided by 3). The formula for

TABLE 9.—*Number of times each alternative was chosen as the correct response and the number of omissions for a multiple-choice item on the Clerical Aptitude Test.*

Groups according to total test score		Alternatives				Omissions		Total number of students
		a	b	c*	d	Item reached	Item not reached	
High third	95							
	65	0	16	28	6	0	0	50
Mid-third	64							
	61	0	10	12	10	10	8	50
Low third	60							
	36	0	9	7	12	17	5	50
Total		0	35	47	28	27	13	150

* Alternative *c* is the correct response.

computing the differentiation index (D.I.), when three groups are used, is:

$$\text{D.I.} = \frac{\text{H} - \text{L}}{\text{N}/3}$$

Where H is the number of students in the high third who answered the item correctly, L is the number of students in the low third who also answered the item correctly, N is the number of students who took the test, and 3 is the number of groups. The differentiation index for the example given would be:

$$\text{D.I.} = \frac{\text{H} - \text{L}}{\text{N}/3} = \frac{28 - 7}{150 \div 3} = \frac{21}{50} = 0.42$$

The index of 0.42 indicates the degree to which the item differentiates between those students who obtained high total test scores and those who obtained low total test scores.

Interpreting Differentiation Index

The range of the differentiation index is from -1 to 0 to $+1$. If all students in the high group answered the item correctly and no one in the low group got the item correct, a $+1$ differentiation index would result. If all students in the low group got the item correct, when none in the high group did so, a -1 would result. If the same number of students in both the high and low groups responded correctly, the differentiation index would be 0. As can be seen, when the test scores indicate that more students in the upper third of a class answer an item correctly as opposed to those in the lower third,

the item is said to have a positive (or plus) differentiation. On the other hand, if more students in the lower third get the item correct, it is said to have negative differentiation. Any item may be neutral or have zero differentiation because of an equal distribution of scores. If this occurs with very easy or very difficult items, it may be acceptable. However, items with very low positive differentiation, zero differentiation, or negative differentiation should be qualitatively examined for validity. If neutral or negative differentiation occurs with items of medium difficulty, the reason should be determined and corrected before the item is re-used.

In general, it is best to select test items with substantial positive differentiation indexes because each item in a test should contribute toward measuring whatever the whole test is measuring. (It is very important to make sure, however, that the test as a whole is measuring what it is intended to measure.)

A minimum overall or average differentiation index for a test is a reasonable goal. As an overall index for a test, a +.25 is frequently considered acceptable. However, an absolute minimum differentiation index cannot be established for individual items. Final examinations, for example, are designed to measure achievement in several phases or aspects of a course of study. One would expect that items testing subtopics would have low differentiation indexes, when the test includes items from several areas. To eliminate items with low differentiation indexes and to retain only those with high differentiation indexes would progressively limit the area tested. Consistency might thus be achieved at the expense of comprehensiveness and, therefore, of validity. Very easy and very difficult items cannot have substantial differentiation indexes. An item which everyone passes or everyone fails must necessarily have a differentiation index of zero. However, if a test is to cover the total range of abilities in a group, it might be well to have one item which every student could be expected to pass.

In analyzing a test, the instructor must consider both the ease index and the differentiation index, and he must weigh each of these against the purposes which the item and the test are to serve.

The differentiation index is a reasonably accurate indicator, and it is considered adequate for most classroom purposes. The test researcher uses more refined statistical methods. As in the case of ease index, the differentiation index can be compared with other statistics only when it is based on an equivalent group and is computed by the same formula.

ANALYSIS OF INCORRECT RESPONSES TO ITEMS

A rather complete analysis of all responses to multiple-choice items can be made fairly easily, and such an analysis is worthwhile. The method described here for multiple-choice items can be adapted for other forms.

Data Distribution

Table 9 shows the complete distribution of the responses made by the 150 airmen to a four-alternative multiple-choice item in the clerical aptitude test. Alternative *c* is the keyed (correct) alternative.

Many aspects of the distribution are worth noting.

- The item has a substantial differentiation index (0.42), as has been shown. The distribution shows a definite relationship between the total test score and correct responses (Alternative *c*). Nearly two-thirds of the airmen who selected the correct response were from the high third of the class in terms of total score. More than half of the airmen in the high third of the group selected the correct response.
- No one in the group chose Alternative *a*. Since the item has essentially three alternatives, Alternative *a* should be reworded or replaced. This alternative should be constructed to appeal to some of the 90 airmen who either answered the item incorrectly or deliberately omitted it.
- Half of the airmen who selected Alternative *b* came from the high third of the group. This fact indicates that these airmen have been given some misinformation or that they have been misled by the wording of the alternative. Only the correct response should be positively related to the total test score.
- Alternative *d* has been selected more often by airmen in the low third than by airmen in the high third. It is differentiating in terms of the total test and is, therefore, a good distractor.
- All 27 airmen who omitted this item by choice were either in the mid- or low-third of the group.

This is to be expected. When considering differentiation ability, instructors should judge a voluntary omission as they would an incorrect alternative. But when diagnosis is the purpose, voluntary omission and incorrect alternatives are considered differently.

- The airmen who did not reach the item were in the lower part of the distribution of total test scores.

Data Interpretation

Data furnished by a tabulation, such as that given in Table 9, are useful to the test constructor and interpretor. If the item is valid, the data may be interpreted as follows:

- Students who selected the correct response to the item can be assumed to have achieved that objective of the instruction.
- Students who selected incorrect alternatives or who omitted the item can be assumed not to have achieved that objective of the instruction.
- Alternative *a* is ineffective and must be replaced; further investigation is required regarding Alternative *b*; Alternative *c* is apparently good as it is.
- Students who reached an item, but omitted it, did so by choice.
- Subsequent items were omitted because the students failed to reach them.

EXAMINATION CRITIQUES

Examinations should be used as teaching devices. If instruction in a phase ends with an examination, the examination is not being used as effectively as it could be. Examinations should be administered throughout a course. After an examination is given, a later class period should be devoted to a critique of the examination. The primary purpose of the critique is to increase student learning. The secondary purpose is to improve evaluation.

As soon as possible after giving the test, the instructor should set aside a period for discussing the test with the class. When the students arrive at the critique, they should know their scores on the total test and on different parts. Ideally, during this period, they should have access to the test items, or problems, together with their responses. The instructor should bring the following material to the examination critique: (1) the key used for scoring, (2) a graph of the distribution of responses to the items of the total test and its several parts, and (3) the complete distribution of student responses to each item, together with the ease index and differentiation index of each item. For certain items, it is often helpful to have item analyses from previous administrations.

The scoring key should be presented to the class during the critique period. Students may then compare their own responses with this key and identify items that they question. The distribution of test scores (total-test and part-test scores) should be shown to the students. If time is available before class and if chalkboard space permits, the graphs may be put on the board, but this plan is seldom feasible. Students should be given an opportunity to locate their scores in each distribution. A complete distribution of selected items should be shown to the class before the items are discussed. During the discussion the instructor should try to learn why certain ease indexes were lower than anticipated, why negative differentiation indexes existed, and why more good than poor students selected certain incorrect alternatives. Students should be asked to explain these variations, as well as items other than those identified by the instructor. Such discussion periods serve to point out faulty construction of items and misinformation, and to provide an opportunity for remedial teaching.

When possible compromise of test items from class to class is a major problem, the instructor might consider the alternative approach of identifying items missed by significant numbers of students and by then re-teaching in the applicable subject areas. When using this approach, it is important that students be made aware of the specific subject areas where they, individually, failed to respond correctly.

ITEM POOLS

All items used in examinations for a course should be kept in a semipermanent file for future reference. Filing items is an easy and worthwhile procedure, especially when selection items are used. Some instructors use a card file (one item to a card); others use loose-leaf notebooks (one item to a page). In either case, items should be identified according to the overall objective and the subject-matter topic to which they apply. Items

ITEM POOL NR.	LESSON TITLE:	INSTRUCTOR
OBJECTIVE OR OUTCOME TESTED:		
DATE PREPARED: REVIEWED:	RECORD OF USE	
ITEM:	CLASS / E.I. / D.I. / ITEM NR. ON TEST	

TEST ITEM RECORD

Figure 60. Portion of Typical Test Item Pool Record Card

may be grouped in the file in either classification, and a system of cross references might be set up.

Each file card or sheet should contain the item exactly as it was used in the examination, together with information obtained from analyses and from the critique. A typical record card used in a test item pool is shown in Figure 60. By referring to this data, the instructor can readily compare the effectiveness of different techniques for teaching certain material. If cumulative records are maintained, the responses of more students are considered. The distribution of responses becomes more stable, and indexes are more meaningful.

When an examination is constructed, items may be selected from the pool and arranged according to difficulty, or they may be selected to give certain weights to overall objectives and subject-matter topics. In this way, comprehensiveness can be assured, validity increased, and predictions made about the capability of the examination to differentiate.

VALIDITY OF TOTAL TEST

Unless the test measures just what it is intended to measure, it is not serving its purpose. In fact, if the test does not measure factors which are related to the real objectives of instruction but the results are treated as though it did, the test is worse than useless—it is misleading, unfair, and harmful. Every test administrator must continually try to determine the worth of each test in order to increase its validity.

Procedures for measuring the validity of a test range from merely inspecting the test in the light of the objectives of the course to computing validity coefficients by complex statistical procedures. Each instructor should use the technique that is most effective within his limitations of time, facilities, and research data.

If the test is designed to measure aptitude for a particular skill, the real criterion of validity is proficiency at that skill. On the other hand, if the test is intended to measure academic achievement at a certain level in the curriculum, the criterion may be proficiency in a later phase, particularly if the earlier phase is a prerequisite for the later one. In any case, the validity of a test can be determined only by comparing the standings achieved by individuals in the test with their standings in the criterion.

A completely satisfactory criterion of validity for all educational tests cannot be established. It is usually necessary to compromise on the best criterion available. In any case, an instructor should never assume the validity of a test that he has prepared. He should constantly seek means or methods of improving validity.

The test scores used here to illustrate a technique of estimating validity are taken from an aptitude test; however, the principles apply equally well to achievement tests. In either case, a major problem arises in selecting a satisfactory criterion that can be expressed quantitatively. A few areas to be tested are listed below with a suggested criterion for validating the achievement test:

Instruction	*Criterion*
Aircraft mechanics	Number of hours per month the airplane is flyable
Instructor preparation	Ratings of supervisors and students
Navigator bombardier training	Circular error of strikes
Motor vehicle operators	Driving records
Weather forecasters	Accuracy of forecasts
Typists	Performance ratings on the job

Other and perhaps better criteria can be suggested by instructors working in the area. It should be noted that a student's standing in relation to the criterion is often affected by factors other than his proficiency.

Establishing Validation Group

To obtain an estimate of the validity of a test, the instructor uses a group of students as a validation group. Each member of the group has taken the test, and his proficiency, as measured in terms of a suitable criterion, is available. A group of 150 airmen were used for the clerical aptitude test. The criterion of validity is the grade received in an Air Force clerical school. The validity of the clerical aptitude test can be established by determining whether the airmen who received high test scores tended to perform well in school, and if those who received low test scores tended to perform poorly. The more observable this tendency is, the more valid the test is for the purpose.

First, the class was divided into three equal groups on the basis of their school grade (the criterion of validity). Fifty airmen make up each third of the validation group. The frequency distribution of the school grades is shown in Figure 61. Since the division line for the top 50 students must include two of the 15 students having a school grade of 41, two of these 15 students were selected at random and placed in the high third. The other 13 were put in the middle third. A similar problem occurred in identifying the low third. Seven of the 12 students having school grades of 37 were selected at random and placed in the low third.

School grade	Number (f)		
47	2		
46	7		
45	8		
44	8		High third
43	12		
42	11		
41	15	2	
40	12	13	
39	8		Mid-third
38	12		
37	12	5	
36	10	7	
35	7		
34	1		
33	7		Low third
32	6		
31	4		
30	2		
29	4		
28	1		
27	1		

Figure 61. Validation Group Divided into Thirds in the Criterion

The next step is to examine the performance of each third of the group on the clerical aptitude test. Of the airmen whose grades are in the high third of the group on school grades, 39 made scores in the upper half of the group on the aptitude test (Table 10). Of the 50 airmen who were in the low third of the group on school grades, only 17 were in the upper half on the aptitude test. Apparently, the aptitude test helps identify those who will do well in a clerical school.

TABLE 10.—*Distribution of the scores made by 150 airmen on the Clerical Aptitude Test.*

Groups according to school grade	*Aptitude test score*		*Total number of students*
	Low half (36-65)	*High half (above 65)*	
High third	42	11	39	50
	41			
Mid-third	35	31	19	50
	34			
Low third	25	33	17	50
Total		75	75	150

Inductees who score high on the clerical aptitude test are more likely to do well in clerical schools than those who score low on the test. However, it is not possible to make precise predictions about individuals. Although precision in making predictions about individual behavior has not been achieved, it is possible to make reasonably sound predictions for groups.

In most educational evaluation, it is well to eliminate subjective opinions and make data comparable. Subjectivity would surely be involved in an attempt to judge the validity of the clerical aptitude test and to compare it with that of another test in the same group or in a group of another size. To reduce subjectivity in such judgments, the examiner should compute an index of the validity of the test for each situation.

Computing Validity Index

A validity index (V.I.) of an examination can be obtained by the following formula:

$$\text{V.I.} = \frac{\text{H} - \text{L}}{\text{N}/3}$$

Where H is the number of students in the high third of the criterion who are in the upper half of the test; L is the number of students in the low third of the criterion who are in the upper half of the test; and N is the number of students in the whole group.

Although the symbols in the formula for the validity index duplicate those of the formula for the differentiation index, the indexes represent different things. The difference lies in the criteria used to obtain a validity index.

To obtain the validity index of the clerical aptitude test shown in Table 10, the following substitutions would be made:

$$\text{V.I.} = \frac{39 - 17}{50} = \frac{22}{50} = 0.44$$

Had a larger portion of the airmen who made high scores on the test been in the high third on the criterion (school grades above 41), or had a smaller portion been in the low third (school grades less than 35), or had both of these situations existed, the index would have been larger.

This value is a rough measure of the validity of the test for the group. Other things being equal, a higher index would indicate a more valid test. The value of 0.44 may be compared with validity indexes of other tests or for other administrations of this test, if the indexes are all obtained in the same way and the criterion remains the same. Validity indexes obtained by different techniques or formulas should not be compared directly.

Interpreting Validity Index

If all 50 airmen in the high third on school grades had been above the middle of the group on test scores, and if all the airmen in the low third on school grades had been below the middle of the group on test scores, the validity index of the test would be +1.00. This maximum index shows a high degree of validity for the test.

$$\text{V.I.} = \frac{50 - 0}{50} = +1.00$$

When the number of airmen in the high third on school grades and above the middle on the test scores is the same as the number of airmen who are in the low third on school grades and above the middle on test scores, the validity index is zero. This lack of a positive index indicates a corresponding lack of validity for the test.

The possibility of a negative index also occurs when all of the airmen in the high third of the class on school grades are below the middle of the group on test scores, and all the airmen in the low third of the class are above the middle of the group. In this case the validity index is −1.00. This maximum negative index indicates that the test is not valid.

$$\text{V.I.} = \frac{0 - 50}{50} = -1.00$$

We can see that the range of the validity index is +1.00 to −1.00. These reference points (+1.00 −1.00) are useful in interpreting validity indexes. This general rule should be kept in mind; a plus index is desired, and the higher the index the more valid the test. The validity indexes obtained through the clerical aptitude testing of airmen indicate that the test has substantial validity for predicting the grades that the airmen will make in Air Force clerical schools.

The validity index should not be accepted at face value, nor should any conclusions be drawn on the basis of one testing. The validity index should be compared with other conditions and statistics, and conclusions should be drawn only after several testings.

The significance of the validity index of a test depends largely on the degree to which scores are spread over the possible range. If scores are massed, very little differentiation is possible, and there is no significant relationship between the test scores and the criterion.

The validity of a test can be measured in many ways. The one described here is relatively easy and requires only simple arithmetic. The index obtained by this technique merely indicates the validity of a test. One of the greatest weaknesses of the formula is that the value of the index may be varied appreciably by adjusting the position of the passing score on the examination. To establish a standard procedure for comparing tests, instructors might divide the test scores at the middle of the class (50th centile), as was done in this illustration.

The grades of the 150 airmen were affected by many factors not measured in the test, such

as variations in health, acceptance by classmates, interactions between the personalities of student and instructor, social activities during school life, kind of acquaintances, and personal problems. Because of these and other factors, a high degree of validity for any test index should not be anticipated.

RELIABILITY OF TOTAL TEST

To determine the reliability of a test is to find out how consistently it makes measurements. No outside criterion is necessary because reliability is not concerned with the nature of things measured by the test. What is important is that the same measurements are obtained repeatedly under identical circumstances.

This formula may be used to obtain an index for the reliability (R.I.) of a test:

$$\text{R.I.} = 1 - \frac{\text{M (n} - \text{M)}}{\text{n (s}^2\text{)}}$$

Where M is the mean of the test scores, s is the standard deviation of the test scores, and n is the number of items in the test. The principles on which the formula is based are beyond the scope of this text.[1] The formula yields values from 0 to 1, with 1 representing perfect reliability.

The formula for reliability might be applied to the scores made by the 150 airmen on a part of the clerical aptitude test. The scores were distributed as shown in Figure 61. With this frequency distribution, the mean of test scores was found to be 38.9, and the standard deviation, 4.6. This part of the test consisted of 50 items. The reliability index was derived by the following steps:

$$\text{R.I.} = 1 - \frac{38.9\ (50 - 38.9)}{50\ (4.6)^2}$$

$$\text{R.I.} = 1 - \frac{38.9\ (11.1)}{50\ (21.16)}$$

$$\text{R.I.} = 1 - \frac{431.79}{1{,}058}$$

$$\text{R.I.} = 1 - 0.408 = .592, \text{ or } .59.$$

[1] This is an adaptation of a formula reported by F. J. Froelich in "A Simple Index of Test Reliability, *Journal of Educational Psychology*, 32:381–385, 1941.

The index of .59 is based on scores made on a part of the clerical aptitude test. The scores obtained from the total test were found to have reliability indexes of about .90.

Most instructor-made achievement tests which contain 50 or more selection items, and which are used with classes of 50 or more students, should have reliability indexes of between 0.60 and 0.85. As a rule, standardized tests in general use have indexes above 0.90.

It is usually true that the smaller the class and the fewer the items in the test, the less significant is the index of reliability which is obtained. The technique suggested here should not be used for classes of fewer than about 50 students, or for tests of less than about 50 items.

SUMMARY

Several important phases are considered in evaluating the worth of a test. When a test is working efficiently the scores resemble a normal curve of distribution, having a wide range with the majority of the scores grouped near the center of the distribution. It is useful to analyze individual test items in terms of difficulty level and ability to differentiate. Through proper interpretation and use of this information from each item, the instructor can plan his tests in such a way that the distribution of test scores approximates a normal curve.

Many factors affect the validity of a test. However, a reasonable check of validity can be made by measuring achievement against a pre-determined criterion. Reliability tells how consistently the test is making measurements. When given under identical circumstances, a test should consistently get nearly the same measurements. The administration of a test is not the end; it is instead the beginning of a study to determine its effectiveness as a tool in evaluation.

BY ORDER OF THE SECRETARY OF THE AIR FORCE

OFFICIAL

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ATTACHMENT 1

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