เอกสารประกอบการบรรยาย

โครงการพระราชทานความช่วยเหลือของ

สมเด็จพระเทพรัตนราชสุดาสยามบรมราชกุมารี

โครงการฝึกอบรมเชิงปฏิบัติการเข้มข้น

หลักสูตร การจัดทำสื่อการสอนอย่างมีประสิทธิภาพ

เรื่อง Intensive Course for Producing Instructional Media Program

ณ มหาวิทยาลัยจำปาสัก สาธารณรัฐประชาธิปไตยประชาชนลาว

วันที่ 6-8 มีนาคม 2549

โดย นางสาวนีรนุช ภาชนะทิพย์ และคณะ

กองบริการการศึกษา สำนักงานอธิการบดี

มหาวิทยาลัยเกษตรศาสตร์

Intensive Course for Producing

Instructional Media Program

for Champasak University Lecturers

Lao People's Democratic Republic (LPDR)

Under H.R.H. Princess Maha Chakri Sirindhorn's Projects

By… Miss Neranuch Pachanatip et.al

Education Service Division

Kasetsart University

Intensive Course for Producing Instructional Media Program

6 – 8 March 2006

6 March 2006

Subject	Instructor	Duration (Hours)
Introduction of Teaching and Learning Detail information about Intensive Course for Producing Instructional Media The meaning and importance of Teaching and Learning	**Neranuch**	**1.30**
Educational Technology Nature of Educational Technology Technology of instruction Background for the instructional design concept	**Pollawat/ Neranuch**	**1.30**
12.00-13.00		
Systematic Planning for the use of media Analyze learner Require learner performance Writing objectives Media and materials selection Utilize materials Evaluate assessing learning	**Sirikanya/ Neranuch**	**2**
Media and Instruction Instructional communication Transactional nature of communication Media, Messages and Methods Why use instructional media The role of media in instruction Technologies of instruction	**Pollawat/ Neranuch**	**1**
Total		**6**

7 March 2006

Subject	Instructor	Duration (Hours)
The Kind of Materials Teaching the conventions of picture Teaching students how to read a picture	**Pollawat/ Neranuch**	**1**
Slides Advantage Taking picture Processing film Preparing slides Editing Recording narration Duplicating slides Selecting a projector Prepare to use	**Sirikanya**	**2**
12.00-13.00		
Transparencies Advantage Preparing Making Filing Prepare to use	**Sirikanya**	**2**
How to be Professional Presentation Speech Commucation How to use visaul aids Presentation speech preperation	**Neranuch**	**1**
Total		**6**

8 March 2006

Subject	Instructor	Duration (Hours)
Transparencies Production Workshop	**Neranuch** **Pollawat** **Sirikanya**	**3**
Conclusion	**Neranuch** **Pollawat** **Sirikanya**	**3**
Hours		**6**
Total		**18**

Instructional Models

Instructional alignment

What is an Instructional Goal?

In most classrooms across America, youngsters are expected to know something about academic content—facts, concepts, and generalizations. A youngster in an E. D. Hirsch Core Knowledge school may be expected to know things at a different level or point in time than other students, but with the emergence of academic standards, the content emphasis is increasing for all students. Further, youngsters are expected to acquire and apply skills unique to an academic subject by applying these skills in the study of academic information. Youngsters are also expected to adopt various attitudes and values that American society considers important in terms of our culture and that are a derivation of the knowledge and skills acquired in the examination and utilization of the academic content.

Determining an instructional purpose is an initial step in the instructional planning process. This takes the form of identifying instructional goals and objectives. This step of the planning model (Figure 1) emphasizes what the students will be expected to do after the teacher has implemented an instructional model. Once the teacher has identified instructional goals and has converted these into performance objectives, there is no prescribed sequence in implementing the planning model. The process becomes interactive in that different steps or elements of the model interact with one another. The instructional planning process model in Figure 3.1 involves three general steps that all teachers need to take in planning lessons or units of instruction:

1. Identifying what students will achieve or accomplish after the lesson or unit is completed. This will involve the first two steps of the model: identifying student goals and identifying student performance objectives. (Both of these will be discussed in the next section of this chapter.)

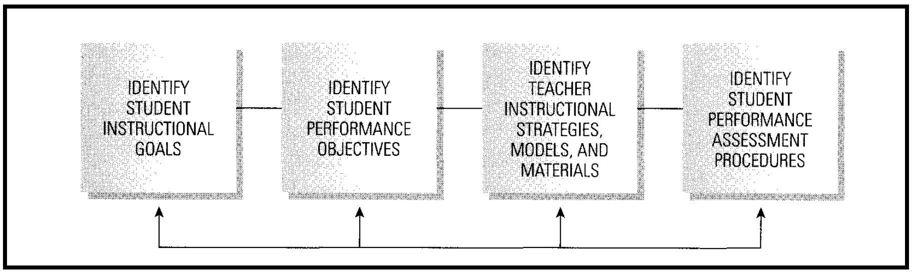


FIGURE 1 Instructional Planning Process Model

2. Identifying how the teacher will help students achieve the goals and objectives of the instructional lesson or unit.

3. Identifying how well the students have achieved or accomplished the instructional performance objectives identified in the second step of the planning model.

All steps in the instructional planning process model are important and interact with one another. Curriculum evaluators call this interaction the concept of *internal consistency or alignment:* Objectives, instructional strategies, and performance assessment must all relate to one another and be congruent based upon what has been developed previously in the model. However, the essential step in implementing the planning process is the first: identifying instructional goals and converting them into student performance objectives. Without these, instructional models and strategies will not provide you the means to arrive at your pedagogical destinations. Knowledge, skills, and attitudes are what we expect students to acquire and apply in their academic studies. In order for teachers to design plans for students to accomplish these expectations, a variety of directional statements need to be written by teachers. Some of these statements are written very broadly with verbs such as understand, appreciate, a-ware, or believe. Other statements are more performance-oriented and utilize such verbs as list, differentiate, share, or defend.

Instructional goals, especially as we will define them here, are broad statements of direction that identify what is expected of students. Goals serve as initial organizers and provide direction for educational participants, including teachers, who plan and write curricular programs, guides, or courses. They are written broadly and in general terms because they cover a breadth of content over longer periods of time. Examples of broad goal statements are as follows:
To understand the causes of the Civil War.

To appreciate the works of Edgar Allan Poe.

To use effective personal health practices.

To understand and appreciate the human experience.

TABLE 1 Verbs Associated with Goals: Words and Phrases Open to Many Interpretations

To understand

To appreciate

To grasp the significance of

To have faith in

To realize

To enjoy

To believe in

To recognize

To fully sense

To take satisfaction in

To understand how human resources are influenced by social and political systems.

To describe how the multicultural composition of American society enhances the quality of life for all Americans.

To know the primary colors.

In the planning process, goals provide a general direction for instruction. However, goals such as "producing effective consumers" or "appreciating the literary works of Walter Mosley" or "being sensitive to the dignity of all human beings" are so general that they leave the teacher and the student wondering where to begin instructionally, and what is expected in terms of accountability and achievement (see Table1). Because of this, the next step in the planning process is to take each goal and convert it into specific student performance terminology. In other words, the teacher needs to determine what is expected of students in specific ways that can be assessed in terms of performance.

That Are Performance or Instructional Objective?

The intent of instructional planning is to determine what students should accomplish, and then to plot a course of action (instructional models and strategies) that facilitates student accomplishment of objectives. Instructional objectives are an outgrowth of the goals discussed in the previous section. They are written in order to provide specific direction and meaning for what is expected from students. Objectives are important in teacher planning because they help facilitate: (1) an identification of what is expected of students at the conclusion of the study; (2) a basis for organizing instructional activities and materials; (3) a means for determining ways to assess student performance; and (4) a performance level of accountability for students. For purposes of this text, performance objectives are defined in terms of student outcomes—what the

Student will be able to do. They are written in terms that clearly delineate the student behavior that will be evaluated. Examples of broadly defined performance objectives are as follows:

• To list three statements of fact and three statements of opinion.

• To solve at least seven radical equations.

• To run the 100-yard dash.

• To convert data on hunger in selected developing countries to a bar graph.

• To identify Maya Angelou's primary life choices in *Gather Together in My Name* and to identify how she resolved each decision situation.

• To predict the height of a plant on the 21st day of growth, given appropriate light and water.

For many teachers, such broadly defined objectives are more than adequate, especially if the teacher knows the specific indicators of success. But for novice teachers, more precision may be necessary initially to ensure that the teacher and students know precisely the goal to be attained. Generally speaking, the more specific learning experiences are intended to lead to particular learning outcomes, the more well-defined performance objectives should be.

Readers who take time to examine the performance objectives just outlined will notice that these statements seem reasonably clear, but they are not specific. These performance objectives provide direction to teachers for what instructional models to employ in helping students achieve these outcomes, but they don't provide some essential information. For example, what type of plant will the students grow? What will be the source of the facts and opinions—the students' imagination or a teacher resource? Also apparent with this examination of objectives is the notion that assessment is not as clearly defined as it might be. Performance objectives utilize precise verbs in identifying what is expected of students after instruction has been completed (see Table 2 for a list of such verbs).

Performance objectives written to communicate the student outcomes and the means of goal assessment exhibit three essential characteristics—the instructional conditions under which the student performance will occur; the student behavior expected after instruction is completed; and the standard, criterion, or performance level that each student is expected to demonstrate.

• *Instructional conditions under which the student performance will occur*

The instructional conditions are strategies that the teacher will employ in help- ing students exhibit the performance expected. The following examples are conditions that could be components of a performance objective:

• Given a three-place subtraction problem with regrouping,...

• Given a standard set of tools, .

• Without the aid of a calculator or computer, . .

• When the student is describing a poem by Langston Hughes,...

Each condition is written after consideration of the appropriate instructional strategies necessary to achieve the outcome.

TABLE 2 Verbs Associated with More-Defined Objectives

To list
To compare and contrast
To construct
To differentiate
To identity
To write
To speak
To assemble
To describe verbally
To describe in writing
To float

• *Student behavior expected after instruction is completed.*

The student behavior is identified in performance terms that will be acceptable as evidence that the student has achieved the objective. Further, this student behavior is written in specific language so that few, if any, interpretations are apparent in terms of what is expected to be performed. This student behavior is then attached to the instructional conditions as described in the previous step. The following are examples of the two characteristics of performance objectives—conditions and student behavior—put together in proper form:

• Given a linear algebraic equation with one unknown, the student will be able to solve for the unknown without the aid of tables, references, or calculating devices.

• Given a list and discussion of factors leading to significant historical events, the student will be able to select and justify at least three economic factors contributing to the influx of immigrants to the United States since 1980.

• Given a description and demonstration of the first 10 numbers of the numerical system, the student will be able to print these 10 numbers in order.

• A standard, criterion, or performance level that each student is expected to demonstrate.

The performance level provides the teacher with a standard by which to assess instructional effectiveness as well as student achievement. This characteristic defines for the student what is expected and what level of performance is required. Through standards, the teacher will have a measure to determine the depth, breadth, and complexity by which to judge students and to judge the teacher's instructional effectiveness. The following examples are provided to demonstrate this final characteristic of performance objectives:

• Given linear algebraic equations with one unknown, the student will be able to solve 8 out of 10 of these equations without the aid of tables, references, or calculating devices.

• Given the knowledge of how to run a dash, the student will be able to run the 100-yard dash within a period of 14 seconds.

• Given both a description of how to float on water and a viewing of videotapes concerning floating positions, students will be able to float on their backs for at least 1 minute.

• Given knowledge of measurement and weights, the student must be able to use the chemical balance well enough to weigh materials accurately to the nearest milligram.

In summary; performance objectives should consist of an instructional condition, an expected student behavior, and a standard by which to judge achievement. After a teacher has completed a listing of all performance objectives for a lesson or unit of instruction, the teacher can evaluate each planned objective based upon the following three questions:

1. Does the performance objective describe what students will be doing when they demonstrate that they have achieved the objective?

2. Does the performance objective describe the conditions under which students will be expected

to demonstrate achievement?

3. Does the performance objective indicate how the students will be evaluated? If the reader will take into consideration these three questions when designing performance objectives, then students will know and teachers will be very clear in terms of the performance expected and of how evaluation will occur.

Though we have spent time describing the characteristics of performance objectives, we believe that the most important component is the identification of the behavior expected from the students. Remember that performance objectives are written for students and for what is expected of students. Our point is not that teachers must write precise instructional objectives but, rather, that they must know precisely what behavior or cognitive processes they want students to exhibit.

Thus far, we have described how classroom teachers can use performance objectives in a very mechanistic manner. Many of the examples provided previously in this discussion have elicited low-level, convergent thinking processes right or wrong/correct or incorrect responses. Schooling in America, especially in its best forms, provides youngsters with more than just correct or incorrect responses! As you will recognize in the following chapters, a good number of instructional models (that is, concept attainment, synectics, inquiry, oral discussion) facilitate the development of youngsters' minds through the use of thinking skill development and the application of these skills to culturally relevant curricula and materials.

One system that can be used to write performance objectives and develop higher-order thinking skills was originally created by Bloom et al. *(1956)* and is referred to as the Taxonomy of Educational Objectives. There are three types of learning objectives (cognitive, affective, and psychomotor) that teachers need to utilize and students need to develop; Bloom has become best known for his work in the cognitive domain.

1. Cognitive Objectives—those that use academic knowledge to develop the intellectual abilities of youngsters.
2. Affective Objectives—those that help youngsters develop values, attitudes, and feelings.
3. Psychomotor Objectives—those that help youngsters develop large and small muscle coordination and manipulative skills.

Models that foster reasoning skills

Concept attainment

Introduction

The model presented in this chapter is an inductive approach to help students critically think through the meaning of a particular concept (for example, symmetry, parts of speech, balance of power, gravity). Perhaps in an “ideal” world teachers would not need to seriously consider and plan for the types of instruction that may occur in classrooms—students would learn, in essence, despite the instructional model that the teacher uses. Indeed, Rousseau once observed that for a child who wanted to learn to read, any teaching technique would work; the child’s natural interests would lead him or her to find a way to decode the written word. If absolutely every student in a classroom exhibited an insatiable desire for knowledge or came from similar cultural (and family) circumstances, then using alternative instructional models might not be an absolute necessity. But because each student is different, because classrooms—regardless of context-are inherently diverse, and because proficiency testing in most states focuses on critical thinking skills and content concepts, it is imperative that teachers create lessons that tap the natural interests and inquisitiveness of students.

Several instructional dynamics frame the way in which the teaching process occurs in the classroom (Ornstein and Lasley, 2000)-understanding student differences, determining the length of instruction, identifying how to foster student participation, and evaluating student understanding. These dynamics focus not only on how high ability students learn, but also on how every student can be engaged to think through ideas.

Concept attainment creates an environment where the teacher has frequent access to student knowledge (a necessary precursor for quality instruction), where teachers visibly see the ways in which students are thinking through ideas, where the natural interests and cognitive styles of culturally diverse students are the incentive for student involvement, and where the teacher decides which concepts are significant to warrant in-depth attention and analysis.

One of the prominent concerns of educational reformers is that classroom instruction is too traditional—teacher controlled and teacher centered. Lessons all too often are organized around specific correct and incorrect responses, and students, especially students from culturally diverse backgrounds, have too few opportunities to use their cognitive style dispositions and to explore their own thinking skills. As a consequence, many students, especially those who lack the necessary "academic skills," begin to exit the system psychologically. Such students subsequently become a part of the great mosaic that makes up America— a mosaic that now includes millions of adults who are functionally illiterate but that also has approximately 40 percent of the school-aged population imperiled because of reading deficiencies (Snow, Burns, and Griffin, 1998).

Riley (1997) states in *Design as a Catalyst for Learning* that because of rapid changes taking place in today's business, the need for educating students in other than the traditional methodology is critical. He cites, "it (creative problem solving) is a creative counterpart to the scientific method and presumes there is more than one right solution to any problem and many paths to each alternative". His comments support and encourage the methodology of concept attainment because they suggest that students must both learn content
and learn how to analyze that content.

The concept attainment model enables each student to construct and justify an answer to questions that make personal sense. The teacher begins to "shape" the students' thinking by adding new data. Concept attainment is grounded on how students view the world and construct ideas, or in the language of Cajete (1994), a Tewa Indian educator and writer, it is learning that focuses on "seeing the whole through the parts" This instructional model also enhances motivation because students are required to search for ideas that make conceptual sense to them; they can personally invest themselves in the ideas. Because all inductive models have "the search" element in common, they build effectively on the natural curiosity of children regardless of their cultural or social background.

Theoretical Perspective

The concept attainment model has deep, rich historical and philosophical roots. Aristotle, over 2,000 years ago, was concerned with how humans discern or "make sense of" the world in which they live. Within the context of that discerning process, people begin to classify the objects and ideas that they perceive. Indeed, Aristotle was the quintessential scientific organizer; his goal was to clarify concepts and order the world he experienced. He did this by creating his own broad categories (living and nonliving things) and then showing how these categories could be further subdivided. Aristotle used characteristics of an object to make the categorization. As Gaardner (1996) notes:

> When Aristotle divides natural phenomena into various categories, his criterion is the objects characteristics, or more specifically, what it can do or what it does.
>
> All living things (plants, animals, humans) have the ability to absorb nourishment, to grow, and to propagate. All living creatures (animals and humans) have in addition the ability to perceive the world around them and to move about. Moreover, all humans have the ability to think—or otherwise to order their perceptions into various categories and classes.

The twentieth-century version of the model is based largely on the research of Bruner, Goodnow, and Austin (1967), and it has been subsequently popularized and identified as a teaching strategy by a number of different authors, most especially Eggen and Kauchak (2001), Joyce and Weil (1972, 1992, 1996) and Joyce, Weil, and Calhoun (2000). The learning of concepts from various academic disciplines is important to understanding the world. Concepts help make the complex and often abstract nature of diverse ideas much more understandable to students. Without concepts, people would have no way of categorizing new ideas efficiently and effectively; they would have to engage in constant learning and could not use past experience to frame new experiences.

At the most basic level, concepts can be either concrete (simple) or abstract (complex). The level of complexity is dictated by the number of inherent attributes within the concept. Concrete concepts (see Figure 2) are those things that can be seen, felt, heard, smelled, or tasted on some direct, experiential level; they can be evidenced by the senses and observed in reality. A car, horse, or whole number can be identified using direct experience—the teacher can point to a Ford, or a stallion, or the number *5.* On the other hand, abstract concepts represent nonobservable instances of a larger, complex idea; they are a collection of meanings that cannot be adequately defined by a single or sometimes even several examples or attributes. The concept of *democracy* is one such abstract concept that is often taught in school. Other examples include ecology, literary criticism, or interdependence.

Concrete Concepts		Abstract Concepts
Voting	⟷	Democracy
Reading	⟷	Literary Criticism
Friends	⟷	Interdependence
Fight	⟷	Revolution
Man	⟷	Humankind
Embryo	⟷	Genetic Engineering

FIGURE 2 Types of Concepts

The concept attainment model can be used by elementary school teachers to teach concrete concepts such as mixed numbers, which is the focus of Maria Sanchez's lesson. With high school teachers, the concepts taught will often be more abstract, and in many instances the appropriateness of the concept attainment model must be carefully assessed before teachers consider using it.

In general, concept attainment (CA) is used most effectively by teachers who are teaching concrete concepts; but as a teacher's skills grow in using the CA model, so, too, can the teacher manifest an ability to transform the model's usage to include a greater variety of complex and abstract concepts.

Concepts are characterized by three elements: a concept name, the essential and nonessential concept attributes, and the attribute value within a concept (Joyce and Weil, 1996). The *concept name* is its common identifier—the term given to the myriad examples within a concept category. Hence, the common identifier for a word that represents a person, place, or thing is *noun.* The term *noun,* in turn, has selected essential and nonessential attributes.

An *attribute* is, according to Bruner, Goodnow, and Austin (1990), "any discriminable feature of an event that is susceptible to some discriminable variation from event to event. . . . When some discriminable feature of the environment is used as a basis for 'going beyond' by inference, it serves as a signal. When such a discriminable feature is used as a means of inferring the identity of something, . . . it is a criterial attribute". In essence, a criterial attribute parallels Joyce and Weil's (1996) notion of essential attribute. If an attribute is changed in value and that change makes it impossible to classify the object, the attribute is essential or criterial for categorizing the object. Changing the color of apples is not criterial; changing their shape would be. Quite literally, what students do during a concept attainment lesson is list in their hypotheses the attributes of the concept.

Essential attributes are those characteristics that enable a person to make specific classifications within particular categories. Any term that is a person (Thomas Jefferson), a place (Chicago), or a thing (chair) is labeled a noun. Of course, it can also be labeled a particular type of noun (proper or common), but the type of noun is nonessential to its classification as a noun. Nonessential attributes are those characteristics that are evident in a concept but are not needed for accurate concept identification. Hence, crayons are nouns, but the actual color of the crayons is not needed (color is a nonessential attribute) to make an appropriate designation as a noun. Chicago is a city and is classified as a (proper) noun—where **it** is located and its size are nonessential to its identifica1ariation as a noun.

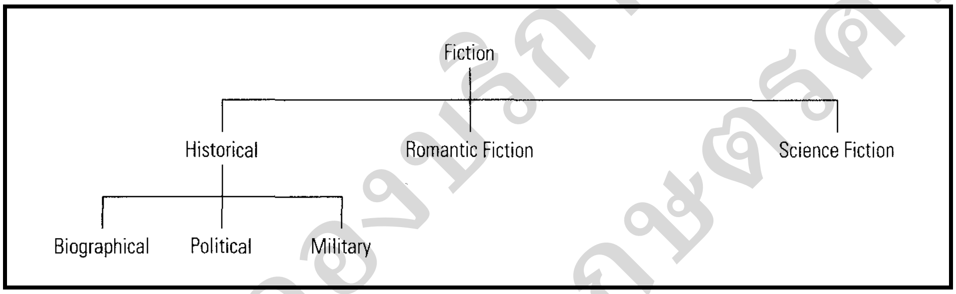


FIG U **RE 3** The Hierarchical Structure of Fiction (Superordinate to Subordinate Concepts)

Attribute value is the degree to which some characteristic is manifested in order to categorize a concept accurately (Joyce, Weil, and Calhoun, 2000). Attribute value is typically less pedagogically evident with concrete concepts than it is with abstract concepts. The presence of seeds (not the number of seeds) represents one essential attribute of fruit. The presence of four wooden legs and a seat (not the quality of the wooden materials) characterizes a chair. For abstract concepts, attribute value plays a more prominent role in the categorization process. As an example, for the concept of democracy, the type of participation of the citizens and the choices they have available are important definitional qualities. A citizen in one country may be able to participate in the political process (when the government dictates) and make choices (for candidates the government specifies) yet live in a dictatorship. In another country;
the type of participation and choices may be sufficiently different to qualify as a democracy (that is, citizens have full participation in the political process; they can vote for a range of candidates;

and political candidates do not require governmental approval in order to appear on a ballot). Attribute value—the degree to which an attribute is manifested in teacher-identified exemplars—is critical to the identification of abstract concepts.

Concepts can also be *superordinate, subordinate,* or *coordinate.* Indeed, one concept can represent or fit definitionally within all of these descriptors. In Figure 4-2, historical fiction is superordinate to political fiction, subordinate to fiction, and coordinate with romantic fiction. The different levels become important as teachers begin to select examples of concepts for concept attainment lessons. In Figure 3, apples are subordinate (in a subcategory) to fruit but coordinate (within the same category) with bananas and oranges. Finally, apples are superordinate to the apple types of Macintosh or Granny Smith.

Providing examples to students is critical in teaching concept attainment lessons. Equally important, especially as the concept attainment lessons are implemented, is the use of nonexamples. It is through the use of both examples and nonexamples that students learn to fully explore the attributes of concepts.

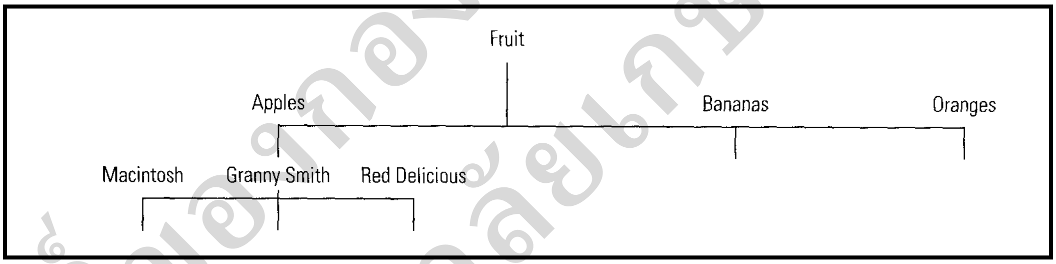


FIG U RE 4 The Hierarchicat Structure of Fruit (Superordinate to Subordinate Concepts)

Examples must possess the essential attributes of a concept, while nonexamples will not have one or more of the essential attributes. Concept attainment lessons require the use of both examples and nonexamples, though how the examples are actually presented to students may vary significantly depending on the type of hypothesizing desired by the teacher.

Concept attainment strategies are intended to frame the essential attributes of a concept while expanding the thinking skills of students. Students in schools are expected to acquire content information and to think actively about that content. Most schools place students in the position of learning content information without critically thinking about how that content is organized or structured—the teacher provides the schema rather than requiring students to independently generate their own conceptual organization.

Concept attainment requires that the teacher identify a significant concept and then structure a lesson so that students identify the salient attributes of that concept. Students must engage in higher-order thinking to determine the concept name and the specific attributes that the teacher predetermines as focal points of a concept attainment lesson.

Teachers usually teach by identifying in lessons a salient concept, providing a definition of the concept (with the appropriate attributes), and then providing examples of the concept (see Figure 4). Such a deductive approach is an efficacious one, especially for teaching certain types of functional skills (for example, how to divide or add fractions). But such an approach to teaching also has limitations because **it** fails to create within students the type of critical thinking skills students need once they enter the world of work. As examples, doctors work from symptoms to diagnosis; lawyers work from a client's problem to an understanding of applicable legal codes; and students retain more when they work from observing and classifying data to defining and articulating concepts. Tennyson and Cocchiarella (1986) compared the effectiveness of treatments in which students induce attributes and definitions as compared with deductive instances where definitions are presented by the teacher and then followed by exemplars. They found that students consistently developed better concept understandings and retained concepts longer when inductive rather than deductive instructional approaches were used.

Concept attainment is an instructional model that utilizes inductive thinking strategies. The teacher moves from specific instances and examples to general ideas and concepts. This instructional process requires that students think through what the student or teacher-generated examples have in common (how the exemplars are alike) and how to synthesize those attributes (consider them in combination) to determine a specific concept name.

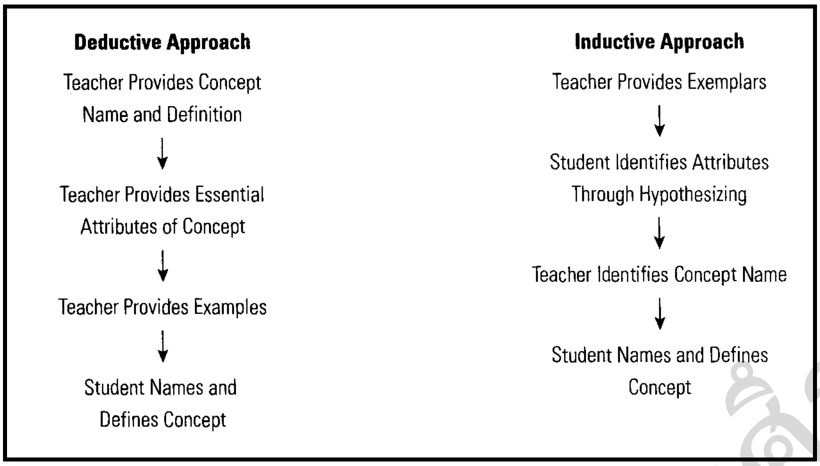


FIGURE 5 A Comparison of Deductive and Inductive Pedagogical Structures

Concept Attainment I

In Concept Attainment I (CAT) the teacher provides one or two positive and negative examples and then asks the student to begin hypothesizing. By limiting the number of initial exemplars, the teacher maximizes the number of hypotheses that will be generated by the students. After the students create a tentative set of hypotheses, the teacher continues by placing another set of positive and negative examples on the board. After each set is provided, the students add or delete hypotheses based on their analyses of the new exemplars. The following is a listing of the example and hypothesizing steps with which students will be involved within a concept attainment lesson:

Concept: Natural Resources

Step I: Teacher presents first set of exemplars

trees—yes

paper—no

animals—yes

gasoline—no

Step II: Students generate hypotheses

• things that are living

• things that are abundant

• things that end in the letter

• things you can touch

Step III: Teacher presents second set of exemplars

sunlight—yes

electricity—no

limestone—yes

cars—no

Step 1V Students add and delete hypotheses

• thing that arc living

• things that are abundant • things that can be used by humans to do work

• things that end in the letter *s*

• things you can touch

Step V: Teacher presents third set of exemplars

crude oil—yes

kerosene—no

rivers—yes

paper bags—no

Step VI: Students refine hypotheses until all invalid ideas are eliminated

The teacher provides as many exemplars as is necessary to identify the appropriate concept attributes (valid hypotheses). The actual number of desired exemplars will vary according to the concept taught, but the positive examples should contain all the essential attributes necessary for fully defining the concept. As a result, Tennyson and Park (1980) note: “The optimal number of examples is probably not an absolute number. It will vary depending upon the characteristics of the concept such as the number of attributes”. In the previous example the teacher is teaching the concept of natural resources and completes the lesson once the students identify the salient attributes of the positive examples (for example, occur naturally, are used to make products for humans, have value, and so on). The invalid hypotheses (for example, things that end in s, and things you can touch) are eliminated.

Concept Attainment II

In Concept Attainment II (CAll) the students are provided with all positive and negative examples before the lesson begins. The teacher starts with one positive and one negative example of the concept to be taught, and then lists the other exemplars, without classifying them as either positive or negative, that will be used as part of the lesson. Hypothesizing starts once students recognize the range of available exemplars. The following is an example of how Concept Attainment II is implemented:

Concept: Natural Resources

Step I: Teacher presents one positive and one negative example of the concept

trees—yes

paper—no

Step II: Teacher presents a variety of other exemplars

animal kerosene

gasoline cars

sunlight rivers

electricity limestone

crude oil paper bags

Step III: Students select items to pair with "yes"

Student 1: "I think electricity will pair with trees."

Step TV Students hypothesize

Student 1: "I think your idea is things needed to make paper. To make paper you need trees, electricity, and probably gasoline [to run machines]."

Student 2: "I think your idea is things that grow in a forest.

Student 3: "I think your idea is things that are living.

The teacher listens to different student ideas and methodically classifies the other exemplars based on each hypothesis presented. For example, after the first student hypothesis, the teacher should ask why? and may even respond: *"If you are right about things needed to make paper, which of the other exemplars would you group with trees?"* Allow students time to think through the category (concept) that they are proposing. Once a student is done, then indicate whether the pairing is correct given the concept you as the teacher are presenting. As students provide exemplars (positive and negative) for each proposed hypothesis, only those that fit the category as the teacher defines **it** should be listed. As a result of this process, each student begins to rethink the validity of his or her original hypothesis (for example, things needed to make paper) as the teacher reveals which items are in fact "yes" and "no" examples. A student may include electricity under “things to make paper,” but needs to eliminate the proposed hypothesis once the teacher labels electricity as a “no.” (In this instance the teacher is teaching the concept of natural resources.) Once the students identify the correct hypothesis (or attributes), and all teacher-generated exemplars are labeled, the teacher then asks students to generate their own additional exemplars.

Eggen and Kauchak (2001) propose another variation, which they suggest fosters even more critical thinking. They suggest that teachers provide the first two exemplars (one positive and one negative) and then ask the students to generate a concept name and then their own exemplars (and appropriate hypotheses) that they would classify under the original two exemplars. Students must defend each example based on either an implied or a defined hypothesis. Students would then provide additional examples and defend them. At this stage of the instructional variation, the teacher indicates whether the student’s example (as a “yes” or “no”) is accurate. Hypotheses are added, refined, or eliminated as a result of this iterative process on the part of the students. As students add more and more examples, the valid hypotheses or attributes are more clearly identified. This technique places the cognitive load on students to defend an idea; **it** places students in the position of having to think critically about ideas and create their own schema relative to the concepts being taught by the teacher. Further, Eggen and Kauchak note:

> One additional advantage of CA III is the opportunity **it** affords learners to gather data.CA III is more authentic or realistic than the other two Concept-Attainment formats because students more actively investigate a concept they don’t fully understand. Because students are not limited to the examples the teacher provides, they can use more of their own background knowledge and initiative in investigating hypotheses. This increases their control of the learning activity, which has been identified by researchers as a factor increasing learners’ intrinsic motivation. . . . In addition, critical thinking is best developed with practice in which students share and explain the thinking processes they use in arriving at their answers.

Concept Attainment I is more appropriate for younger students or for students who are just learning how to use this approach. *Concept Attainment II* may be more effective with older students who have the verbal and critical thinking skills necessary to analyze concepts from several different perspectives. Thus, the efficacy of the different approaches is often dictated by the developmental abilities and needs of the students and the pedagogical proficiency of the teacher in dealing with these needs.

Inquiry

Introduction

American schools are instructionally organized more for the transmission of discrete knowledge than they are for student construction of personal knowledge. The former assumes that knowledge is fixed and that the teacher is the source of that knowledge. Students, as a consequence, work independently to acquire necessary, teacher-defined information. Because of this orientation, students exit the school environment often knowing lots of disconnected facts but not fully understanding what they have acquired. An example illustrates the point. Most readers of this text know how to divide 1/4 by The division of fractions (learning how to invert and multiply) is rather standard fare in the intermediate grades. If you know how to divide these numbers, let’s now look at the question: “Why does one invert the 1 to derive the correct answer?” If you don’t know the reason for inverting, perhaps you can tackle a “simpler” problem: “Think up a story problem for 1/4 divided by If you are struggling with the examples, don’t feel as though you are alone. Borko and her colleagues (1990) found that almost 70 percent of all elementary education majors were unable to develop a story problem for this simple algorithm.

Some of the reasons for the above circumstance are related to the fact that prospective teachers do not have the academic background knowledge required to fully understand requisite mathematical concepts. Tyson (1994) writes that “many subjects that teachers are expected to teach in public school aren’t taught in college. [For example] mathematics majors are rarely exposed to fractions, at least not as students in the mathematics department. Another reason for this lack of conceptual understanding is that elementary and secondary school students are rarely required to think, to question, and to explore ideas. Most questions asked in a classroom are teacher-initiated. Those that do originate with students typically deal with procedural issues (that is, how should an assignment be accomplished?). Hyman (1980) described two research studies, one involving 43,531 classroom behavior incidents, of which only 728 included student questions; the other involved an ethnographic study in which student initiated questions accounted for only 4 percent of the classroom instructional time. Is it any wonder that American students lack depth in what they have studied? Teachers are performing most of the intellectual work; they are doing the thinking for the students.

Inquiry requires that the teacher engage students with content in a way that fosters exploration, discovery, and critical thought. Students become active participants in the learning process because they can use what they already know to explore the reasons for what they sense. As a consequence, the inquiry instructional model utilizes student past experiences (cultural and intellectual) to become a part of the teaching-learning process. Inquiry also has two inherent advantages over more didactic approaches. First, it builds on the natural curiosity of students and, hence, is more motivational, especially for students who feel disenfranchised within classrooms because they seldom are the first to know the *right* answer. With inquiry, student success is based on good questions, not right answers. Second, because the assumptions of inquiry methods are different from those of more traditional, teacher- directed approaches, many students can experience success who were unable to achieve at a higher level using more traditional instructional approaches. Formulating a question is far different from knowing an answer. Ironically, many high-achieving students are very good at the latter, but quite weak with respect to the former. On the other hand, many students from dysfunctional family environments who are suspicious of the school as an advocate for their learning have learned how to ask difficult, and at times contentious, questions; these same students have spent much less time memorizing correct answers. Even though inquiry builds upon the natural curiosity of students, the teacher's role is to channel the students' interests and ideas in ways that develop their critical reasoning abilities.

Guided Inquiry: Teaching Phases

Phase I: Discrepant Event and Confronting the Problem

Guided inquiry lessons begin by having the teacher create an event or present a problem that cannot be easily explained or immediately solved. Wright (1981) provides one of the best definitions of a discrepant event—"a phenomenon which occurs that seems to run contrary to our first line of reasoning". The students in Ms. Lange's class were asked to look at the various duck and bird tracks and make some sort of sense out of what they observed. The third phase of the discrepant event created particular excitement because it was at this point that students saw duck tracks, but no bird tracks.

The key to a good inquiry lesson is an effective discrepant event. Teachers who have experimented with the inquiry model will quickly note that the more powerful the discrepant event, the better the student participation in a lesson. A weak discrepant event is one that can be explained quickly and that has very few competing ideas that represent possible explanations for the event. A powerful discrepant event is one that engenders a tremendous number of student questions and can potentially be explained in several different ways. The following examples are from three classroom lessons the authors have observed, and Table *5-1* is an example of several others identified by Wright and Govindara e jan (1992).

1st grade: The teacher takes two eggs (one soft-boiled and the other hardboiled) and asks the students to explain why one egg will spin for a long time and the other just a couple of times.

7th grade: The teacher uses tongs and takes an empty pop can that has been heated on a hot plate and places it in cold water. Once in the cold water, the pop can implodes. Students are asked to explain why the implosion occurs.

11th grade: The teacher takes raisins and places them in a jar of carbonated water. Once in the water, the raisins begin to "dance" or move up and down in the jar. Students are asked to describe why this movement occurs.

All three of these discrepant events focus on science, but a discrepant event is possible in every disciplinary area. The only disciplinary area that often proves problematic for teachers is mathematics. Because of the very nature of traditional mathematics (that is, mathematicians describe behavior in order to predict behavior, and they use mathematical theory to accomplish this), math ematics teachers, especially high school mathematics teachers, often express frustration when attempting to generate good discrepant events. However, teachers should be able to identify axiomatic paradoxes for use with students of all ages. The mathematics evidenced in the social sciences (e.g., voting strategies in elections) provide one place where discrepant events are evidenced. The most natural areas for using the inquiry technique are social studies, science, and language arts. In general, the more content depth a teacher has acquired in the academic discipline, the easier it is to recognize complex relationships and to determine what discrepant events are embedded within the content of a discipline.

One additional note regarding discrepant events is needed. It is imperative, especially for guided inquiry, that teachers have some reasonable knowledge of the phenomenon the students are observing. Several years ago, one of the authors watched a dry ice lesson for an intermediate-level class. The teacher un1) covered the dry ice, and the vapor that emerged looked like smoke; the students were, to say the least, very engaged. Her discrepant event was, “How can something so cold create something that looks so hot?” There was only one difficulty. As the students asked questions (and they were truly excited about what they saw!), the teacher repeatedly had to answer, “I don’t know.” After several minutes, the frustration of the students became apparent. The teacher does not need to know everything about a phenomenon, but the teacher must possess sufficient knowledge to sustain the momentum of an inquiry lesson and enough knowledge to “guide” the inquiry of the students. There are exceptions to this observation, but they really are exceptions. Teachers really need to be educated in the content areas in order to know how to use questions to enhance student learning.

TABLE 3 Sample Discrepant Events

Phenomenon, Event, or Question	***Probable Student Response***	***Conceptual Discrepancy***	***Scientific Principle or Concept Illustrated by Conceptual Discrepancy***
1. An amoeba could theoretically become as large as an elephant if it were in a liquid medium of suitable temperature and nutrients.	*True*	*False*	*In general, volume increases by the power of three, while surface area increases by the power of two. The area/volume ratio decreases as size increases. Eventually, the surface area would become too small to accommodate the needs of the organism.*
2. Can two individuals who are both brown-eyed, whose forefathers all had brown eyes, become the biological parents of a child with blue eyes?	*No*	*Possible*	*The possibility exists when a mutation of the dominant brown-eyed gene takes place in both the sperm and the egg that produced the zygote with the recessive trait of blue eyes.*
3. Girls are physically more flexible than boys.	*False, at least as indicated by boys.*	*True. Have both sexes face a wall and pace back three steps. Place a chair between each student and the wall. Ask students to bend over with their head against the wall, take hold of the chair, and in one motion stand up straight. Girls can do this easily. Boys will find it impossible.*	*The superior aperture of the pelvis is greater and wider in females, allowing greater flexibility. Also, the pubic arch in females forms an angle greater than 90 degrees, causing the female to have a greater freedom of movement. In males, both the above features are not as prominent.*
4. It is not possible to light sugar cubes with a match. What will happen if you sprinkle burnt cigarette ash on a cube before lighting it with a match?	*Nothing*	*It will burn.*	*Cigarette ash acts as a catalyst. The scientific concepts of catalyst and catalytic functions in biochemical systems should be stressed. An interdisciplinary extension into the study of physiological chemistry of glucose (in sugar cubes) and its metabolism in the body will interest students.*

(continued)

Phenomenon, Event, or Question	Probable Student Response	Conceptual Discrepancy	Scientific Principle or Concept Illustrated by Conceptual Discrepancy
5. *A man's weight went from 190 lbs. to 0 lbs. and back to 190 lbs. in one day and he lived. Is this biologically possible?*	*No*	*Yes*	*Introduce concepts of mass and weight in antigravity conditions by informing students about the phenomenon; also, this serves as an excellent interdisciplinary focus when aspects of physics and biology are discussed. If the man traveled to and returned from space in one day, his mass would remain constant but he would be weightless in space.*

Adapted and reprinted from E. L. Wright and G. Govindarajan. 1992. "Stirring the Biology Teaching Pot with Discrepant Events." *American Biology Teacher* 54(4) (April): 205–210.

Phase II: Questioning and Data Gathering

Once students have observed a discrepant event, the next step is to have students ask questions about what they have observed so that they can verify the nature of the "objects" and gather more data. The questions that the students ask should be structured so that the teacher can answer with either a "yes" or a "no" response. The teacher first asks students to identify pertinent information. Students have a tendency to jump ahead and identify possible hypotheses—they attempt to develop theories before they fully understand the facts. Students should generate hypotheses (phase III of the inquiry process) only after all available pertinent information (facts) are identified. Ms. Lange, for example, should have tried to elicit some specific data about the types of animal tracks students saw in the picture. *("Class, ask me questions about the types of animals who made these tracks, and then ask questions about the patterns of the tracks.")* There is absolutely nothing wrong with focusing students' attention on what types of questions to ask.

If a student asks a question and if **it** cannot be answered with a "yes" or "no" response, then ask the student to reword the question: "Please reword that so I can answer **it** with a 'yes' or 'no." This is a very common problem! Some teachers try to help students understand how to engage in inquiry by playing 20 Questions with the students. The "20 Questions" game enables the students to practice the "yes" and "no" questioning skills and to understand the guided inquiry process.

Teachers who have used this strategy also have found **it** useful to record data generated by the students as the students ask the questions. Ms. Lange created a chart for the student. Other teachers have found **it** useful to use a handout similar to the one in Figure 6. As students generate questions that can be answered with a "yes," they place the appropriate information in the "yes" column. If a "no," then they use the "no" column.

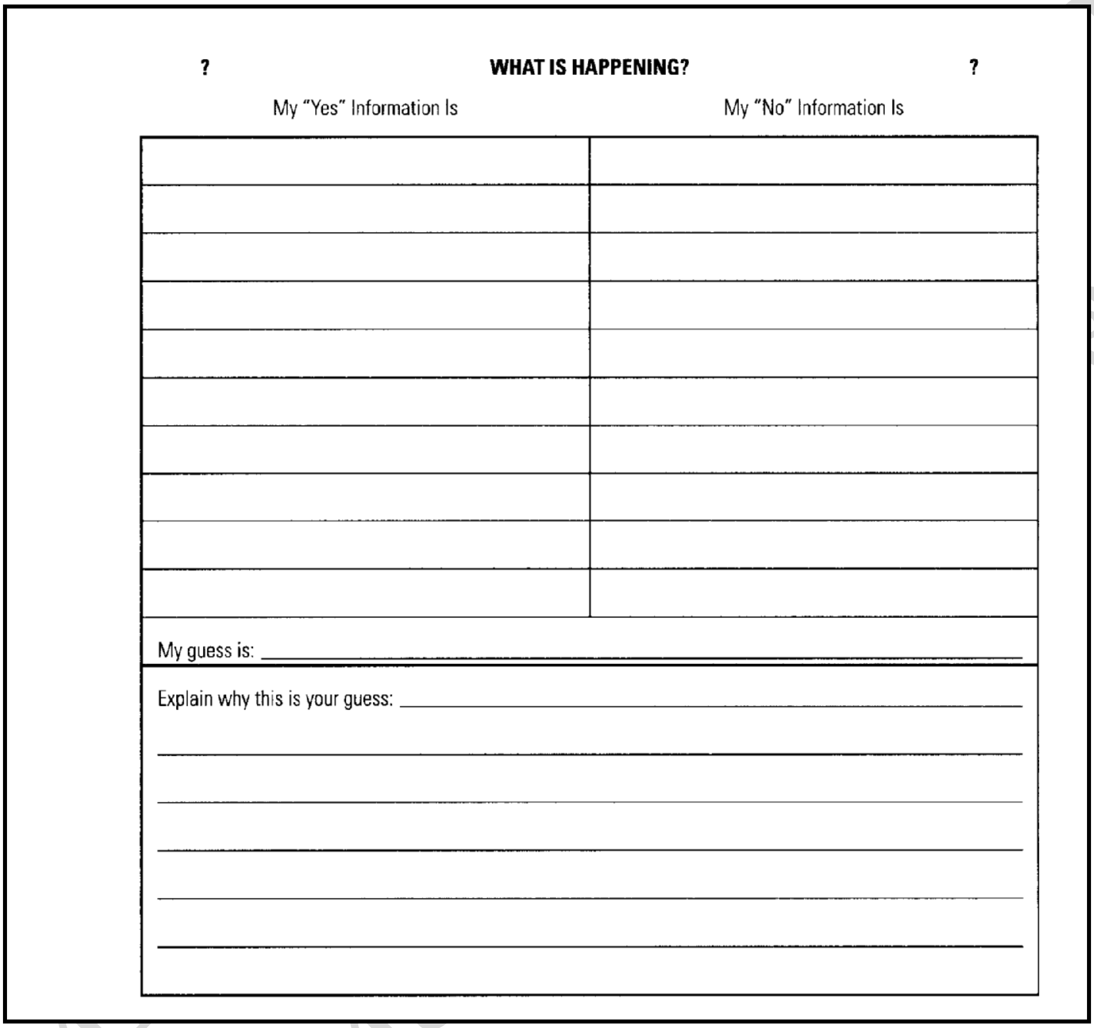
Such a strategy is especially useful with young children, but **it** is potentially helpful for all students, especially when a substantial amount of data is to be generated and when the students are not accustomed to this type of critical- thinking experience. After the students have generated many basic "yes" and "no" pieces of information, the teacher can then ask the students to move on to the next stage, which requires student hypothesizing.

Phase III: Experimenting and Generating Hypotheses

In the hypothesizing phase, the teacher attempts to have students synthesize the "yes" column information in a way that will enable them to create a logical explanation of what they see. As the students provide their guesses or hypotheses, it is imperative that the teacher continue to ask clarifying questions such as the following: *"What facts in the 'yes' column were most useful in forming your hypothesis? Are there any 'no 'facts that would eliminate or contradict your hypothesis?"* In essence, the teacher writes down all student ideas but also challenges students to defend their ideas and conceptually ground their hypotheses. Teachers should attempt to solicit as many hypotheses as possible. The goal during this phase is to see how each student is synthesizing the information in order to formulate a hypothesis that can be defended with the use of data.

Phase IV: Closure and Formulating a Hypothesis

Once all hypotheses have been generated and tested, the teacher begins to focus the students' attention on eliminating invalid hypotheses. At this point some teachers find it very useful to analyze each hypothesis relative to the "yes" column data. Ms. Lange did not do this in her "bird track" lesson. If she had, she would have taken the first hypothesis and asked something like, *"Class, let's look at each fact we have and see if it supports the various hypotheses you have generated. Our first hypothesis is, 'Two birds are walking to a lake.' Given what we know at this point (our 'yes' data), is this hypothesis valid? First, is there a lake nearby? [Students are directed to the chart (Figure 5—1) and to notice that 'lake' is, in fact, listed.] Second, are the tracks smaller than those that might be made by humans?* - . "The teacher would then continue through the “yes” column data and either retain a hypothesis (if all the “yes” data applies) or eliminate it (if the pieces of “yes” data conflict with a hypothesis). Such systematic checking of the data is particularly important for students who are experiencing the technique for the first time. It forces students to consider closely each piece of data.



? **WHAT IS HAPPENING?** ?

My “Yes” Information Is	My “No” Information Is

My guess is: ______

Explain why this is your guess: ______

FIGURE 6 Record Data Chart

A common scenario in implementing the inquiry model is for students to conclude the lesson with several workable hypotheses. If the hypotheses are variations on the same idea, then the teacher can work with the class to synthesize the wording and to create one workable hypothesis. If, however, the hypotheses represent very different explanations of the same phenomenon, the teacher should have students return to the previous discussion and gather more data. More “yes” and “no” questions need to be asked until the students can either validate or reject each one of the hypotheses.

Phase V: Analysis

At the completion of the inquiry lesson, once a valid hypothesis is agreed upon by the class, the teacher asks the students to evaluate which data helped them determine the valid hypothesis. The teacher, through phase V, is attempting to focus the students' attention in a way that makes them more critical consumers of information. Recall that Ms. Lange asked, *"Class, what data from the 'yes' and 'no' columns were the most helpful to you in reaching your conclusion?"* Students generally will identify two or three key prior questions that really helped them understand the phenomenon. A common student response might be something *like,"Nickc question was the one that really did it for me. When you answered 'yes' to his question about the lake, that when I knew what was occurring."*

Phase VI: Extension

Once students have a working hypothesis and know the relevant data that support that hypothesis, the teacher then needs to identify ways of extending the students' thinking. Ms. Lange had students do research on the feeding behavior of birds, but other variations might also be considered. As we will discuss in the next section, it is at this point that the natural interests of the students can be nurtured and the teacher can foster a more culturally responsive classroom atmosphere.

Unguided Inquiry: Teaching Phases

Unguided inquiry, at least the way we present the model, involves many of the same cognitive tasks as Taba's (1966) "interpretation of data." That is, in unguided inquiry the students are looking at raw data and then evolving personal theories to explain how that data can be logically connected.

Phase I: Provide Data

The teacher begins an unguided inquiry lesson similar to a guided inquiry lesson, by providing some type of discrepant event or unstructured data. As an example, Orlich and his colleagues (1985) describe how some teachers use discarded phone directories from different cities and then ask students to discuss what they see in the directory. In unguided inquiry, the teacher is not looking for a particular explanation, a single workable hypothesis. Rather,

TABLE 4 Cost of Garbage Collection and Disposal in Selected Ohio Cities

CITY	*YEAR*	*TOTAL NET COST*	*COST PER CAPITA*	*COST PER TON*
Cincinnati	*1909*	*$90,000*	*$.25*	*$2.59*
Cleveland	*1909*	*38,989*	*.07*	*0.87*
Columbus	*1909*	*40,706*	*.23*	*2.46*
Dayton	*1908*	*21,000*	*.19*	*2.11*
Zanesville	*1909*	*5,695*	*.21*	*4.71*

Source: *Investigating Solid Waste Issues,* Ohio Department of Natural Resources, 1994.

Observations: What do you notice? (Write down facts.)

1. ______________________

2. ______________________

3. ______________________

Questions: What additional information do you need? (Write down your additional questions.)

1. ______________________

2. ______________________

3. ______________________

Generalizations: What significant relationships are evident?

1. ______________________

2. ______________________

3. ______________________

the teacher is attempting to see how students synthesize information and make sense Out of what they observe. Other types of data that might be provided in- dude charts or graphs that require students to analyze and then ask questions about the data provided. Table *5-2* provides data on garbage disposal and collection for several Ohio cities.

Based on the data provided, the students would then be asked to generate observations (possible questions and/or hypotheses) that they perceive as relevant given the data in the chart. The observations could be declarative statements *("Cincinnati's costs were greater than Cleveland's")* or questions that require them to collect more information (for example, what was the population of each city in 1908 or 1909?). Another example can be found in Table *5-3.* In this instance, students would make observations about the way in which two housholds spend money and consume resources.

TABLE 5 Household Resource Uses: Two Cases

Annual Income and Expense Figures

Case: Wesley and Wilma

Wesley and Wilma enjoy the benefits of having two children and two incomes. If they monitor their spending carefully, they have a few dollars left over for emergencies or special occasions. Working leaves Wilma with little free time. It also requires that everyone in the family contribute to housework to make sure all the necessary chores are accomplished.

Average trash disposal per week: 20 pounds

Income before taxes:	*$38,262*
Total expenditures:	*32,753*
Food at home:	*3,066*
Food away from home:	*1,987*
Shelter:	*7,951*
Clothing:	*1,985*
Transportation:	*6,384*
Health care and pension:	*3,959*
Personal taxes:	*3,761*
Other expenses:	*5,004*
Utilities including sanitation and waste collection:	*2,114*

Case: Horace

Horace is a college graduate with a degree in business. He was recently hired for his first job as assistant manager at Big's Warehouse. Horace leads an active single life. He spends little time at home in his small apartment, except to eat microwave dinners and watch TV. His active single lifestyle leaves him with little cash. He uses credit to finance his independent lifestyle and to make sure his telephone answering machine is in good working order.

Average trash disposal per week: 3.5 pounds

Income before taxes:	*$18,551*
Total expenditures:	*18,726*
Food at home:	*1,794*
Food away from home:	*1,288*
Shelter:	*5,875*
Clothing:	*1,353*
Transportation:	*5,623*
Health care and pension:	*3,291*
Personal taxes:	*2,980*
Other expenses:	*4,232*
Utilities including sanitation and waste collection:	*1,749*

Source: *Investigating Solid Waste Issues*, Ohio Department of Natural Resources, 1994.

Observations: What do you notice? (Write down facts.)

1. ____________________
2. ____________________
3. ____________________

Questions: What additional information do you need? (Write down your additional questions.)

1. ____________________
2. ____________________
3. ____________________

Generalizations: What significant relationships are evident?

1. ____________________
2. ____________________
3. ____________________

Phase II: Make Observations and Ask Questions

Once the students have had an opportunity to examine the data, the next phase in unguided inquiry is to make relevant observations. Some of the students may make declarative, factual statements about the data: *"Cincinnati spent more per capita in 1909 for garbage disposal than did Cleveland."* With declarative statements the teacher attempts to focus students' attention on why this might have been the case. The teacher may or may not know the answer—that is relatively unimportant. The key issue is to enable students to make thoughtful observations and to determine what other data they might need in order to answer specific questions. Indeed, as a follow-up, students might be asked to do research on some of the unanswered questions.

As the students make observations, the teacher keeps track of what observations have validity and what questions need answers. As with guided inquiry, **it** is probably best to write the information on the board (or on notepaper) as the students generate ideas. In some cases the teacher might find **it** useful to place sections on the data sheet for students to make their observations, write questions, and prepare generalizations.

Phase III: Create Generalizations

After a substantial amount of data is generated, the next step is to determine what generalizations make sense relative to the ideas the students have enumerated. A generalization is nothing more than the relationship between two or more concepts. One generalization might be *"The size of a city influences directly the costs of collecting and disposing of garbage."* Any generalization is acceptable as long as students can show what data they used to formulate and support their ideas. The teacher at this phase in the lesson is literally teaching the students how to learn, to be critical consumers of ideas, and to recognize how to support an argument with data. In this phase of the lesson, the teacher needs to ask plenty of questions such as, *"What ideas that we have on the board support your generalization?"* or *"What additional data would you need to make your generalization even stronger?"* All student generalizations should be written on the board so that students can clearly identify the conceptual relationships. It may be useful then to review each generalization and to assess the degree to which students perceive that data are available to support each of their statements.

Phase IV. Follow- Up

In the final phase of the lesson, the teacher can ask students to engage in several different types of activities. Each of these activities (for example, defending generalizations and predicting alternatives) is intended to enable students to refine their thinking and to consider what additional information might be required.

Defending a Generalization Ask students to select the generalization they like the best and then to describe (in one or two paragraphs) why that statement is the best representation for their ideas.

Predicting Alternatives Ask students to make "what if" predictions based on the generalizations and data they have available. For example, one generalization for Table 5 might be "Cities on lakes have lower disposal costs than do cities that are situated on rivers." As a consequence, a prediction the students might make is "Chicago had lower disposal costs in 1909 than did Indianapolis." The students can then do research on their hypotheses to determine the level of support for their ideas. Of course, not all the predictions can be analyzed. But unguided inquiry lessons are enhanced when some of the predictions are examined to determine if the students' ideas can be verified.

Models that foster reorganizing skills

Concept Formation

Introduction

The purpose of concept formation is to "see" the thinking processes and conceptual schema of students. In far too many classrooms, what students experience is the reality of the teacher's thinking. That is, the teacher does the thinking for the students. The teacher determines what concept is going to be taught, provides the students with a definition of that concept, gives a variety of examples that illustrate the definition, and then provides practice activities (homework) to ensure that students learn the material. Some might describe this approach as traditional. Parker (1987) described this as the content mastery approach. Such an approach is disadvantageous when it occurs with such regularity that students have no opportunity to critique what they are learning or fully understand why they are learning the material.

The traditional content approach is not educationally unsound. Indeed, in many instances, such a strategy has real efficacy. When we will discuss direct instruction. However, the teacher-controlled approach to learning becomes a barrier to student growth when students are not provided with instructional alternatives. The ideal instructional system eliminates the use of one model exclusively; the ideal system utilizes many different instructional strategies as a means of tapping the full intellectual potential of students. Wiggins and McTighte (2000) capture this idea effectively: "Given the complexity of all instructional methods, there is no one best or preferred approach to teaching for understanding. No single method of teaching will work all the time. Particular instructional methods and techniques follow from the specific types of learning needed to achieve the desired results (evidence of understanding) in the unit or course".

Concept formation is an instructional model that places the *emphasis on student thinking, not teacher thinking.* This focus upon who is thinking is a very importance distinction and must be kept in mind when using this instructional model. In order for this model to have maximum impact, teachers need to sequence and plan the way in which students approach prescribed learning activities In essence, teachers create the conditions (set the stage), but the students are given latitude in terms of how to respond and think (create their own "play"). Whimbey (1977) asserts that to teach students how to think, teachers must carefully demonstrate to students how to process information, and then provide students with an opportunity to practice what they have learned.

Concept formation, according to Parker (1987), enables students to systematical examine data in a way that (1) fosters an understanding of how a label for a concept is just that, a "label"; (2) engenders more complex thinking "about the content, [and creates] further sense making as learners try to capture with a single term [determined by them] the similarities' essence" (p. *52);* and (3) enables student to connect their experiences with the available data. As Parker notes, "Student generated labels are more likely to be connected meaningfully to students' present experiences than are conventional [teacher provided] labels.

This last characteristic of concept formation is perhaps most important for teachers of culturally diverse youngsters. Because students come to school with such varied backgrounds from varied child-rearing practices, the concept formation model enables teachers to build on the existing cognitive schema and life experiences of students. It also fosters a respect for what students know. Rather than having students sit in classrooms where they are *"being done to,"* students are in a position to *create their own meaning,* to warrant their own back- grounds, and to compare what they know with what is already known.

Concept Formation: Teaching Phases

Phase I: Data Generation

The first phase of concept formation requires that students examine a data set. That data set can be either teacher- or student-generated. With teacher- generated data, the teacher makes a determination regarding what ideas to present to students, and each student in turn categorizes the data into "concept groupings." For example, a teacher of social studies may use a set of terms associated with the continent of Africa (for example, *Nile River, Zulu, Sahara, nomads,* and so on). The students would take these terms and inductively create categories such as *landforms* or *tribes* or *cultural groups.* An English teacher might give the students an extensive set of words such as *yellow, beautiful, fire, store, box,* and so on. The students would then be asked to create groupings that might include the various parts of *speech—adjectives, nouns, verbs.* The actual labels of noun, verb, and so on would not be imposed on the students by the teacher. Rather, the labels would emerge from the students' understandings of the concept—parts of speech. The students, however, may or may not use the actual terms *noun, verb, adjective.* With an inductive strategy such as concept formation, the actual category label that students generate may not be the category label that the teacher expects. The category label is the students' to formulate and appropriately defend, not the teacher's to dictate. However, the teacher can help shape the emergent categories by sharing with the students the focus of a lesson: *"See how many categories you can create that deal with important features of Africa"* or *"Put together groupings that focus on parts of speech."*

Student-generated data occur in response to a rather open-ended question provided by the teacher. As an example of this, we once observed a teacher who had just completed a unit on the Revolutionary War. The teacher asked the students to go to the chalkboard and write down a word or phrase that captured something about the Revolutionary War that was important to them. The process was iterative. After every student listed one term on the board, the teacher asked the students to carefully read what terms were listed and to add any other terms they thought deserved inclusion. After some time passed, a large number of additional terms were added to the board. This process continued until the chalkboard was literally covered with a wide variety of words and phrases. From this point the teacher began the process by having the students sort, categorize, and label the data. Another example we witnessed involved a high school science teacher's conducting a unit on water resources. This teacher asked the students to identify all the items they could think of related to water usage. As each student responded, the teacher wrote the term on the chalkboard. The students created over 100 water-related terms, which formed the basis for a concept formation lesson. And yet another was a 4th grade teacher who had just completed a unit on the Holocaust. She asked students to go to the board and write down terms they associated with the Holocaust. Such lessons enable teachers to literally recognize (to "see") the schema used by students. With such information, the teacher is in a better position to identify student understandings and misunderstandings.

In the teaching scenario that introduced this chapter, the teacher used a combination of student- and teacher-generated data. Mr. Tripodi began by listing 16 resources that he thought students should consider. The students then provided additional items of their own, using the conceptual lead provided by Mr. Tripodi. With younger children, a combination of teacher- and student- generated data may be necessary, especially if the unit material being covered is not well known by students. Teachers should not hesitate to add data to the data set, especially if students are inadvertently leaving out certain critical terms.

Essentially, there are many appropriate alternatives to generate data. The teacher's goals for a lesson, coupled with the background knowledge of the students, will dictate which approach—teacher-generated or student-generated data or some combination of each—is most efficacious for helping students subsequently construct categories that make conceptual sense.

Phase II: Data Grouping

In phase II of the model, students take all the data and begin to create groupings of conceptually similar terms. There are several ways to accomplish this successfully. Before beginning the grouping process, the teacher needs to check carefully and make certain that all of the students understand the meanings associated with each listed term. This can be accomplished by asking students to define selected terms, randomly asking students to define terms, or asking students if they need specific terms defined before the lesson begins. Once all terms are defined and clarified, the teacher can begin the grouping process, usually through the use of a teacher-generated example. That is, the teacher can ask a student to pick any term from the available list and to place that term in a large circle. (Incidentally, there is nothing magical about circles. The circle is nothing more than a symbolic way of "enclosing" or defining a concept.) Recall that Mr. Tripodi began the grouping process as follows: *"I am going to provide each one of you with a sheet of paper that has three circles on it. I want you to work in your peer pairs and group these terms in a way that makes the most sense to each of you. For example, f I select one term, such as 'paper,' what item or term would you put with it?"*

The students construct the groupings based upon their own perceptions of how the terms fit with one another. They place as many terms together in one circle (or group) as they feel logically and conceptually fit. Once they "fill a circle," they then pick another term at random, place it in the next circle, and begin the grouping process again. Remind students that terms can be placed in several different circles. Once a term is used in one circle, it is not excluded

Some students tend to label the groups before they begin the categorization. This needs to be discouraged by the teacher. Teachers should encourage students to select a "first" item randomly and then conduct the grouping process based on that first selection: What item is similar to the first item? Students should be cautioned, in essence, not to label a group too quickly. Sparks-Langer et al. (2000) argue that it is important for the teacher to do some anticipating of categories so that the teacher questions can be used to shape the students' thinking. The goal is not to make the students think like the teacher, but the categories (or groupings) formed need to be conceptually sophisticated in order to achieve the objectives of the lesson and to maximize the best use of the model. In essence, carefully observe students as they form their categories and do not hesitate to help them shape those categories with questions. For example, Sparks-Langer et al. (2000) use a "shaping" question relative to heating a home: "If we relied on wood for heat, perhaps we could plan a wooded lot near the home so we would never run out of fuel. Are there any of our other sources for which we could plan for additional fuel?".

Phase III: Labeling

Once students have created their groupings, they then determine the best concept label for that grouping of items. Recall that for Mr. Tripodi's class a 10-item group emerged *(natural gas, forests, water minerals,* and so on), and one of the students (Lucinda) provided the label, *"Natural resources that people use."* Parker (1987) notes that "by letting students label the concept. . . we accomplish several things. First, we want students to learn that the name is just that, a name for the idea, not to be confused with the idea itself... . Second, the naming act involves further thinking about the content. . .

The labels should be simple conceptual descriptors that connect and embrace all the terms listed within the circle. The students are the ones who have responsibility for creating the labels, not the teacher. The teacher can have a preconceived concept that needs to be taught, but that concept should not be imposed on the students. Some teachers become very intrusive because they believe they know what labels are best suited for the item groupings (and in many instances this is true). But, in general, the teacher's concept should emerge from the lesson just as naturally as does the students'. Remember, one of the goals of the concept formation model is to provide students with opportunities to create or construct their own meaning relative to the enumerated terms. The teacher also needs to require that students justify the categories. Students should be able to explain why each item is included in a grouping.

Teachers should not hesitate to challenge student thinking by asking plenty of "why" questions. Students should be able to defend each item within each group by describing why and by what criteria they categorized each item.

Phase IV: Expanding the Category

Once students have grouped and labeled the terms, the teacher reviews each grouping to determine how students thought through the categorization process. Some teachers have each student pair describe one of its label groupings for the entire class. Peer pairs may describe the grouping category on a transparency; or they may write the terms and category label on the chalkboard. As each label grouping is described by a peer pair, the teacher and the students have responsibility for determining what additional items could logically be placed in that grouping. The teacher also checks the understandings of the other students in the class. Recall that Mr. Tripodi asked, after the first grouping was presented, *"Now, class, what other items might we put into this grouping that Lucinda's group left out? You may even be able to identify some that were not on our original list."*

Expanding the category is necessary to fully explore the meanings and interrelationships of the identified terms. Some teachers just have students present their categories; they provide no critique of what else makes sense to add to each grouping. One of the salient goals of concept formation is to enhance the thinking skills of students, and for that to occur, teachers need to extend and expand student understanding of concepts by identifying additional terms and by delineating the rationale for including the additional terms within the various groupings.

Phase V: Closure

The final phase of the concept formation model varies depending on the objectives of the unit and/or the purposes of the teacher. For those teachers who use the technique to introduce units of instruction (that is, the teacher wants to see how students are thinking about an idea and to explore their schema before content coverage occurs), the closure process may include nothing more than collecting the groupings and explaining to students that they will reexamine the "groupings" once the unit is completed. Students will then have a "before and after" perspective on a concept they will be able to see their schema before a unit of instruction is presented and after the unit is completed.

Other teachers use concept formation as a unit review—at the conclusion of a unit. They want to see how students have developed and organized their understandings of the key concepts that the teacher presented during the unit of instruction. Once students present categories in this way, the teacher may have them do one or more of the following: (1) create a generalization relative to each of their categories, (2) describe how different terms within a category relate to one another, or (3) create an assignment from the listed terms that enables students to explore fully the meanings of the different terms in that category. Recall that Mr. Tripodi used the third approach when he stated: *"Class, let's go back to Lucinda's grouping. What I want to do now is look more* *carefully at the interrelationshi p of the natural resources we've identified and the actual products that result from those resources. I want you to read Chapter 4 in your text and then select two resources from Lucinda c grouping and identify some products that result from each resource."*

If the generalization (or first) options were to have been selected, Mr. Tripodi might have requested the following: *"Class, for each one of categories, I want you to create a generalization that indicates the relationship of the items you selected and the title you developed. For example, for Lucinda s grouping I might develop the generalization, 'Resources such as crude oil are found naturally in the earth and are used to make products that we use in our homes.' Then I want you to support that generalization by providing an example. In this instance you will actually identJ5i a product that is used in your home."*

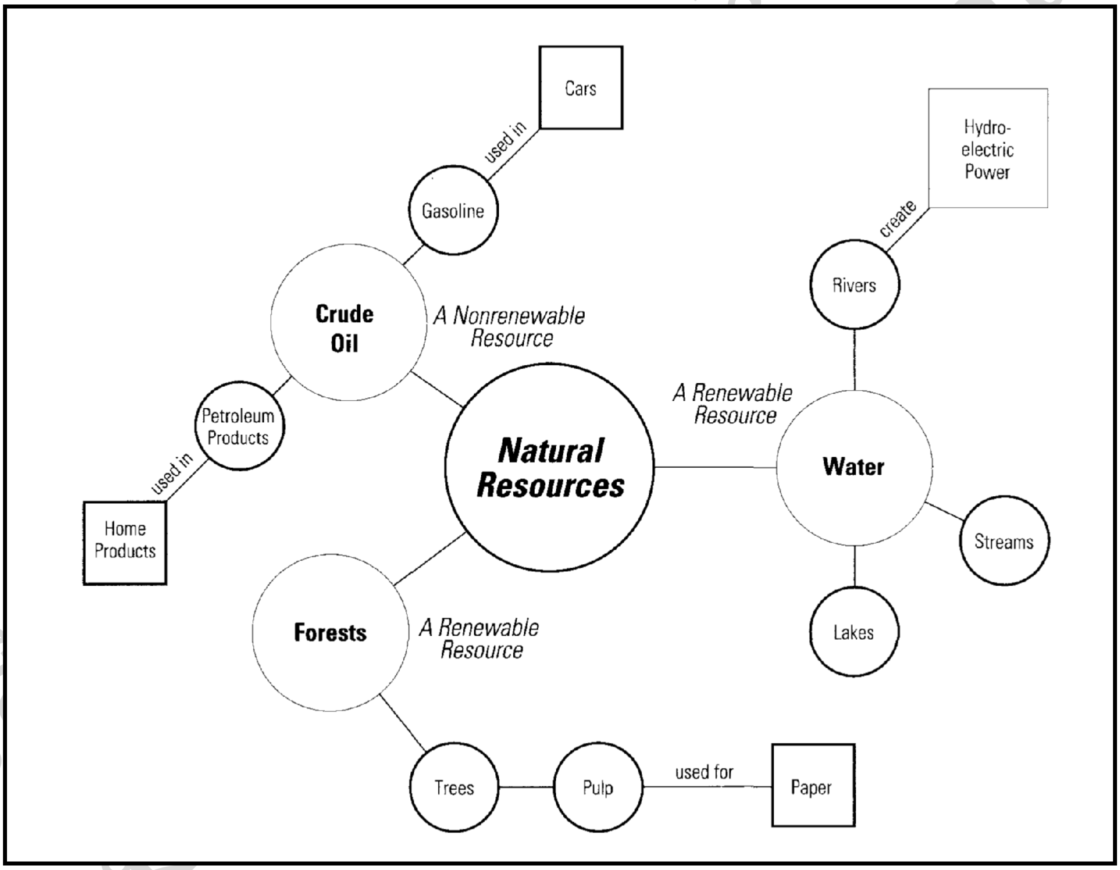


FIGURE 7 Web for Natural Resources

The second option, showing how terms interrelate, can be accomplished through the creation of "webs." Students would select a conceptually broad item to use as the title for their category and to serve as the conceptual focus; they would then develop a web such as the one in

Figure 7. The teacher might have the students extend the web in each area until an item appears that is synthetic or manufactured rather than naturally occurring. Hyerle (1996) observes that "practiced with depth . . . webs offer students the opportunity to break the stiff intellectual molds of the 'behavior list' classroom and to spin new interpretations and construct new forms of knowledge". Webs help students develop a measure of fluency with the ideas offered by the teacher. As students brainstorm the various conceptual relationships, they develop a better and deeper understanding of requisite content area concepts. Arends (1994) outlines four steps to constructing a web.

Step 1. Create the core; which is the locus of the web. This would be the name of the concept.

Step 2. Construct strands branching out of the core. These strands are critical attributes of the concept.

Step 3. Draw strand supports, which connect the critical attributes to the concept.

Step 4. Identify the strand ties, which show relationships among the various attributes.

Synectics

Introduction

No cultural group holds the patent on creativity. A quick perusal of eminent individuals who have evidenced excellence in their personal performance and who have been creative in their exploration of ideas illustrates that regardless of personal or cultural background, creative ideas are possible. In literature the names range from Toni Morrison (African American) to Amy Tan (Asian American) to Gerald Viznor (Native American) to Jose Antonio Villarreal (Hispanic American). With regard to mathematical reasoning the names include Benjamin Bannecker (African American), Yuan Lee (Asian American), Luis Alverez (Hispanic American), and Robert Whitman (Native American). In essence, cultural background neither advantages nor disadvantages the capacity for creative thought. Some individuals may be more creative than others, but a genetic cultural advantage cannot be claimed by any group.

Creative thinking is a by-product of how students learn to explore ideas. Although some argue that creative problem-solving cannot be taught (see Torrance, 1986), many others assert that students can learn how to think creatively if they use "disciplined" techniques for thinking through problems. Syriectics is one such step-by-step technique. It is a technique that can be used by all students, not just those who claim the status of "gifted" or "talented." Indeed, one of the real advantages of synectics is that all students can participate in the creative process because creativity is more broadly defined as "everyday thinking that results in something new, either to the person doing the thing or to the world". A definition such as this suggests that everyone has an ability to think about old ideas in new ways. The essence of the creative process is for each individual to make new connections that make personal sense and enhance personal perspective.

Teachers tend to make conceptual connections for students. They create the conceptual structures; students are expected to memorize those structures and, on demand (through tests), give back what has previously been given to them by the teacher. The intellectual "cost" of this approach for many students is substantial. As Weaver and Prince (1990) argue, it tends to "foreclose on many promising lines of thought. [Students in these types of classrooms have] . . . a way of thinking that seems to be reinforced by an emphasis on precision, on right and wrong answers, and on punishment for mistakes". Many suggest that high stakes testing is exacerbating the conformist thinking of students. Ovando (2001) writes:

> Unfortunately, high-stakes testing, such as TAAS [the Texas proficiency test] often forces administrators to sacrifice creativity and inspiration in teaching and learning for the top-down pressure to coach students to do well on these tests. Schools that meet or exceed established test criteria are rewarded monetarily and with kudos in the Rio Grande Valley. Students who do well on the TAAS, and thus make the schools look good, are given favorable press in the local and state media and sometimes receive personal awards. Conversely, teachers and administrators whose schools underperform on the TAAS exams jeopardize their careers—and in extreme cases the future of their schools.

Whether TAAS compromises student creativity is debatable but that crcativity is important for future American citizens is not. As the following simulated 4th grade classroom example illustrates, creative problem-solving can occur in lots of different contexts and does not mean an absence of intellectual rigor. Rather, it is a way of enabling students to see (and reinforce) the familiar in new and more intellectually demanding ways.

Synectics I: Teaching Phases

Phase I: Identification of Topic Area

The synectics lesson begins once the teacher determines what concept the students should fully explore. Typically, the teacher will want students to develop a fuller, richer understanding of some big idea. If the class has been studying the respiratory system, the teacher might want students to focus on respiration and to understand in new ways how respiratory functions parallel what happens in other types of complex systems. In essence, the first step in synectics is to identify what concept, ideas, or knowledge structures require fuller exploration and development by the class.

How will the teacher know what ideas require such exploration? Through intuition and experience! Teachers who use synectics see it as a way of helping students see *"old"* ideas in new ways. The history of ideas is filled with examples of people who evidenced this ability for creative insight, except they seemed to do it almost naturally: Copernicus thought about the earth's relationship to the sun in ways that contradicted other astronomers; Freud thought about dreams in ways quite different from those who preceded him (that is, he describes manifest dreams, the actual imagery of a dream, latent dreams, and the hidden meaning of the imagery). Students, in synectics, begin to think about the earth or cells or respiration in new ways, and their revelations represent new understandings.

Phase II: Direct Analogy

Once the teacher identifies what concept to extend and explore, the teacher then creates a direct analogy. A direct analogy is nothing more than a metaphoric comparison between two ideas (one the concept and the other an analog). For the respiratory system, a direct analogy might be "How are a train and train track like the respiratory system?" Recall that Mr. Rodriguez offered the direct analogy of *"The earth is like a peach."*

Many teachers find it difficult to identify perfect direct analogies. That's because few, if any, perfect analogies exist. All objects differ in some ways; as a result, all efforts to create comparisons that reveal objects as identical in every way will fall short of the ideal. As Joyce, Weil and Calhoun (2000) note, "the real purpose of a direct analogy is to transpose the condition of the real topic or problem situation to another situation in order to present a new view of an idea or problem".

The teacher poses the direct analogy and asks students to think of(l) all the characteristics of the conceptual object, (2) all the characteristics of the analog, and (3) all the ways that they are analogous. A simple example follows for "An opera is like a football game" (see Table 7-1), which incidentally, is a direct analogy that one of the authors used while teaching a synectics lesson on opera to adults in Vienna, Austria—the goal was to enable the students to think about operas in a different way.

TABLE 6 Analogical Comparison for Opera and Football Game

Characteristics of Opera	Characteristics of Football Game	Comparison
Costumes	*Uniforms*	*An opera is like a football game because in an opera the performers wear costumes, and in a football game the players wear uniforms.*
Acts	*Quarters*	*An opera is like a football game because in an opera there are acts, and in a football game there are quarters.*
Diva	*Quarterback*	*An opera is like a football game because both have "stars"—in an opera the soprano who sings the lead role is called a diva; in a football game the star is called the quarterback.*

Students are expected to make a list of the characteristics of the object and the analog. Once exhaustive lists of individual characteristics are developed, they then make the comparisons. Some teachers find it useful actually to write out the comparisons; others rely on verbal representations.

Phase III: Personal Analogy

Once students have an understanding of the direct analogy, they then attempt to "lose themselves" in the concept. This is both an exciting and a challenging step for students—though much depends on how the teacher organizes and orchestrates the experience. The teacher needs to be able to sell this idea to the students by asking them to become the conceptual object and the analog. Recall that Mr. Rodriguez started this phase by stating, *"You have really developed some terrific ideas. Now I want you all to close your eyes. Think with me for a few minutes about what it must be like to be the earth. Picture yourself as the earth, a living thing. .*"

The students then go on to share their ideas. One student, Ernesto, responds that "I feel hurt because the people keep drilling more and more holes in me." Ernesto's response is a first-person description of an emotion—he feels hurt. But students can, according to Gordon (1961), describe other first-person sentiments as well. They may provide factual descriptions, like the student, Sarah, who felt bruised because of all the strip mining that occurs on her "surface." Or the student might have an empathic response similar to Minda's. Minda shared that she felt exploited and that she identified with the earth as an organic object. Personal analogies release the creative impulses and enhance the intellectual vitality of the individual. Gordon (1961) writes, "Personal identification with the elements of a problem releases the individual from viewing the problem in terms of its previously analyzed elements".

The teacher should encourage students to become both the analog and the object. As students express their ideas, the teacher lists the description, emotions, facts, or empathic feelings on poster board or on the chalkboard. This helps student see the commonalities associated with their feelings; it also is essential if teachers decide to use a compressed conflict strategy, which we will describe in the alternative model Synectics II section.

Phase IV: Analog Contrast

In the fourth phase, the student begins to contrast the analog and the conceptual object. As we shared earlier, no metaphoric comparison is perfect. All comparison fall short in some ways! Thus, in the fourth phase, students begin to examine differences between the analog and the concept. Mr. Rodriguez offers the following as a transition to phase TM "Now that you've shared how it feels to be a peach and the earth, I want you to think about the differences between a peach and the earth. In what ways are peaches and the earth different? We agreed that in some ways they are similar. Now consider ways in which they are different. Work with your partners to generate three differences."

One problematic statement that teachers use (and it is especially noticeable on the Association for Supervision and Curriculum Development Teaching Strategies tapes) is to say something similar to this: "Class, we have been studying how the earth is like a peach. But is the earth really like a peach? No. I don't think so. Let's look at all the differences." Such a statement ("No. I don't think so.") implicitly says to the students: "I lied to you earlier. I said the earth was like a peach. Now I'm telling you that it's not." The teacher can create the contrast without being so pedagogically duplicitous. Teachers should simply share with students that conceptual objects and analogs are both alike and different. In the previous two phases the similarities are emphasized. In phase IV the students examine and list the differences. Encourage the students to write down statements that describe these differences and then have them share those with the class. Recall that Tara (from Mr. Rodriguez's class) noted that a peach grows on a tree, but that the earth does not grow on anything.

Phase V: New Analogy

Once students have examined both similarities (phases II and III) and differences (phase IV) between the conceptual objects and the analog, they are ready to create their own direct analogy, which is hopefully conceptually stronger than the original direct analogy. Most teachers who have conducted a synectics lesson observe that at some point during the implementation of a synectics lesher son either they or the students think of metaphoric ideas that they like better than the one originally presented. Phase V provides an opportunity to explore new metaphoric possibilities. In phase V, the teacher asks the students to generate their own analogs. Mr. Rodriguez has the students work in groups in this phase as a way of stimulating more ideas. This is a good way to proceed, especially if students are using the model for the first time. As students develop more comfort with this instructional model, it will become more possible to have them work either independently or in cooperative learning groups to think of analogies that make sense.

Once students have finished the activity; the teacher should return to the original theme or conceptual topic and have students provide their reflections. Mr. Rodriguez had his students write a short essay that described their support for or opposition to strip mining. Synectics lessons should immeasurably enhance the type of language used by students to express their ideas and attitudes. Essay responses, of course, are not the only refocusing tasks a teacher might use (for example, the students might watch a movie on strip mining and orally discuss their reactions or go on a field trip to a rock quarry and take pictures of the effects of mining). The critical dimension is to make certain that students return to the original topic in order to "play with" the concept in a different way.

Synectics II: Teaching Phases

The Synectics I lesson structure just outlined is a relatively simple form of the creative process encouraged by Gordon (1961). Many teachers find Synectics I a good one to start with when they first begin to use creative-thinking activities in the classroom. A second form of synectics, which some teachers we have worked with describe as more complex, requires the use of a compressed conflict. In this approach the teacher intentionally fosters contradictory ideas, but this is done in such a way that **it** enables students to formulate familiar ideas in new and creative ways. Many of the phases are similar to those outlined in Synectics I. However, some significant differences do exist, and these, in particular, will be given a more detailed description. The case study in the sample lessons section at the end of this chapter is an example of the compressed conflict approach.

Phase I: The Topic

The teacher begins a compressed conflict synectics lesson in a similar fashion to that described in Synectics I. The students typically have spent some time prior to the synectics lesson trying to understand some specific content material. For example, they may have been studying a topic such as revolutions or cell structure or natural resources. Whatever the topic, the teacher begins by having students share descriptive words or phrases that they associate with the topic. The teacher then writes these terms on the chalkboard as they are being shared.

Phase II: Direct Analogy

Once all the terms are listed, the teacher begins to create a direct analogy; In the Synectics I lesson, Mr. Rodriguez provided the direct analogy. *In this instructional variation, the students are responsible for creating the metaphoric idea.* The process begins when the teacher asks the students to look at the terms on the board and then think of a *game, plant,* or *machine* that they would associate with those terms. For example, for *opera* the students might begin by generating the descriptive terms in Table 7.

TABLE 7 Descriptive Terms for Opera

Long	*Treachery*
Several acts	*Expensive*
Costumes	*Hatred*
Music	*Lots of people*
Singing	

TABLE 8 Personal Analogy Statements

Tired *because the game is so long.*	***Dirty*** *because I'm muddy after the game.*
Beautiful *because my costume or uniform is so expensive.*	***Protected*** *because of my equipment.*
	Energized *because of the cheering audience.*

When one of the authors taught a lesson on opera, students were asked to think of a game that had the identified qualities (that is, was long, involved costumes, and so on). They generated a long list of potential analogical ideas that included things like the following:

Baseball because the games are long, the players wear uniforms, and so on.

Hockey because the players seem to hate one another and have to wear cumbersome, expensive uniforms. *Football* because of the pageantry and the large number of people who watch in the stadium.

Based on the many game options generated, the students were then asked to identify their favorite possibility among all those generated by the class—in the case of the lesson on opera, the author's class selected football: An opera is like a football game! This analogy was then written on the board and became the foundation for the next phase of the lesson. Incidentally, make certain all the students know the game. On a couple of occasions, teachers have selected a game (for example, chess) for the class to use only to discover that many students did not know how to play. That makes the next phase almost impossible to operationalize.

Phase III: Personal Analogy

This phase parallels what occurs in phase III of the Synectics I variation. Essentially, the students describe what it feels like to be the object and the analog. In the case of the opera and football game analogy, students would describe what it feels like to be a football game, and the teacher writes the terms down as students provide them. The terms in Table 8 are provided for the opera and football game analogy. Notice that the students provide a brief explanation justifying the term. The teacher should solicit student responses and require that students defend their responses with a "because" statement.

Phase IV: Compressed Conflict

Teachers who read about using compressed conflict often find the notion of combining words that are in dynamic tension with one another to be an overly complex process. But teachers who have enabled students to use compressed conflict find **it** to be very effective in fostering creative thought on the part of the students. 'With compressed conflict, the teacher has the students look at the descriptive terms used during the personal analogy phase (phase III) and then combine those terms that tend to be opposite one another. For example, beautiful and dirty or tired and energized. That is, things are not normally thought of as being both beautiful and dirty, but a football coach would perceive a lineman as "beautiful" if his uniform is dirty at the end of a game.

The students combine words that conceptually (and dynamically) fit together (for example, beautiful and dirty are adjectives describing how one looks), yet are contradictory when found in nature (that is, how can one be both beautiful and dirty?). The teacher has the students generate as many compressed conflicts as they can identify. The students should then vote about which of the compressed conflicts they like the best. In this instance, let us assume that beautiful and dirty are selected.

Phase V: New Analogy

The teacher next asks the students to create a new direct analogy. The teacher takes the compressed conflict (beautiful and dirty) and has students identify some object (animal or machine or food) that has these compressed conflict qualities. The object (animal or machine or food) does nothing more than provide a focus for the students' ideas—it keeps their ideas somewhat together in the pattern of their thinking. The options developed in this case might be:

• An engine in a car (the engine is dirty, but the car is beautiful)

• A "dirt" cake as a dessert (the cake looks messy once eaten, but **it** is beautiful just before the dessert is cut and distributed)

After students generate a number of new possibilities, the teacher then asks them to select the one they like the best. (Usually students reach some sort of consensus, but the teacher may need to d some modest "directing" to make certain all students understand the selected new analogy.) In this case, the students select "an engine in a car."

Phase VI: Topic Refocus

In this phase, the teacher begins to revisit the original topic. If the original topic was the students' perceptions of the opera, then the teacher asks the students to consider how the opera (the topic) is like an engine in a car (the new analog). The students then generate as many ideas as possible—actually this process usually starts slowly, and then as some students see possibilities (that is, other students create ideas), the rest of the students in the class become more generative in their thinking. For instance,

An opera needs music, and a car requires gasoline.

An opera needs a conductor, and a car requires a driver.

Phase VII: Extension

After students have generated a substantial list of new ideas concerning the concept, the teacher should begin to critically extend some of the students' ideas. The teacher might, for example, have students write a description of what it means to "run" an opera, or to develop a report on all the different elements that need to be in place if an opera is to be "run" effectively.

Some teachers get to phases VI and let the lesson drop. This significantly mitigates the power of this instructional model. The model is intended to stimulate student thinking about a topic, and unless the teacher intentionally extends the students' thoughts about the topic and forces them to reexamine that topic, the full impact of the lesson will not be achieved. Remember synectics is not a gimmick or game. It is, instead, a pedagogical vehicle for enhancing the quality of student thought.

Models that foster remembering skills

Mnemonics

Introduction

The model presented in this chapter is useful for helping students learn and memorize new information. In ancient times, the memory capacity of individuals was essential to the educational process because books and other printed materials did not exist. Oral traditions were dominant. Salient ideas and stories were remembered and passed down from one generation to the next by those who possessed the gift of imagination and the capacity for memory Modern American educators still place substantial emphasis on remembering facts, concepts, and generalizations, but they spend very little time showing students how to recall information. Some might argue that memorizing information is antithetical to educational enlightenment. Indeed, many of the recent reform initiatives focus on enabling students to become better problem-solvers and processors of information; students need to know how to access information, but they do not necessarily need to memorize facts. Others view the acquisition of certain facts as essential, if not necessary, to being an educated citizen. Our view is that either extreme position represents a potentially negative circumstance. To disdain any need for memorization (why learn facts when you can always look them up?) would be foolhardy. Although it is true that much information can be looked up, imagine the complications of daily life for someone who is so information deficient that the individual could not make change or did not know basic information about how to access necessary services in a community. On the other hand, imagine how ludicrous it would be to memorize mountains of data, some of it remote in relevance, when computer access makes the information instantly retrievable.

Sizer (1992) suggests that a balance between the extreme positions can be attained if teachers selectively engage students in what he describes as "exhibitions." In essence, the student in some way must "exhibit the products of his or her learning". Sizer identifies several different types of exhibitions that might be illustrative of the expectations schools have for students to memorize information. Examples include reciting an important speech from history (for example, the Gettysburg Address), drawing a freehand map of the United States, or reciting an important poem (for example, "Mending Wall").

The student memorizes information not only for mental discipline but also to acquire the intellectual habits necessary for leading the good life. One of the essential intellectual habits, argues Sizer (1992), relates to the pleasure "of knowing some things well enough to commit them to memory, and [to] the joy of reciting them".

Teachers need to make conscious decisions about what "exhibits" students need to have in their long-term memory. Such decisions require substantial dialogue about what ideas are so important that they warrant student memorization or, as the following case illustrates, what content knowledge is of sufficient significance that, by memorizing it, students are able to more effectively process other types of relevant data.

Another example of using memorization comes from the KIPP academies that have been featured on *60 Minutes* and hyped by the national media and even President Bush. One of the intellectual leaders of the school is Harriett Ball, who uses mnemonic devices to ensure that students learn essential skills and facts. The following example taken from Ball's work with teachers illustrates how mnemonics can be used to help students learn their multiplication tables.

With that, she [Ball] says, "Now, let me hear you say your nine-times table."

> At first, the voices are confident and in unison: "Nine! Eighteen! Twenty-seven! Thirty-six." But things quickly fall apart, and the teachers [students in the workshop] break out laughing.

"All right, watch this," Ball says. "Lay down your pencils, and don't write anything." She wants the material imprinted in their brains, not scribfocus bled on a piece of paper.

At the blackboard, Ball draws an upside-down T. On the right side of the vertical line, at the bottom, she writes a zero and says, "Remember, zero is your hero!" (If you forget to start with zero, the chart won't work.) Then, moving up the vertical line, she writes the numbers one through nine. On the other side of the vertical line, she writes a nine at the bottom, an eight on top of that, and so on, until she gets to zero. As she writes, she's careful to keep the numbers on the left side lined up with the ones on the right. In fact, she offers a little saying to remind the students to do just that. "Now, I want you to 'keep **it** lined up," she says, writing "ML U" on the board, "or **it** will kill you."

The result is a nine-times table, with the number nine (written as 09) on top, 90 on the bottom, and all the other two-digit multiples of nine in between. Ball has similar lessons to help kids learn all the multiplication tables.

Memonics: Teaching Phases

Phase I: Focus Attention

For students to remember anything, they must pay attention to what is important. Anyone who has ever read a book in preparation for a test understands this phenomenon. That individual often takes some type of highlighter and marks passages or ideas that need to be retained for long-term memory. Other devices for recalling information are also used. For example, one of the authors of this book has a daughter who is just starting college. When she prepares for tests, she makes lists of those ideas she needs to remember. Recall that Ms. Sternberg used "focusing" when she said, *"I want you to look at the map of Canada and read each province name silently to yourself"*

There is no right way to focus students' attention. The key is to make certain that students are really paying attention to what is being taught. Using the author's daughter as an example again, her science grades for one term while she was in middle school were very low. Test after test she received grades lower than her father expected. Then, one day, she showed up at home with a high grade. Her father asked, "Wow, what did you do differently?" She responded somewhat nonplussed, "I paid attention!"

Phase II: Create Connections

Most mnemonic strategies are nothing more than visual or conceptual connections of familiar material with the unfamiliar. Four such connecting strategies can be used in classrooms and have been highlighted directly or indirectly earlier: first-letter mnemonic, keyword, linkword, and pegword.

First-letter mnemonics entail using a series of letters or lines in which certain letters form a name or message when sequenced appropriately. *Acronyms* are the simplest of these mnemonic strategies. When students take art they learn ROY G BIV, which represents the colors of the spectrum (red, orange, yellow . . . indigo, violet); and in geography they learn HOMES, which represents the five Great Lakes (Huron. . . Superior). A student in one of the authors' classes required her students in English class to memorize the eight parts of speech and used the acronym NAVACIPP (noun, adjective, verb. . . preposition). Acronyms are useful, especially when the number of items to be recalled is relatively limited in number and when the word formed by the first letter makes sense. They have less utility when a large volume of factual material must be remembered or when a meaningful acronym cannot be formed. It is, however, a technique that can be used quickly and efficiently.

There are lots of different uses of acronyms. Hock, Schumaker, and Deshler (2001) even use them to help students recall the steps of the problem solving process:

> The [learning] strategy [using acronyms] might include several steps. The tutor could even create acronyms to help students remember the steps later. For example, the learners first *Map out the problem* by carefully reading it, underlining key words, and determining what to solve, Then, they *Analyze the problem* by identifying the type of problem, looking for similar problems in the textbook, and estimating the answer. Next, they *Take*

action by selecting a method or formula. Finally, the students *Rave a look back* by comparing the answer with the estimate and by checking their calculations. The students remember the strategy because the first letters spell *MATH.*

Acrostics or superimposed meaningful structures entail using the first letter of words to be remembered, and connecting (or linking) those letters by creating some type of meaningful phrase (Higbee, 1996; Ormrod, 1999). For example, after students learn the five kingdoms in biology; the teacher might say, *"Class, let's think of an acrostic we can use to recall this information. One might be: AJI (Animal) My (Monera) Pretty (Protista,) Ponies (Plants) Ely (Fungi)."* One of the most famous acrostics is the one many people learn relative to the positions of the nine planets: My (Mercury) Very (Venus) Educated (Earth) Mother (Mars) Just (Jupiter) Served (Saturn) Js (Uranus) Nine (Neptune) Eizzas (Pluto). Even some textbooks now use acrostic-like mnemonic devices to help students remember information. The Harcourt Brace Jovanovich (1992) *Mathematics Plus* text encourages students to remember the order of mathematical operations by using Elease (Parentheses), Excuse (Exponents) *My* (Multiplication) iear (Division) Aunt (Addition) Sally (Subtraction).

In the beginning of this chapter, we showed how Harriett Ball (KIPP) used mnemonics to aid student learning. Now notice a specific example that she used with 6th graders in a Columbus, Ohio, middle school. In this instance, she used a first letter (acrostic) mnemonic device.

"Good morning. My name is Harriett Ball, and I'm from Houston, Texas.

I'm going to do some fun things with math today. All eyes on me. Say, 'Try Big Mac tonight!"

The kids have no idea who this strange looking lady with the fancy clothes and the long hair and the costume jewelry is, but they quickly get into the groove, repeating her chant: "Try Big Mac tonight!"

"Try Big Mac tonight!"

"Say it again now!"

"Try Big Mac tonight!"

"All right," Ball says, "guess what? You just learned how to read a 15- digit number."

The students, baffled, look at each other as if to say, "What's this lady talking about?"

Ball steps up to the blackboard and writes a 15-digit number: 426, 804, 392, 774, 903.

"OK, what's that *number?"* she asks. "Don't everybody raise your hand up at one time."

One boy makes a half-hearted attempt and then stops.

Ball says, once again, “Try Big Mac tonight,” and the kids repeat the phrase. Then Ball writes on the board “TBMT.”

“See those letters?” she asks. “That trillion, billion, million, thousand.”

Something seems to click inside the students’ heads. ,,

OK, Ball continues, when you see a number, don **t** be afraid of **it.** All you have to do is this: Count your commas and label. Say what?”

“Count your commas and label,” the students reply.

How many commas do you see? Ball asks.

“Four!”

“So who is this?” she asks, pointing to the first comma.

“Try!”

“Who is this?”

“Big!”

“Who is this?”

“Mac!”

“And this?”

“Tonight!”

Eventually, Ball leads them through the number step by step, showing them how to use the easy-to-remember “Try Big Mac tonight” chant as a tool to figure out the place value of a multi-digit number. The students, mightily impressed with this new information, give Ball—and themselves— a round of applause.

Keyword strategies are useful for memorizing social science data (for example), state capitals), scientific data (for example, information about the periodictable), information in the language arts area (for example, the parts of speech), and foreign languages. In fact, the strategy was originally created in the mid i 1970s to assist individuals in learning foreign languages (Highboy, 1996). Key- words are useful for recalling facts that need not be remembered in any particular order. With the keyword approach, a familiar term is used to remember an unfamiliar term. Higbee (1996) observes that the keyword mnemonic entails the use of “substitute words and visual associations”. The visual associations enhance the memory capacity. For example, when Ms. Sternberg taught the students the province capitals of Canada, she could have created a picture similar to the one in Figure 8-4, where for Winnipeg, Manitoba, you see tuba man (the substitute word for Manitoba), or a giant man in a tiny tuba, holding a Winnie-the-Pooh bear (or

Winnipeg). The substitute words are *Winnie-the-Pooh* and *tuba man,* and the visual image *is* similar to the one in Figure 8. In the Bornstein (1983) mnemonic cards for state capitals, the Topeka,

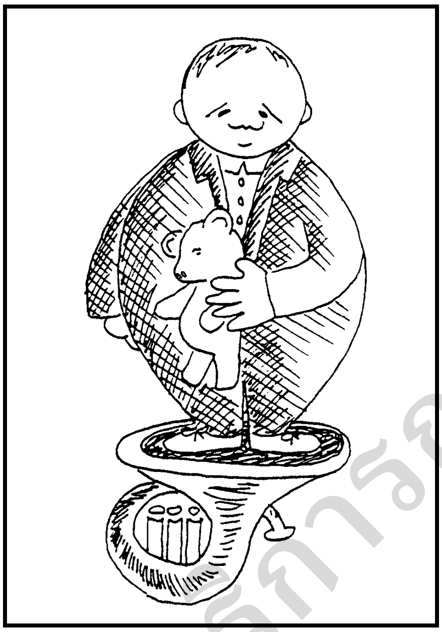


FIGURE 8 Example of a Mnemonic Illustration: Winnipeg, Manitoba
Source: Illustrated by Janet Olney Lasley.

Kansas, substitute words are *tapioca* and *can* and the visual association is tapioca in a can. Highboy (1996) observes that keyword mnemonics can be used for learning either abstract or concrete terms:

> The procedure for using imagery to help remember abstract terms is the same as for concrete terms except that you add a step using "substitute words." You substitute a concrete word to represent the abstract word. One way of doing this is to use objects that typify the abstract term: for *liberty,* you might picture the Liberty Bell; for *justice,* a judge; for *happiness,* a smiling face; for *education,* a schoolhouse; for *fashion,* a model; for *depth,* a hole; for *agree,* a nodding head; for *salary,* a paycheck. A second way of substituting a concrete word for an abstract one is to use objects whose names sound like the abstract term: celery for *salary;* fried ham for *freedom;* happy nest for *happiness.* You can even use this technique to remember nonsense syllables: Cage for KAJ; rocks for ROX; seal for ZYL; sack for XAC. . . . Research on the Keyword mnemonic has found that people are quite adept at using the above two approaches to "concretize"

abstract materials for effective visual images. However, one study found that for college students who had no experience with substitute words, the first approach (based on meaning) was more effective than the second approach (based on sound-alikes) but was also more difficult to use.

Link strategies are used to remember ideas and facts that need to be connected. For example, the teacher may want students to remember the names of the original 13 colonies or the sequencing of the different geologic ages of the world. By recalling one link in a sequence, the student is able to create a connection with (and remember) the items (using the substitute words) that are linked with the identified term. If the student recalls the substitute word *tuba man,* then the student will link that with where the tuba sits (on tar, or *Ontario),* and who observed the tuba man sitting on tar, *Saskatch* (or *Saskatchewan).* The "story link" is also a relatively easy mnemonic for teachers to use. We have heard story links used to help students learn the position of colonies, countries, and parts of machinery.

Pegwords are used when the teacher wants students to recall not only the sequence of ideas, but also the specific position of an item. If someone asks who the 16th President of the United States was, the learner should not have to count the "links" to 16, though that is one possibility. Rather, a peg strategy can be used to identify a president quickly.

The pegword strategy is based on the connection of the numbers to rhyming sounds (one is bun, two is shoe, three is tree . . . ten is hen) or to body parts (start with the forehead and work down to the foot). Each noun in the rhyming method (for example, *bun)* rhymes with a corresponding number (for example, one). Once students have learned the pegs, they are ready to peg the word to a specific idea within a sequence. Recall that in Figure 8-3 the major reason that *three (tree)* was used for the dinosaur's extinction was the exploding star theory. Once the student learns the peg-word system, that student will visually picture a tree (three) with an exploding star. Or if students use the "body parts" approach, the numbers 1—10 would correspond to body parts: 1 (forehead), 2 (nose), 3 (chin), 4 (shoulder), *5* (elbow), 6 (wrist), *7* (hand), 8 (hip), 9 (knees), 10 (foot). Sprenger (1999) describes how to use the body peg-word apation proach to teach students 10 prepositions.

When the fly climbed **aboard** my forehead, I noticed that he was **about** two inches from my nose. There was some peanut butter above my chin that I

was sure he was interested in. I was surprised after he flew past my shoul;ubstitute der, **around** my elbo and landed beyond my wrist **on** my hand. Then he buzzed over my hip until my knee hit him and he rested **under** my foot.

The rhyming peg-words we suggest (and that the students must memorize) are the same as those recommended by Levin (1993) and Sprenger (1999):

one—bun (sun) six—bricks (sticks)

two—shoe seven—heaven

three—tree eight—rake (gate)

four—door nine—pine (line)

five—(bee)hive ten—hen

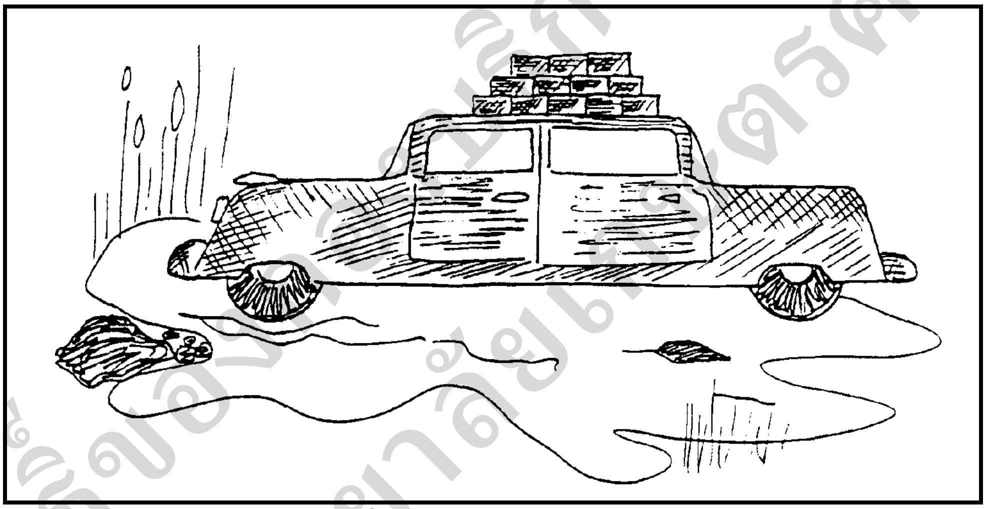


FIGURE 9 Example of a Mnemonic Illustration: Abraham Lincoln

Source: Illustrate by Janet Onley Lasley

Essentially, the pegs are all concrete images, and these concrete images are used for remembering the order of information. The peg system can also be expanded to help students remember more than 10 objects by simply taking sets of 10 and connecting them to specific seasonal locations (the *loci* system). Hence, 1—10 would be near a house in the spring, 11—20 would be near a lake in the summer, and so on. For example, item 16 (the 16th U.S. President, Abraham Lincoln) could show a Lincoln car with bricks (the peg for six) on its top sitting near a lake in the summer (see Figure9 *)*. If the teacher wants to have students also remember certain facts about each president, images can be added to the picture. For example, if the teacher wanted students to remember that Lincoln signed the Emancipation Proclamation and was president during the Civil War, then on one side of the car the teacher could place a man reading a proclamation and on the other side show two men fighting. Highboy (1996) writes about the effectiveness of the combined peg and *loci* strategies:

> Eighth-grade students used the Peg and Loci systems to learn the names of the U.S. presidents. They used the pegwords for the numbers from 1 to 10. Seasonal loci represented decades of numbers; 1—10 was a spring garden scene, 11—20 a summer beach scene, 21—30 a fall football scene, and 31—40 a winter snow scene. Presidents' names were represented by substitute words, and the associations were presented in pictures. Two sample associations are: Tyler (tie) . . . 10 (hen) . . . garden [spring], and Garfield (guard) 20 (hen). . . beach [summer]. The students also learned biographical information on the presidents. This combined Keyword-Loci-Peg system has been expanded for extreme cases to learn up to 260 items, using alphabet scenes from an *airplane* scene to a *zoo* scene (10 pegwords x 26 alphabet loci = 260 items of ordered information).
>
> Sixth-grade students who were trained over several days in the use of the Peg system used it to learn a list of names and recipe ingredients. In another study, learning-disabled students in the sixth to eighth grades used the Keyword mnemonic (substitute words) and the Peg system to learn information on dinosaurs. In both studies, students who used the Peg system remembered the information better than those who did not use it. (p. *165)*

Use of any of the strategies, first-letter mnemonics, keywords, linkwords, and pegwords, takes practice and requires student attention, as we will discuss more fully in phases III and TV

Phase III: Create Associations

To remember anything requires effort—learners must pay attention to what they want to learn. Memory capacity is enhanced when the associations that are formed are ridiculous—the more ridiculous, the better! Four rules for creating ridiculous associations were described earlier in this chapter. Those rules, as Joyce, Weil, and Calhoun (2000), Lorayne and Lucas (1974), and Higbee (1996) describe them, are the rule of substitution, the rule of exaggeration, the rule of out-of-proportion, and the rule of action. These four rules are essential for enabling students to fully recall ideas. But even after the students have the visual images clearly in mind, the teacher must create conditions for practice to enable students to recall ideas or facts once they are learned.

A teacher may even demonstrate the technique to students similar to what Sprenger (1999) suggests:

> A rhyming peg system works well for me, and it is easy for my students to remember... . I always introduce it to my students by first performing a "magic" feat. They are fascinated by this ability and even more pleased when I explain how it is done.
>
> I stand with my back to the chalkboard, and I have one student go to the board and write a list of items suggested at random by the other stua dents. For instance, we might list school supplies. The student compiling the list calls on students one at a time. The students call out both the item and the number on the list where it should be placed. A student might say, "Number four is a ruler." This continues until the list of 10 is complete. The students must give me a moment between items, so I can take the time to "attach" them to my peg. Because my peg for number four is a door, I might imagine a door made out of rulers. The more outrageous I can make my visual image, the easier it will be for me to remember. Therefore, I might imagine opening the door and having thousands of rulers falling on top of me.
>
> When they are finished compiling the list, I give them the list forward or backward. Sometimes they call out random numbers and ask me for the item. I usually get applause for this "miracle." Then I share my peg system with them and give them a list to memorize in 10 minutes or less. Their responses are almost 100 percent accurate. From there we discuss how to use this strategy to study vocabulary by using definitions in their visual images. An example would be the word *pachyderm.* Its definition is "a thick-skinned animal." If it is the first word on the list (remembering that the peg for one is sun), the students may visualize an elephant in the hot sun sweating so much that his thick skin is falling off! In this way the word and the definition are attached to the peg. The students enjoy creating the "pictures" as they use this mnemonic device.

Direct Instruction

Introduction

One of the most misused and least understood models is direct instruction. For as long as schools have existed, "teacher talk" has dominated the way in which students learn information and teachers communicate facts. Indeed, some teachers believe that once they utter the words in the classroom, the students have learned the information. Teacher talk for many teachers has been considered synonymous with student learning. Such a circumstance is regrettable! For although direct instruction does require that teachers make a number of preinstructional decisions, it does not suggest that students are unimportant, passive observers in the teaching-learning process. Direct instruction requires that teachers make explicit instructional decisions, but it also demands that teachers know what they are going to assess and whether students adequately acquire the requisite skills taught by the teacher.

Not all concepts taught by teachers are amenable to direct instruction. Several years ago, the then Secretary of Education, William Bennett, was asked to teach a lesson to high school students on James Madison's *Federalist Paper 10.* Not surprisingly, Mr. Bennett exhibited substantial content knowledge of the James Madison treatise regarding why the Constitution should be ratified. The lesson was taped and a transcript sent to several evaluation experts in the field of education, one of whom had considerable expertise in direct instruction as an instructional model. The expert, Barak Rosenshine, reviewed the tape for instructional effectiveness and suggested that it was difficult to assess the lesson because Mr. Bennett was teaching content concepts, not specific, concrete skills. What that expert observed is fundamental to understanding how and when to use direct instruction: The model is best used when teachers are teaching skills, not when communicating conceptually complex content ideas. To illustrate this, Rosenshine (1986) describes the difficulty of using some steps of the direct instruction model when teaching content material.

> My main point is that it is difficult to apply some of the major findings we have learnt from studying the teaching of skills to lessons which teach content. Some of these findings include checking for student understanding, providing for active student participation, providing for a high success rate, correcting errors, and providing for guided practice and independent practice. But such findings do not, and will not, transfer easily to the teaching of content.
>
> In this [Bennett's] lesson, the students need practice in explaining the problems and solutions developed in Federalist 10, their relevance for our time, and the view of human nature and human rights embodied in the thought of these founders. The teacher needs to

> hear how well the students are doing, and the students need feedback on their efforts. All these would occur easily when teaching a skill. Unfortunately, we do not have mechanisms for doing this when teaching content.

In essence, the instructional model a teacher uses is influenced by the instructional goals the teacher establishes. A teacher who wants to teach a specific skill (for example, how to divide fractions, how to diagram a sentence, or how to construct an origami butterfly) is best served by using the direct instruction model. On the other hand, a teacher who wants students to understand social issues or appreciate poetry will be far less pleased, as will the students, with the results of a direct instruction lesson. Rosenshine (1987) writes:

> These findings [about direct instruction] are less applicable for teaching in areas that are less well structured—that is, those in which skills do not follow explicit steps or where concepts are less identifiable and distinct. Thus the results of this research are less relevant for teaching composition writing of term papers, reading comprehension, analysis of literature or historical trends, or discussion of social issues or concepts such as liberalism or modernity.

Teachers make decisions about what to teach. If what they plan to teach is a concrete skill, then direct instruction is the most appropriate strategy to ensure maximal student achievement. If the teacher is planning to teach content concepts, then direct instruction still has applicability, though the teacher will need to rely a bit more on the literature regarding lecturing and explaining (see Rosenshine, 1986). That is, for presenting content material the teacher needs to do such things as use questions to maintain student attention, signal transitions between sections, signal those points that are most important, use humor to hold student attention, summarize material within the context of the lecture, give or ask students for relevant examples, and review relevant background knowledge.

Direct instruction requires that teachers proceed in a way that limits information flow but enhances information transfer. The human brain can process only so much information at one time. Some teachers present too much information, and what they do present is covered in a very disjointed fashion. The teacher's obligation is to find ways of clustering and connecting ideas, facts, and information so that students can effectively process what the teacher presents. That means that the teacher must be clear about specifying the goals of a lesson, systematic in identifying how students are to learn material, and vigilant in checking on whether students are actually learning the content. In essence, the teacher must determine what skill to teach and then teach that skill in a step- by-step process. Finally, the teacher must check to see whether students have learned what has been taught. Let us see what this looks like in one 6th grade classroom.

Direct Instruction: Teaching Phases

Phase I: Review

The first step in the nonscripted direct instruction model is to review what students already know about the topic to be covered. Although the review process appears self-evident (wouldn't any good teacher conduct a review?), the reality is that many teachers fail to make the conceptual connections necessary for students to see how what is taught one day fits with what was taught on another. Borich (1988) describes several ways that teachers can create meaningful review processes:

1. Students might correct each other's homework at the beginning of a class.
2. Students who represent a range of abilities can be called upon to assess their level of understanding.
3. Teachers can specifically review the material that has been previously taught.

Notice that Mr. Carthridge in the opening case study used the third strategy. He wanted to assess the students' understanding of multiplying fractions so, in a step-by-step fashion, he reviews the steps students must follow when solving a multiplication problem. The second strategy (calling on a range of students) can also be effective. All too often teachers call on top-performing students and exclude input from lower-performing students. The reasons for this circumstance are obvious, but the educational costs are equally evident. For direct instruction to work, students must experience a high degree of success. That success is jeopardized if the teacher ignores an important segment of the student population.

Phase II: Presenting New Material

In the second phase, the teacher begins to frame the ideas and present the new content material. The teacher begins this phase by stating the purpose of the lesson. Some teachers do this in a very explicit way, similar to Mr. Carthridge's approach. Recall that Mr. Carthridge quite specifically noted that there were two purposes for the lesson, and he then discussed those with the class. Some teachers even write TLW (The Learner Will) statements on the board that explicitly describe what students will be able to perform by the end of the class: *"The Learner Will* be able to subtract two-digit numbers" or *"The Learner Will* be able to define what a noun is and correctly identify nouns in a sentence." Teachers who work with older students often resist writing specific objectives. Although this is understandable for some types of lessons that involve substantial brainstorming, we would argue against the practice when teaching students a discrete skill. If you want students to know RNA/DNA translation and transcription, then specifically state that expectation in the form of performance objectives at the beginning of the lesson.

The specificity of the objective also suggests something about assessment. The more generally the objective is worded, the more varied assessment procedures necessarily have to be to ensure that students understand requisite content. Anderson and Krathwohl (2001) cogently make this point:

> Consider the following instructional objective: "The student will learn to add three two-digit numbers with regrouping." This objective can be as- by many items because of the many possible two-digit combinations from which to select. Inevitably, teachers select a sample of the possible tasks and use students' performance on that sample to infer how they would do on other similar, but unassessed, tasks. The more general an objective, the larger the universe of possible assessment tasks.
>
> Now compare the relatively narrow range of evidence needed to assess the two-digit addition objective with the broader range of evidence needed to assess learning of the following educational objective: "The student will learn to apply various economic theories." The specificity of the first objective permits inferences to be made about student learning from relatively few assessment tasks. In contrast, the second objective is much broader, thereby allowing for an almost unlimited set of assessment tasks. Because any single assessment can sample only a small portion of the assessment tasks, the more general an objective, the less confident one is about how adequately a student's performance validly represents his or her learning across its full breadth. Again, this

concern is particularly salient when objectives emphasize more general knowledge categories or more complex cognitive processes.

In stating performance objectives and describing how various ideas fit (today's lesson with yesterday's), many teachers use advance organizers. An advance organizer, according to Ausubel (1960), is nothing more than a conceptual focus for understanding the context for and meaning of new material (in relationship to old material). Teachers use three types of organizers in present in content material to students: expository; comparative, and sequential.

Expository organizers are used when a teacher creates a vertical conceptual organization of unfamiliar ideas. That is, the teacher works from a broad conceptual construct and then begins to break down one concept into a number of different subordinate concepts. (Refer also to the "Concept Attainment.") The teacher progressively differentiates the disciplinary concepts with students' learning more and more conceptual detail (Joyce and Weil, 1992). If, for example, a teacher has been teaching the parts of speech and plans on covering common nouns, the expository **organizer** might look something like:

"We have been covering the parts of speech. Recall that all sentences are composed of words and each of those words has a function. Some are nouns: a person, place, or thing. Other words are verbs: they act on the noun. We have also talked about adjectives and adverbs. Today, we are going to begin taking some of these parts of speech and showing how they can be of different types. Today and tomorrow we will be studying common and proper nouns. . ."

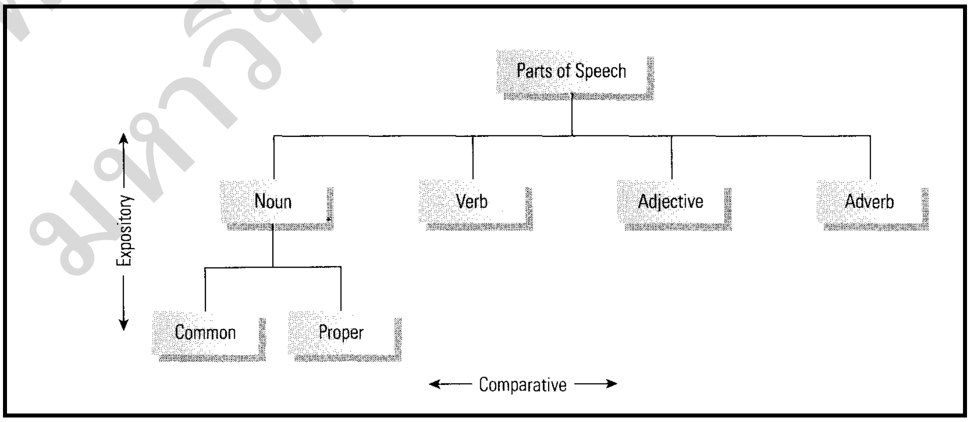


FIGURE 10 Advanced Organizers

Figure 10 shows how the parts of speech would be structured using expository and comparative organizers.

Comparative organizers are used when the teacher utilizes what is known at one level of conceptual thought to make a comparison at the same level (that is, nouns to verbs). Mr. Carthridge uses a comparative organizer when he uses multiplication of fractions to introduce students to division of fractions. Mr. Carthridge uses what the students know about multiplying fractions to help them understand the steps for dividing fractions. Joyce, Weil, and Calhoun (2000) observe that comparative organizers “are typically used with relatively familiar material. They are designed to discriminate between the old and new concepts in order to prevent confusion caused by their similarity”.

Sequential organizers are used, particularly in mathematics, to show students the steps that will be followed in performing a skill (Borich, 1988). Mr. Carthridge uses a comparative organizer to help students see the division of fractions in relationship to the multiplication of fractions. But he uses a sequential organizer when he lists the steps on the board for students to follow. Although teachers most frequently use advance organizers in deductive (direct instruction) lessons, there is nothing that precludes the use of organizers in other types of lessons. Indeed, teachers who use concept attainment lessons rely on organizers as they decide how to present concepts and identify concept attributes.

Once the students know the purpose of the lesson and understand the conceptual context, the teacher then presents the information. Teachers need to present academic material in a step-by-step fashion by using an abundant number of examples at each step. One of the major weaknesses of many teachers is that they assume too much about what students know. This is especially true of high school teachers, but it is equally true of teachers in general. Japanese teachers tend to teach for overlearning by meticulously taking students through class routines or lessons in a step-by-step fashion (Stevenson and Stigler, 1992). The Japanese also place a premium on understanding the con tent, and they use problem solving to ensure that students engage the content (Stigler, Gonzales, Kawanaka, Knoll, and Serrano, 1999). American teachers tend to be more focused on keeping students busy and on broad content coverage; teachers seem less concerned with making certain that everyone understands content material before they initiate independent practice. American teachers assume that if they presented the material, students learned it. But they fail to sequence the learning with a sufficient number of step-by-step demonstrations. Rosenshine (1983) notes:

> Recent research in Grades 4—8 has shown that effective teachers of mathematic spend *more time* in demonstration than do less effective teachers... For example, [one researcher] .. . found that the most effective mathematic teachers spent about 23 minutes per day in lecture, demonstration, and discussion, compared with 11 minutes for the least effective teachers. The effective teachers are using this additional presentation time to provide redundant explanations, use many examples, provide sufficient instruction so that the students can do the seatwork with minimal difficulty, check for student understanding, and reteach when necessary.

Notice that the use of repeated explanations (or recursiveness) and numerous examples is essential for student understanding. Educators have long understood that clarity is an important characteristic of good teachers. Clear teachers use different explanations and myriad examples to ensure student understanding. Unclear teachers explain ideas a second time, in the same way, but louder.

Clear teachers also present material in ways that are attentive to the knowledge their students may lack. The efficacy of direct instruction with lower- income students is reasonably well established. Part of what good, clear teachers do with direct instruction is to never assume that students know something that in fact, they may not know. Gersten Taylor, and Graves . . (1999) describe this as teachers who know the details of curriculum design, and they write,

> Many experimental studies have demonstrated how these details of curriculum design can significantly reduce students' misconceptions. For example, when teaching fractions, traditional curriculum series provide exercises in which students need to discriminate between addition problems and sub- traction problems and between division problems and multiplication problems, *but never between addition problems and multiplication problems.*
>
> Experimental research examined how a conventional sequence for teaching fractions, taken from a major basal series, and a sequence in which students were taught early on to distinguish simple multiplication problems from addition problems affected the learning performance of students with learning disabilities and of remedial high school students. Results indicated that students taught with the conventional sequence *made four times as many errors* as those taught with the more carefully designed sequence. Most of the misconceptions could be linked to flaws in the curriculum. For example, students

explicitly taught to distinguish multiplication problems from addition problems rarely confused them, whereas students never provided with such practice often did.

Phase III: Guided Practice

Once students have been introduced to the skill or content material, teachers proceed by enabling students to practice what they have learned. They can do this by asking a variety of questions, by striving to ensure high levels of student success in answering questions, and by checking for understanding.

The use of questions to assess student understanding is critical to the success of direct instruction. Some questions will be highly specific and demand immediate student recall of a step, process, or piece of information. A quick review of Mr. Carthridge's lesson at the beginning of this chapter illustrates this point. Mr. Carthridge, however, not only asked for informational recall, but he also demanded that students think through why they did what they did. One segment of his lesson illustrates this point:

"Now, class, I'm going to give you a third problem. But in this case, you will be helping me. Let's begin. I'll start by giving you a problem: $3/5 \div 1/2$ **=?** Joshua, whats the second step that we use?"

"You invert the numbers and multiply."

"Which numbers?"

"The ½"

"Why?" responds Mr. Carthridge.

"Because it's on the right side," says Joshua.

"Yes, and a little later you'll also know the more technical reason for inverting the ½

One of the most underutilized and misunderstood elements of a direct instruction lesson are guided practice. Most teachers assume that once they have taught material (phase II), they are ready to allow students to engage in independent practice (phase V). This spurious reasoning explains why so many students exit schools with an inadequate understanding of salient skills and content. Rosenshine (1983) observed that the most effective teachers (those who taught students to retain skills or concepts) were those who "spent more time in guided practice, more time asking questions, more time correcting errors, more time repeating the new material that was being taught, and more time working problems under teacher guidance and help" (p. 341).

Asking a lot of questions, though, is only part of the equation for teacher success. Another extremely important ingredient is for students to be able to answer questions correctly—not necessarily 100 percent of the time, but at least at an 80 percent rate. Effective teachers work toward high success rates, and they involve a wide variety of students in the guided practice phase. Anyone who has ever taught knows that it is quite possible to obtain high levels of student success if only certain students are involved. If the teacher calls on only the high-ability students, success rates can be inflated. Effective guided practice requires that the teacher call on a wide range of students, and this can best be accomplished by calling on both volunteers and nonvolunteers. We suggest that guided practice start with involvement by volunteers, and then as the lesson progresses the teacher should call on students who do not have their hands raised (nonvolunteers). Mr. Carthridge used both volunteers and nonvolunteers, but he also relied on a form of group responding—the use of slates on which all students could write their answers. That technique is supported in the research (see WI. C. Becker, 1977) and is an excellent way for the teacher to monitor whether students are understanding the content material.

Regardless of what strategy the teacher uses to check for understanding (for example, calling on students to summarize points, calling on students who raise their hands, or students' raising or lowering their thumbs to show agreement or disagreement with the teacher), the important factor is that the teacher assess whether students have really learned the material. Another salient difference between American and Japanese teachers is the emphasis on understanding. Once American teachers provide initial information, they tend to proceed to application. The Japanese spend much more time on ensuring that students understand concepts, a result, perhaps, of a curriculum that is "thinner" than the American curriculum. Stigler et. al. (1999) write,

> There appears to be a clear distinction between the U.S. and German scripts on the one hand and the Japanese on the other. U.S. and German lessons tend to have two phases: an initial acquisition phase and a subsequent application phase. In the acquisition phase, the teacher demonstrates or explains how to solve an example problem. The explanation might be purely procedural (as most often happens in the United States) or may include development of concepts (more often the case in Germany). Yet the goal in both countries is to teach students a method for solving the example problem(s). In the

application phase, students practice solving examples on their own while the teacher helps individual students who are experiencing difficulty.

Japanese lessons appear to follow a different script. Whereas in U.S. and German lessons, instruction comes first, followed by application, in Japanese lessons, the order of activity is generally reversed. Problem solving comes first, followed by a time in which students reflect on the problem, share the solution methods they have generated, and jointly work to develop explicit understandings of the underlying mathematical concepts. While students in U.S. and German classrooms must follow their teachers as they lead students through the solution of example problems, Japanese students have a different job: to invent their own solutions then reflect on those solutions in an attempt to increase understanding.

As the reader will note in the next section, student success must also be "read" by the teacher to determine if students really understand ideas in depth.

Phase IV: Feedback and Correctives

Once a student responds to a teacher, the teacher is positioned to see how the student understands the material presented in phase II. A correct response on the part of a student is most desirable, but an incorrect response also communicates important information to a teacher. Incorrect responses reveal something of the conceptual schema of students. Therefore, when students respond to teacher questions, teachers need to assess both the correctness of the response and the nature of their own reaction to students so as to maximize student learning.

If a student responds to a teacher question with a correct, certain answer, *then* the teacher acknowledges the answer ("Yes," "Good," or "Correct") and asks the next question.

If a student responds with hesitancy, then the teacher acknowledges the response ("Yes," "Good," or "Correct") and also provides, according to Rosen- shine (1983), some type of "process" feedback. Process feedback is nothing more than a reexplanation of how a student obtained an answer. It might sound something like this:

Teacher: *"What do you do after you invert in dividing fractions? Jerrod?"*

Jerrod: *"You.. . ab. . . you.. . I think you see if it* c *possible to reduce anything."*

Teacher: *"Right. Remember that the next step is to see f any of the opposite numerators and* *denominators are factors. So in 1/2* x *8/3, the 2 is a factor of 8. Thus the 2 is reduced to 1. The 2 divides into 2 one time and the 2 divides into the 8 four times."*

If the answer is incorrect, *then* the teacher has three choices:

Choice 1: Match the student's incorrect response with a statement that makes the incorrect response correct. Example:

Teacher: *"What do you do after you invert in dividing fractions? Jerrod?"*

Jerrod: *"You solve the problem."*

Teacher: *"No, you solve the problem after you reduce all numerators and denominators. I asked what you do after you invert."*

Jerrod: *"You reduce."*

Teacher: *"Correct."*

This approach enables students to understand how the relationship of what they say fits with what the teacher expects (this student did know to solve the problem!). It cannot (and should not) be used in every instance, but it does represent an option for the teacher to use.

Choice 2: Reteach the material so that the students see the steps once again. This approach may be especially useful at the beginning of the phase ***W*** process, when students may still have an unclear understanding of the skill or content that is presented by the teacher.

Choice 3: Provide hints or ask an even simpler question. Rosenshine (1983) and Stallings and Kaskowitz (1974) argue for using this technique, but teachers need to be careful when the students do not understand the material well. In essence, hints may be useful when students have a reasonably good grasp of the material just presented by the teacher. But teachers will be ineffectual if students are not able to quickly use the hint to answer a question correctly. We have observed teachers provide so many hints that they both frustrate students and destroy the momentum of a lesson.

Regardless of what strategy the teacher uses, the most important thing to remember is that an incorrect response must not go unrecognized. Further, when a student provides an incorrect answer, the teacher should stay with that student to help elicit a correct response. Such an approach helps teachers see the "process" of how students reason: How did they derive an answer? Most teachers simply call on another student, who provides the correct response. Such a strategy does little to help the first student who responded incorrectly, and it does little to help the teacher understand how a class presentation might have created the incorrect response given by the student.

Phase V Independent Practice

Perhaps one of the most problematic aspects of direct instruction is independent practice, especially if students do not fully understand a skill or concept. Rosenshine (1983) argues that it is during this time that students go through *unitization* and *automaticity:*

> During unitization the students are putting the skills together. The students make few errors, but they are also slow and expend a good deal of energy toward accomplishing the task. After much practice the students achieve the "automatic" stage where they respond successfully and rapidly and no longer have to "think through" each step.

Independent practice within American schools occurs either during independent seatwork or through homework that is specifically assigned by the teacher. For independent seatwork to be successful, teachers need to spend more time in the guided practice phase to make certain students *know* the skills they are going to practice. American teachers are inclined either to start independent practice before students really know the skills, or fail to review and evaluate the work of students once students spend time working independently (Stevenson and Stigler, 1992). To ensure the maximum impact of independent practice, teachers must make certain students have a reasonable understanding of the skills the teacher has taught. Work that is assigned to be completed at home requires that students strive for automaticity. Too many teachers assign students skills to practice (for homework) that students simply do not fully understand. Such a circumstance leads to mislearning—students practice skills incorrectly and mislearn how to use a skill. Not only do American children often practice skills at home that they do not fully understand, but when they do have reasonable skill understanding, teachers fail to assign enough practice to ensure automaticity.

Stevenson and Stigler (1992) observed in their cross-cultural study that Asian teachers assign significantly more homework than American teachers; in some cases the rates of assignments were up to seven times as high (these comparisons were for Taipei schools as compared with Minneapolis schools). Homework is not busywork! Homework is intended to ensure that students truly understand the content material presented by the teacher. Some do's and don'ts of assigning homework are provided in Table 9-3.

TABLE 9 Some Do's and Don'ts of Homework

1. Do not ever give homework as punishment
2. Do not make up spur-of-the-moment homework assignments.
3. Do not assume that because there are no questions asked about a homework assignment students have no questions about the assignment
4. Do not expect students (even your best students) always to have their homework assignments completed.
5. Do understand that not all types of homework assignments are equally valuable for all types of students.
6. Do explain the specific purpose of every homework assignment.
7. Do listen to what students say about their experiences in completing your homework assignments.
8. Do acknowledge and be thankful for efforts students make to complete their homework.

Source: D. A. England andJ. K. Flatley. I95. *Homework—and Why.* Bloomington, IN: Phi Delta Kappa.

In essence, for independent practice to be useful, teachers need to (1) be certain that they have adequately taught material before allowing students to engage in practice, (2) be able to check the students' progress and success in using the skill (by circulating around the room while students work), and (3) be able to provide immediate feedback to students who are having difficulty. That feedback, incidentally, should be of relatively short duration (a quick correction). If a teacher finds that long periods of time are spent explaining material to students, then it is quite likely that the guided practice phase was not sufficient (did not take hold) to ensure full student comprehension of the skill.

Models that foster relating skills

Cooperative Learning

Introduction

In many American classrooms, the primary learner is the teacher. The teacher decides what content to teach (usually after consulting a district course of study); the teacher determines how to teach the material; and the teacher even creates a conceptual structure for students to follow in learning the material. In essence, the intellectual burden appears to be on the shoulders of the teacher more than **it** is on students. Some teachers are quite satisfied with this circumstance. They see no reason to instigate change. Others, however, advocate a new direction—one that places more intellectual burden on the student. Roy Smith (1987), a junior high school English teacher, embraces cooperative learning because **"it** places the responsibility for learning where **it** belongs: on the students". More recently, Crawford and Witte (1999) note,

When Ms. Herrera, IVIr. Anderson, and Ms. Hayes use student-led groups to complete exercises or hands-on activities, they are using the strategy of *cooperating—learning in the con text of sharing, responding, and communicating with other learners.* Working with their peers in small groups, most students feel less self- conscious and can ask questions without a threat of embarrassment. They also will more readily explain their understanding of concepts or recommend a problem- solving approach for the group. By listening to others, students re-evaluate and reformulate their own sense of understanding. They learn to value the opinions of others because sometimes a different strategy proves to be a better approach to the problem.

Many teachers experience real discomfort when they do not have complete control over how students process content. Such teachers believe that they have somehow lost control of the teaching-learning process. The irony is that even within the most didactic and structured pedagogical circumstances, the teacher really does not have total control. Teachers cannot make students learn; they cannot force students to assimilate ideas. Teachers experience a false sense of control over what is occurring in the classroom. In essence, they create the environment for learning, but they cannot force students to learn.

The question becomes, then: Under what pedagogical conditions do students learn best? The answer is both simple and complex: They learn best when they have a positive attitude (toward themselves and their classmates) and when they enjoy what they are learning and how they are learning it! These conditions for learning are not easily met, but increasingly advocates suggest that one strategy stands out as an effective vehicle for enabling students to experience enhanced achievement and an improved attitude toward learning. That strategy is cooperative learning! As the reader will recall from the first few chapters of this book, culturally diverse youngsters have demonstrated affective tendencies to- ward building and maintaining relationships with others. These interactional activities of collaboration and communication by diverse learners are strengths that schools need to capitalize upon in developing the skills of all youngsters. As the following example illustrates, cooperative learning not only focuses on the content knowledge that students need to learn, but also on the social interactions between and among students as they begin to explore ideas together.

Cooperative Learning: Instructional Variations

As indicated earlier, teachers can use a host of cooperative learning strategies to enable students to effectively work together. The more options the teacher knows, the more vital cooperative learning can be as an instructional model. Some of these models are relatively simple to use; others require more practice and attention to detail. It is literally impossible to provide any comprehensive look at possible strategies in the context of a chapter such as this one. Our intention is to provide the reader with a sufficient overview so that the possibilities for classroom practice can be determined. References are made within each instructional variation description so that the reader may explore each variation in more depth.

Informal Cooperative Learning

The first set of strategies we discuss are what Baloche (1998) describes as informal cooperative learning strategies. These techniques occur when teachers ask questions and then have students work cooperatively to get an answer, when teachers read stories or lecture and then ask questions, or when teachers ask the students questions and then encourage them to summarize or synthesize ideas. Often times, informal cooperative learning strategies are linked to another teaching model, such as direct instruction. When that occurs, Baloche argues that the outcome might appear as follows:

1. Teacher asks a question that serves as an anticipatory set or advance organizer for the story; video, demonstration, or lecture that is to follow. Students discuss.

2. Teacher reads story, shows video, or delivers lecture—stopping every few minutes and asking students to discuss a teacher-prepared question or problem. Questions and problems might be factual or conceptual; they might focus on the material that has just been presented or might help students bridge to a new segment of the presentation. Students discuss.

3. Teacher asks a question that helps students summarize and synthesize the material that has been presented and provides closure for the lesson. Students discuss. Selected informal cooperative learning approaches are outlined below. In addition Table 10-4 describes other informal approaches a teacher might use when attempting to foster team building skills among students or class building or student mastery of content. Notice how color coded co-op cards might be used to enhance student memorization of material.

TABLE 10 Overview of Selected Informal Cooperative Groupings

Structure	***Brief Description***	***Functions: Academic & Social***
	Team Building	
Round-Robin	*Each student in turn shares something with his or her teammates.*	*Expressing ideas and opinion, creation of stories.* Equal participation, getting acquainted with teammates.
	Class Building	
Corners	*Each student moves to a corner of the room representing a teacher-determined alternative. Students discuss within corners, then listen to and paraphrase ideas from other corners.*	*Seeing alternative hypotheses, values, problem-solving approaches.* Knowing and respecting different points of view, meeting classmates.
	Mastery	
Color-Coded Co-op Cards	*Students memorize facts using a flash card game. The game is structured so that there is a maximum probability of success at each step, moving from short-term to long-term memory. Scoring is based on improvements.*	*Memorizing facts.* Helping, praising.
Pairs Check	*Students work in pairs within groups of four. Within pairs, students alternate—one solves a problem while the other coaches. After every two problems the pair checks to see if they have the same answers as the other pairs.*	*Practicing skills.* Helping, praising.

Source: Paul J. Vermette. *Making Cooperative Learning Work* (Upper Saddle River, NJ: Prentice Hall, 1998), 23. Reprinted by permission of Prentice-Hall, Inc.

Numbered Heads Together

This technique is the one that Ms. Bernardo used in the case study provided at the beginning of this chapter. It fosters student mastery of content by having students consult with one another in response to a specific teacher question. Kagan (1989/1990) describes the following steps:

1. The teacher has students number themselves off within their groups, so that each student has a number: 1, 2, 3, or 4. (Groups can consist of three to five students.)

2. The teacher asks a question.

3. The teacher tells the students to "put their heads together" to make sure that everyone on the team knows the answer. (All students need to discuss the material relevant to the question and be able to respond.)

4. The teacher calls a number (1, 2, 3, or 4), and students with that number can raise their hands to respond.

Kagan (1989/1990) notes that this cooperative learning strategy is especially helpful in enhancing academic and social skills such as checking for understanding and comprehension.

Groups of Four This is a variation of Burns' (1981) group investigation model. Students work in small groups to solve problems that require both cognitive processing of information and social interactions that foster group interdependence. The following steps were followed by teachers in one study that sought to assess the efficacy of the Groups of Four strategy.

1. Students work together in groups of four members.
2. Each group's membership composition is assigned randomly.
3. Each group member is assigned a particular role in the working of the group.
4. All groups work on the same problem or problem-solving activity....
5. Each group works toward one product for which each member receives a group reward.

King attempted to empirically assess the thought processes of students who participated in a Groups of Four cooperative learning activity. He was especially interested in the reactions of low achievers who were participants in the Groups of Four strategy. King noted some of the problems confronted by low achievers in heterogeneous groups (for example, they were influenced by the dominant leadership style of selected high-ability students), but even more important was King's notion that for cooperative learning to accomplish its purposes, teachers need to carefully work with students on how to function within the group situation (see step III of the previous section).

Think-Pair-Share In Think-Pair-Share, students are required to use academic skills such as hothesizing, inductive reasoning, and application (Kagan, 1989/1990). The social skills they utilize include group participation (learning to get along with others) and listening. The technique is intended to enable students to develop concepts and critical-thinking skills. The essential steps of the model include:

1. The teacher provides the students with a topic or idea.
2. The students then reflect independently about the meaning of the topic— the teacher should give students a short period of time for independent thinking.
3. The students pair up with other students to discuss the topic and to share respective thoughts. (This can be a random pairing.)
4. The students then share their thoughts with the class—the teacher needs to wait after each student shares *(3—5* seconds) for all students to *think* about what has been *shared.*

The teacher might use Think-Pair-Share with students at the beginning of a unit when students are attempting to explore the meaning of a topic. This strategy is not difficult to implement and requires only limited practice before teachers and students feel comfortable and successful. It will require teacher patience, though. Most teachers are not used to waiting after the sharing. If teachers pair students to create questions, the technique is called Think-Pair- Question, and if they pair to create a "web," it is called Think-Pair-Web.

Groups of Three The Groups of Three strategy is effective for skill building (for example, enhanced math proficiency or vocabulary development). Typically, Groups of Three can be used on an ongoing basis (that is, the group membership would remain relatively permanent for a grading period or semester). Such permanence enables students to work together over long periods of time and to learn from one another how to develop academic and social skills. The groups are heterogeneously formed based upon academic ability. Provided below is a description of the steps and how to implement the strategy in the classroom.

1. Heterogeneous groups are formed based upon academic ability.

2. Work tasks are assigned to the group on a weekly or biweekly basis (for example, define and use vocabulary terms).

3. Opportunities are created for both group cooperation and individual accountability. (See the Jigsaw II process in the next section.)

Smith (1987) describes his use of the technique with high school English students:

> I use students' scores on a pretest to form the first-semester groups. Each group has one member from the top third of the class, one member from the middle third, and one member from the bottom third...
>
> The students look up the meanings of words independently. Early in the week, working in groups, they review the word meanings together. Since they have used a variety of dictionaries for their homework, the definitions they share with one another encompass a variety of shades of meaning.
>
> Late in the week, the students take two quizzes. They work with their groups to complete the first quiz (20 items involving sentence completion, analogies, and antonyms). The second (20 items involving synonyms) they complete individually.
>
> The group quizzes yield two obvious benefits. First, they give students a chance to review the week's words together. The more often students see, say, hear, and write the words, the more likely it is that these words will become part of their daily vocabularies. Second, the group quizzes give students another opportunity to strengthen their problem-solving skills.

Formal Cooperative Learning

Throughout the 1 990s selected and more structured approaches to cooperative learning also surfaced. These strategies require a much more sustained commitment on the part of the teacher, especially if the scoring regiments are to be used. The models have in common an affirmation of each student's experiences and thoughts and, ideally, should constructively use peer pressure to enhance individual student learning. We have found that the teachers who use these models best are those who systemically received training and then mentoring on the model's usage. Whereas, informal cooperative learning strategies can be used with limited professional development, the formal approaches require more teacher training to ensure the approach is used correctly. A number of different formal approaches exist including STAD (Student Teams-Achievement Divisions) and TGT (Teams Games Tournament)—(see Devries, Edwards and Slavin, 1978; Kagan, 1992; Silver, Hanson, Strong and Schwartz, 1996). We suggest that teachers who really have an interest in the more formal approaches pursue the type of professional development work that is needed to ensure proper usage of the model. We will go into detail for one of the formal approaches (for example, Jigsaw) in sufficient depth to ensure that the reader understands the approach, but for full mastery of formal cooperative learning there is no substitute for in-depth training in the model.

One of the real virtues of formal cooperative learning approaches is the emphasis they place on improvement points. In essence, these approaches really encourage students to learn while at the same time rewarding students who continue to perform well. Clearly, one of the real reasons so many students fall into a cycle of failure is that they see few opportunities to contribute in the way a high achiever does. Jackson and Davis (2000) describe the issue poignantly:

> How schools acknowledge student achievement is another determinant of the intergroup climate on campus. As schools are increasingly able to help all students reach or exceed high academic standards, students from all backgrounds will naturally be honored for their achievement, indicating plainly to everyone that no one group is more able than another. Until this occurs routinely, and as long as gaps in achievement between groups persist, schools can supplement the practice of honoring students whose absolute level of achievement is outstanding by honoring students who have shown substantial improvement in their academic performance.

Jigsaw II The Jigsaw II strategy; which is based on Aronson et al.'s (1978) work, requires that students learn how to work together to enhance their total understanding of a topic. Each student *is* given a portion of the topic to learn well (to become an expert on that part of the topic). After the students have had some period of study with other group members who have similar responsibilities, the teacher provides all students with an opportunity to share their under standing of the topic with other group members. In this way, the students develop a more comprehensive understanding of the topic.

For a more complete understanding of Jigsaw II, the essential steps include the following:

1. Inform students that they will be working in their Jigsaw groups to achieve the lesson goals. If students have previously used Jigsaw II, the teacher's statement will be brief. If students are using **it** for the first time, then students need to be oriented to the size of the group (four members), the structure of the Jigsaw II activity (each person will be assigned a specific area to study within the broader topic), and the goal of the activity (to enable each "expert" to teach what is learned to the rest of the group members).

2. Create heterogeneous groups. There are a number of different ways to create the groups. Some teachers categorize all students in the class according to general groupings such as high ability, above-average ability, below- average ability, and low ability. They then select one person from each of these general groups to form the study groups. Other teachers literally rank students top to bottom with a number (1 through 28, for example) and then "renumber" the students so that seven groups of four can be formed heterogeneously (see Table *10-5).*

The result would be that all the is form a group (that is, Fumi, Lavonne, Sarah, Tanaya). That group of students then creates a name for itself (the Fab Four, for example). At the end of this step, all students are thus assigned to a group and have a name for their group.

Bailey (1996) elaborates on the dynamics of the group assignment process:

> One technique that teachers can use to gain a picture of their classes is to develop class projects in which students serve as data collectors. Students are keen observers of the world around them. Having them keep a record of who is taking part in class can serve as a springboard for important discussions. These discussions can raise everyone's awareness of classroom dynamics, dynamics sometimes so ingrained that they have become invisible.

3. Present rules to govern group behavior. Once the students are in their groups, the next step is to make certain that all students know what is expected of them. Gunter, Estes, and Schwab *(1995)* identify the following rules to govern group behavior:

a. No student leaves the group to meet with other class members until everyone in the original group finishes the teacher-assigned task.

b. Each student must make certain that his or her teammates become experts in the assigned group material. Each student is, thus, responsible not only for knowing the content, but also for making sure that group members have a thorough understanding of the same material.

c. Each student in the group is a resource. If an individual student does not understand some of the content, that student must get help from the group members before seeking help from the teacher.

4. Present content material to the whole class. There are a number of different ways this can be done. The teacher might present a lecture on the topic and then ask the students to use supplementary texts as content resources. For example, assume a teacher is preparing to have the students read a chapter in a text on communism. The textual material examines communism in the former Soviet Union and focuses on its roots, its emergence as an ideology, and its apparent demise in some industrialized countries. Students are to read 17 pages of content material concerning this concept. Four topical areas of interest are identified by the teacher: (1) persons who shaped the communist movement, (2) countries that embraced the communist ideology (3) political structures found within communist countries, and (4) the economic consequences of communist ideology.

TABLE 11 Group Membership Assignment: A Sample

Student Name and Rank	Group Assignment
1. Fumi	1
2. Sue	2
3. Rodrigo	3
4. Josh	4
5. Abraham	5
6. Lori	6
7. Tonya	7
8. Nikki	7
9. Jacque	6
10. Serita	5
11. Bobby	4
12. Aurora	3
13. Nicole	2
14. Lavonne	1
15. Sarah	1
16. Julianne	2
17. Lindsay	3
18. Ramone	4
19. Latoya	5
20. Zachary	6
21. Yung Chang	7
22. Sharad	7
23. Noel	6
24. Libby	5
25. Donnelle	4
26. Jerod	3
27. Shawn	2
28. Tanaya	1

Students are ranked on left column according to ability as perceived by the teacher.

The teacher at this point has identified specific academic content for the overall topic—communism--—-and has four specific topical areas that be- come the foundation for group exploration and development.

5. Develop expert groups. The heterogeneous expert groups are then asked to study the various topic areas, and each member selects one subject within the specific topic. Hence, for our Fab Four group, Fumi selects the eco nomic consequences of communism, Tanaya selects the political figures who shaped the communist movement, and so on. Once all the students have selected one of the four topics for study, the teacher then forms the expert study teams. In essence, each person who selected a topic is going to become an expert in that area.

6. Organize expert groups. The teacher then has all the experts get together and study each topic. That is, all the students from all the groups who plan to study political figures in communism get together and investigate the topic as thoroughly as they can. They need to make certain that all group members thoroughly know the topic so that they can eventually teach this topical material to their original “home” team.

7. Return to study teams to teach expert knowledge. Once the students have had an opportunity to become experts, they then go back to their “home” study team and share their knowledge. Each individual shares with teammates all topical material that has been acquired. The teammates ask questions, take notes, and review the content to ensure that they understand what the expert is sharing (the expert is “teaching” the other group members). Remember everyone read all the original content material, so all team members have some understanding of each topic. The experts have more knowledge because as an “expert group” they focused on the content material in different ways: They read, watched, listened, and discussed the topic in depth.

8. Evaluate student knowledge. The teacher then tests students to assess their understanding of the topic. Students are assessed in two ways and receive points based on both their contributions to the group and their own performance. Each student receives an actual score on the test. As an example, the quiz scores of the Fab Four on the communism test are: Fumi, 96; Lavonne, 86; Sarah, 81; Tanaya, 78.

The teacher then compares each student’s actual quiz score with a base score. The teacher computes a base score by looking at previous quiz and test grades and averaging all available grades. The actual and base scores for the Fab Four are provided in Table 10-6 as well as the point differential between the two, which represents the improvement score, from which improvement points can be calculated using Table 10-7. (Incidentally, the improvement points scale can be adjusted based on the students’ performance and the difficulty of the quiz.)

The teacher then records the actual score in the grade book. The improvement points are used for team recognition, which is described in the next step.

9. Provide team recognition. Prior to the team recognition step, the teacher determines what average improvement scores the teams will need for different levels of recognition. Calculate the average improvement score by having the students add their

improvement scores and divide by the number of group members. For the Fab Four the total was 80 and the average was 20.

The teacher created three levels of recognition. Super teams are those with averages of *25* Great teams are those with averages of 20+. And good teams are those with averages of *15+*. The teacher then provides each team with a recognition certificate (or some other "reward") that acknowledges the team's level of performance. In the previous example, the Fab Four would be given a Great Team certificate.

TABLE 12 Scores of Fab Four Students

	Base Score	Actual Score	Improvement Score	Improvement Points
Fumi	*95*	*96*	*+1*	*20*
Lavonne	*87*	*86*	*-1*	*10*
Sarah	*80*	*81*	*+1*	*20*
Tanaya	*67*	*78*	*+11*	*30*
				Total 80
				Average 20

Source: Adapted from Cooperative Learning Series. 1990. Alexandria, VA: Association for Supervision and Curriculum Development, p. 101.

TABLE 13 Improvement Points Scale

Quiz Score	Improvement Points
More than 10 points below base score	*0*
10 points below to base score	*10*
Base score to 10 points above base score	*20*
More than 10 points above base score	*30*
Perfect paper (regardless of base score)	*30*

Source: Cooperative Learning Series. 1990. Alexandria, VA: Association for Supervision and Curriculum Development, p. 101.

Some teachers find that they do not like to use the team recognition after each testing situation. Instead of giving team certificates for super or great teams, the teacher has students accumulate team points and then change the points for some teacher defined “goods.” For this to work, it is imperative that teams work together to decide how they will use their points. The “checker” in the group records the improvement points; then the team members can exchange their points when a certain level is achieved (for example, *50* improvement points can be exchanged for two answers on a quiz; *75* points can be exchanged for a homework assignment).

Instructional Connections: Combining Teaching Models

Cooperative learning interfaces nicely with many other instructional models. Teachers would tend not to use this model in isolation; more typically, they would use it in combination with another instructional strategy. and cooperative learning are combined—teachers taught a skill using direct instruction and then used cooperative groups to check (and reinforce) student understanding of the skill. Table 10-8 provides an example of how cooperative learning is combined with concept attainment, and Table 10-9 illustrates how it is used with concept formation. We also discussed how easy it is to combine informal cooperative learning with direct instruction. The important point is that as teachers develop their mastery of the models, they can begin to combine the models in ways that enhance the overall involvement of the students so that they learn requisite material.

TABLE 14 Syntax for Concept Attainment and Cooperative Learning

Sequence of Phase	Teacher/Student Behavior	Cooperative Options
1. Present goals and establish set	*Explains the goals of the lesson and gets students ready to learn*	*Think-Pair-Question*
2. Present examples and nonexamples	*Presents both examples and nonexamples*	*Think-Pair-Web*
3. Compare and contrast	*Emphasizes the comparison of examples and contrasting with nonexamples*	*Think-Pair-Share*
4. Identify concept and agreement	*Has students state the essential characteristics of the concept in pairs*	*Think-Pair-Share or Group Discussion*
5. Test attainment and justify	*Provides additional examples; students test the concept and justify their answers*	*Think-Pair-Share Group Discussion Numbered Heads Together*
6. Analyze and evaluate	*Helps students analyze their thinking processes and evaluate the effectiveness of their strategies*	*Think-Pair-Share Group Discussion Numbered Heads Together*
7. Demonstrate understanding through independent practice of the concept	*Has students independently create or find additional examples*	*Think-Pair-Share Group Discussion following the independent practice*

Source: L. H. Mauro and L. J. Cohen. 1992. "Cooperating for Concept Development." P. 162 in N. Davidson and T. Worsham (eds.), *Enhancing Thinking Through Cooperative Learning*. New York: Teachers College Press.

Oral Discussion: Teaching Phases

Phase I: Identify the Focus for Discussion

One of the first steps in oral discussion requires that the teacher identify what the focus will be for the lesson. A lot depends on whether the discussion is being used as a way of extending information covered for a lecture or if it is used as an ongoing method of helping students transform content, as one would find in Socratic Practice. If the former, the teacher might begin by asking the students to consider some topic—for example, the Mexican-American War—and then ask students to generate questions regarding that topic: Where did it occur? Why did it occur? Who were the primary military leaders? and so forth. The teacher then begins the lecture and delivers content, but then allows for discussion as each question is directly or indirectly addressed. The teacher might also add several questions that seem appropriate for students to consider, but that are not asked by the students (for example, In what ways are the Mexican War and the American Civil War connected?)

A second approach is grounded more in a "defined" curriculum of "great books." These books are, by their very nature, complex and difficult. The discussion and use of different types of questions helps students assimilate the content. Gunter, Estes, and Schwab (1995) use the "great books" approach, which requires that the teacher begin by selecting content material for the students to read (for example, the works of Tolstoy, Bacon, Chaucer, or Virgil) and then creating different types of questions (factual, interpretive, evaluative) for students to reflect upon and respond to based on those readings. Table 11-1 includes examples of questions at each of the levels for the book *Teammates* by Peter Golenbock (1990), which, incidentally, is a "good" book but certainly not one of the "great" books.

TABLE 15 Types of Questions for Discussions: Three-Level Approach

Factual	*1. What one fact clearly suggests that Branch Rickey was not afraid of change?* *2. What obstacles did Jackie Robinson face as a result of having made the Brooklyn Dodgers team?*
Interpretive	*1. What did Pee Wee Reese mean by "If he's good enough to take my job, he deserves it"?* *2. Why did Pee Wee Reese need to respond publicly to Jackie Robinson in front of the Cincinnati crowd?*
Evaluative	*1. In what ways does what happened to Jackie Robinson still happen to people today?* *2. Do you agree with the way in which Pee Wee Reese showed his support for Jackie Robinson?*

Factual questions are essentially questions derived directly from statements connected to specific textual material. These questions elicit correct or incorrect responses. Little, if any, divergent thinking occurs at this level. *Interpretive questions* focus on meaning; the reader must move beyond facts and explore the nuances of words and/or ideas. Usually these questions ask students to take information that they understand and to apply it to a new situation. These questions call for divergent thinking processes. *Evaluative* questions focus on the relationship between what the readers read and what they actually experience in their own lives. These questions are divergent in nature and ask students to make judgments about phenomena. They ask students to make decisions and draw conclusions. Some teachers reading this text will be more familiar with Bloom et al's *(1956)* taxonomy. Bloom orders questions hierarchically in six levels of thought processes, but like Gunter, Estes, and Schwab's question types, the lowest level focuses on factual recall of material, and the highest level demands that students pull together disparate ideas and create meaningful conceptual relationships.

We use the Gunter et al. approach in this chapter for the sake of simplicity— three levels rather than six. Actually, what is important is that teachers ask questions that foster different types of student thinking.

Once the teacher has the questions prepared—some prepared questions are essential for purposes of conducting a good discussion—the teacher should review the questions to make certain that they are clear and logically ordered so that students progress from convergent (factual) to divergent (evaluative) thinking processes. Convergent questions are not answerable in more than one way. Factual questions have "right" vs. "wrong" answers. Evaluative questions have responses that necessitate that students use facts to support their arguments, but the direction of the argument will vary according to the student making a particular point.

Teachers may find it useful to ask more factual questions at the beginning of a discussion (establishing a common understanding among students regarding the contextual facts) and then proceed to the more interpretive and evaluative questions once students have established their background knowledge.

TABLE 16 Types of Questions for Discussion: Six-Level Approach

Knowledge	*What were the baseball leagues for blacks called in the mid-1900s?*
Comprehension	*What does the phrase "the great experiment" mean regarding Branch Rickey and Jackie Robinson?*
Application	*What do you think would have happened if that great experiment had never occurred?*
Analysis	*How important was it that Pee Wee Reese take a public stand to support Jackie Robinson?*
Synthesis	*Identify other ways that Pee Wee Reese might have shown his support for Jackie Robinson.*
Evaluation	*What additional data about Jackie Robinson or Pee Wee Reese do you need in order to better understand what happened in Cincinnati?*

Finally, there are some basic procedural considerations that need to be taken into account if a discussion is to be effective. Though Brookfield and Preskill (1999) outline these for use with older learners, they are equally applicable to all learners.

Don't be vague. Make certain questions are clear and unambiguous. Teachers who begin with a "What do you think?" question will be less satisfied than those who begin with a specific question, "What one reason do you think caused South Carolina to secede from the Union?"

Don't play favorites. Make certain that there is equitable student participation. Classrooms are marked by inequities. Find ways to involve all the students.

Don't fare silence. Far too many teachers fear quiet during discussion time. Let students think, reflect. Do not needlessly fill the air with words.

Don't allow students to talk over one another. Students need to learn how to respect others and listen to their comments.

Phase II: Pose the Question for Discussion

For oral discussions to be successful, the teacher must begin by posing a questions that embraces the experiences of the students and is not cast at a level of abstraction that is inappropriate based upon the developmental level of young- sters or the development of the lesson and its content progression. The teacher, in essence, starts by creating, through the questioning process, some type of cognitive dissonance, but that dissonance should emerge from what the students already know and understand. Such dissonance can be facilitated in several ways: a key question, devil's advocate, student questions.

Key Queion A key question is an umbrella question that supersedes all other questions. For example, for the novel *Teammates,* the teacher might begin with the key question: "Why *was it so diffi cult for people in the 1950s to change their beliefs about who should play baseball?"* From this question, the teacher can then lead into the various factual, interpretive, and evaluative questions that have been enumerated in Tables 11-1 or 11-2. Gunter, Estes, and Schwab ***(1995)*** label key questions as "basic." For key questions to be workable there can be no one correct response. Key questions foster dialogue, but they are not easily resolved or "correctly" answered. Good and Brophy (1997) also suggest the use of indirect questions. Such questions are less threatening and more inclusive in tone. For example, "Class, I wonder what would have happened if people like Pee Wee Reese were not willing to take a stand."

Devil's Advocate A second way to begin classroom discussions is by taking a position that the teacher knows will be controversial. The teacher purposefully instigates a controversial (dissonant) stand on an issue. The teacher still needs to have factual, interpretive, and evaluative questions prepared, but the oral discussion begins by the teacher's posturing of a particular position: *"Nothing good happens when those who 'have' try to help those who don't 'have.* " This statement could be made relative to the novel *Teammates,* and discussion would center around Pee Wee Reese's decision to demonstrate his support for Jackie Robinson.

The devil's advocate approach really stirs debate; **it** can also create big problems if the teacher is not aware of how to handle controversy. Teachers who use this technique must be aware that some students may identify the position with the teacher and subsequently either believe that the position is one that students should accept or, worse yet, share with others their perceptions of what the teacher believes (for example, "Mom, do you know that . . . really believes that African Americans should never have been allowed to play baseball?"). Anyone who has ever taught knows that this latter circumstance is a real possibility. The devil's advocate approach must be used cautiously! Quite obviously, the teacher must take special care to let students "explore" the statement, but then also make them aware that the statement does not necessarily represent a personal stance. Some teachers accomplish this by saying, "Class, some people would argue that. . . ." By couching the statements for students in this fashion, teachers are able to personally separate themselves from owning potentially inflammatory and controversial statements.

Student Question Another approach is to ask students to generate their own questions before the content is covered. This approach builds on the natural curiosity of the students. Though some student questions may be worded poorly, a teacher can help shape them and then put them on the board for subsequent review. The teacher might then present some content and then return to the student questions as a way of extending the content.

Phase III: Foster Participation

One of the most difficult aspects associated with conducting good discussions is trying to ensure broad student involvement. Some students tend to dominate; others are reticent to participate at all. Part of the difficulty with quality oral discussions relates to room arrangement.

Some teachers keep students in rows (an arrangement suitable for recitation) but forget that a primary goal of oral discussion is for students to build on the remarks of their peers. Three different classroom organizational structures enable this to occur:

Whole-Class Roundtable With this arrangement, all the students in the class put their chairs in one large circle and/or square. The teacher becomes one of the participants within the larger configuration (circle or square), but the structure enables everyone to hear and see what is being said to and by others. Teachers must be cautious in using this technique. Because of the large size of the group, student participation can be quite limited with a few verbal students dominating the group's deliberations. Teachers should consider using the whole-class strategy as a precursor to the myriad small-group strategies—see Chapter 10, "Cooperative Learning." Other teachers can use small-group formats to "set up" the large group design—the Touchstones Project (see Zelderman, Comber, and Maistrellis, 1992) would be an example of this approach. The Touchstones Project is based on carefully selected texts that engage students at specifically designed times to discuss these texts. The texts are short (for example, an excerpt from "About Revenge" by Francis Bacon) and are assigned to be read just prior to the discussion time. Because all students read the material at the same time, they begin the discussions on "equal footing." The teacher is not an authority on the textual material, so students are required to discern their own meanings by relying on personal interpretations and interpersonal dialogue or discussion.

Buzz Group In buzz groups the teacher divides the class into heterogeneously grouped students of four to eight. The teacher then poses a key question and asks students to identify a common response to the teacher- posed question—a response that all buzz group participants can support. One person in the group is a recorder; another serves as a reporter. The students in each group then share their ideas; the teacher has the students use factual, interpretive, and evaluative questions to refine the various concepts related to the originally posed question.

Inner Circle In an inner circle the teacher forms students into two groups—an inner small group (those engaged in the discussion) and an outer large group (those acting as observers). McKeachie (1986) and others who advocate this strategy find that the different roles enable some students to participate effectively while others try to understand the direction of the discussion and the positions of those offering different arguments. The Touchstones Project approach (described above) relies on this type of inner-circle structure. Zelderman, Comber, and Maistrellis (1992) write,

A typical Touchstones class has a number of segments, each designed to encourage the students to take ownership of the activity and to learn to cooperate. The class generally lasts for 40 to *45* minutes. Students enter the classroom, move the chairs into a large circle, and choose where and next to whom they sit. The books are then distributed. The text to be discussed is read aloud and then silently. Students are then given time to write down a question they feel would be interesting to discuss. Next, students work in small groups of three to five members, either assisting one another in reformulating their individual questions, devising a group question, or discussing how to approach a text as if they were to lead the discussion. The small- group work is always composed of task-oriented activities requiring cooperation. ‘A/hen the class reconvenes, the groups report their results to the class. A Touchstones class occurring about 10 weeks into the year raises the cooperative task to a different level. In this meeting, the students are divided into two groups. For the first 10 to 12 minutes one of the groups will discuss a text while the other group sits in an outside circle and uses a student observation sheet. The observers keep track of the speech incidents, determine the reason for silences if these occur, and evaluate the discussion itself—giving a grade and justifying it. In the second segment of the class, the groups switch roles and go through the same process. In the last 12 minutes of the class, the entire class is reunited. The students in the outer circle present their reports, propose recommendations for class improvements, and discuss these. At this stage the students begin to cooperate, not only on specific tasks, but also on the issue of how to deal with those areas where the group is failing to cooperate.

Before initiating any discussion, it is imperative to establish certain ground rules with the students. Discussions are intended to help students better understand their own ideas—to explore what they believe and why they believe it. For that reason, discussions require that students

1. Have a reasonable knowledge base before dialogue begins or have specific content (such as a Great Book) to discuss.

2. Listen to the contributions of their peers. No two people should speak at the same time. Discussions are not the functional equivalent of *Crossfire* (the CNN talk show) simulations; they

are an opportunity for students to critically examine ideas in ways that enable them to synthesize reasonable conclusions.

3. "Play off" the ideas of other students, not just the statements or questions asked by the teacher.

4. Defend their assertions. Teachers need to ask a lot of "why" questions when students suggest ideas. Teachers should also seek out how other students feel— *"Esteban, do you agree with Tameka c observation?"* When students offer an idea that appears to lack support, the teacher should not hesitate to critically explore the idea.

Phase IV: Summarize the Students' Positions

All too often teachers conduct discussions but fail to bring closure in ways that really help students clarify their thinking. As one of our colleagues suggests, discussions can become nothing more than a sharing of collective ignorance. To avoid this, it is absolutely imperative that students start with a knowledge base and then have an opportunity to synthesize their understandings. This synthesis can occur by using one of three techniques:

Synthesis The teacher writes the students' ideas on the board as they are shared and then asks the students to write in paragraph form a summary of what has been shared.

Small-Group Synthesis The teacher asks students to work in small groups (4—8) and identify salient ideas that they all can support. They then share those ideas with the class by putting the information down on poster paper. For example, recently we observed a 6th grade lesson on owl pellets. At the completion of the lesson, the students were required to work in groups to discuss the dietary habits of owls and then write down their conclusions on poster paper. Each group then stood up and shared its conclusions with the rest of the class.

Personal Synthesis Based on all that has been discussed concerning the concept or idea, the teacher asks each student to write a brief statement of personal belief. The writing of personal belief statements enables students to more pointedly comprehend what they understand and do not understand relative to a given situation.

Instructional Variations

Tutorial

The preceding discussion presumes that the teacher has established a content topic and identified questions that need to be explored related to that topic. Quite obviously, such a strategy is not always necessary or desirable. Three instructional variations—tutorial, inquiry group, and Socratic seminar—are described in this section. Once again, before deciding upon an instructional strategy, it is absolutely essential to determine the objective of the interactions the teacher desires among the students. The first strategy listed below is intended to enhance academic and social skills, and the second focuses more on problem-solving abilities. The first might be a complement to a direct instruction lesson; the second would be more efficacious with the inquiry model.
One of the most powerful instructional strategies known in education is the tutorial. Walberg *(1995)* observed that the tutorial achievement effects were substantial for both tutors and tutees, and especially evident in content areas such as mathematics, where skill definition is more clearly articulated. Students who work in **tutoring** situations get direct and immediate feedback, and they experience enhanced achievement. With the tutorial discussion, the emphasis is on ensuring that specific students exhibit task mastery. According to Orlich et al. ***(1985),*** the teacher first identifies specific students with high levels of expertise and then groups them with students who lack those same skills. The teacher then has the tutors

1. Pinpoint the learning problems of the tutored students—what don’t they understand?

2. Provide the requisite knowledge that the “tutee” student lacks—the tutor teaches the information and/or helps in practicing the skills needed by the tutee.

3. Encourage the tutee students to ask their own questions and direct their own learning.
Group sizes in tutorials should be kept small—no more than four students and preferably smaller. The learning tasks must be relatively specific (for example, the tutor helps students memorize math facts or understand the steps in long division), and the tutors must truly have enhanced skill competency.

Inquiry Group

The inquiry group focuses on student problem-solving. The desired group size for inquiry is 6 to 10 students. Teachers who use this strategy should have students who are familiar with inquiry as an instructional model. According to Orlich et al. *(1985),* this oral discussion strategy fosters scientific thinking and the enhancement of student problem-solving skills. Either teachers or students can lead inquiry groups. Before implementing this strategy; teachers need to make certain that students know how to make thoughtful observations and how to ask questions to solve a problem.

The teacher starts by presenting a problem. The problem should be one for which there is not a readily apparent answer (a discrepant event). Once students recognize the problem, they then break into their inquiry groups and create questions for which they need a solution relative to the problem. The students should generate as many questions as they can think of. Once all the questions are listed, the students then must work together to answer those questions. Rather than relying on the teacher for the answer to a "yes" or "no" question (as occurred with inquiry*),* the students must rely on themselves for the information. For example, the teacher might start by stating, *"How is it possible to remove an eggshell without using your fingers?" The teacher then provides the students with the following: a 1 -pint jar with a lid, 1 raw egg, 1 pint of water, 1 pint of vinegar, and 1 pint of clear pop. She tells the students that by using these materials they can remove the eggshell. The students then move into their groups and begin asking questions and forming hypotheses. They should record all of their questions and answer those to which they know the answers. Based on what they know, they then test each hypothesis.* (Incidentally, the correct solution is: vinegar in a closed jar with the egg submerged—vinegar is acetic acid; egg shells are calcium carbonate. The reaction between the acid and the calcium carbonate causes the eggshell to disappear.)

Socratic Seminar

The Socratic seminar is an outgrowth of Tredway's *(1995)* work to engage students in critical-thinking activities. The process for conducting a Socratic seminar is relatively simple and straightforward, but quite intellectually demanding for all involved. Tredway writes, They [Socratic seminars) typically consist of a 50—80 minute period once a week. Students, usually in groups of *25* or fewer, read a common text prior to or during the seminar—a novel, poem, essay, or document. Or, they may study an art reproduction. They then respond to questions the teacher (or other facilitator) asks about what they've read or seen.

At Paul Junior High School in Washington, **D.C.,** for example, a group of 7th graders were engaged recently in a series of seminars on "How to Be Kind and Forgiving in a World That Is Often Not," a compelling issue in the lives of many young people. They read excerpts from two works— "About Revenge," an essay by Francis Bacon, and *Middle Passage,* a novel by Charles Johnson in which the main character (Ngonyama) leads an uprising on a slave ship, but insists there be no revenge against his captors.

The teacher then posed this question:

To what extent would Francis Bacon agree with the ideas and actions of Ngonyama—totally, mostly, some, not at all?

The students voted on the answer, and their votes ran the gamut. To support their positions, they cited evidence from the text, disagreeing with one another's reasoning, asking one another questions, and, in a few cases, changing their minds based on classmates' ideas. Several times during the seminars, students set up comparable situations from their own experiences with friends or in the community to determine whether they agreed with the advice of Bacon or Johnson.

The question the teacher posed required students to evaluate options and make decisions. They then participated in a conversation about **it.** All subsequent questions in the seminar were based on the students' ideas and contributions in response to this initial question. Thus, the term *Socratic* seminar. The technique is derived from an ancient form of discourse— Socratic dialogue: Through doubt and systematic questioning of another person, one gets to ultimate truth.

The Socratic Seminar becomes a systematic way of helping students appreciate and understand complex content. Unfortunately, as schools become more focused on standards and the content embedded in those standards many teachers view discussion as a waste of time. It is if the teacher is not focused on genuine inquiry But true Socratic Seminars cause teachers and students to really challenge the thinking of one another. The following extended description of a Socratic Practice lesson is presented by Strong (1997). The example includes not only the classroom dialogue but also Strong's "reflection on action" as the dialogue occurs. This example illustrates the technique and, in abbreviates form, what happens when the technique is first tried.

Introduction to Educational Technology

Education and industrial training have always tended to depend more upon contrivance than design, and it is for this reason that art and craftsmanship have been rightly emphasized in the teaching process. However, times have changed. In the past, ideas have always lived longer than people, but today people live longer than most ideas. As De Bono has pointed out (1969) 'technology has so speeded things up that ideas may have to be changed within a generation, instead of between generations. Yet our culture and education have always been concerned with establishing ideas, not with changing them.' One reaction, however, to this state of affairs has been the emergence of a technology of education capable of providing a conceptual framework, which allows for the planning and organization of learning resources with a view to realizing specific, operationally defined objectives or performance levels. Indeed, the techniques of analysis, synthesis and decision-making, implicit in the overall concept of educational technology, are already beginning to supply an answer to those twin problems that have always beset the educationist: What ought to be taught, and to whom?

Nature of Educational Technology

In the space of a very few years, educational technology has come to mean many things to different people. Whatever meaning is attached to it, however, it can best be viewed as a well disciplined and systematic approach to education and training, characterized by explicitness (particularly in regard to objectives), by sophisticated analysis and synthesis, by the utilization of optimal decision-making procedures and by rigorous empirical evaluation. Although the development of educational technology cannot be entirely explained as the flowering of any purely educational or psychological theory, its antecedents are clearly discernible in the evolving principles of programmed learning as summarized in Table 1

Table 1: Changing Emphases of Programmed Learning

1960	1963	1967	1971
Small steps	Task analysis	Task analysis	Systems analysis
Overt responses Immediate feedback	Behavioral objectives Small steps	Behavioral objectives Subject analysis	Task analysis Contrast analysis
of results	Logical sequencing	Flow charts	Behavioral objectives
Self-pacing Validation	Active responding Immediate feedback Self-pacing Validation	Small steps Active responding Presentation as a communication problem Validation	Structuring material (via analysis and synthesis) Appropriate teaching strategy Controlled interaction via: digestible steps appropriate stimulus content relevant response modes reinforcement Presentation as a communication problem Appropriate instrumentation Validation and evaluation Installation and implementation

The Two Educational Technologies

Generally speaking, the term 'educational technology' has come to have two entirely different, and seemingly opposing, meanings in the literature. Lumsdaine (1964) has designated these two meanings as Educational Technology1 and Educational Technology2 in the following manner:

1. Educational Technology refers to the application of engineering principles or technology to instrumentation useful to the process of teaching. This is the meaning that Finn (1960) and his colleagues have given to educational technology. Essentially it is a hardware

approach, stressing the urgent need for developing audio-visual aids for teaching, rather than simply trying to apply aids which have been primarily developed for other purposes. In this regard, it is interesting to remember that the teaching machine is the only mechanical aid deliberately invented as an educational tool. Television, i6 mm and 8 mm film, slide projectors, overhead projectors, sound recordings, and photography were all developed for markets other than the educational one. Figure 1 illustrates some of the interrelationships amongst the developments in hardware as they are related to this view of educational technology. In this way, the process of teaching has been mechanized through the production of teaching aids. These transmit, amplify, distribute, record and reproduce stimuli materials with a consequent increase in teacher impact; at the same time, the teacher can deal with larger and larger groups of students. Because of this, it has become possible to deal with more and more children, without decreasing the avail ability of properly qualified and experienced teachers. The impact that teaching makes has thereby been increased, without necessarily any substantial increase in the cost per pupil taught—indeed, since the educational system is able to deal with an increased number of children, the actual cost per pupil has sometimes even been reduced I It is only fair to point out, however, that the last five years has seen an increasing use of such instrumentation for individual as well as for group use.

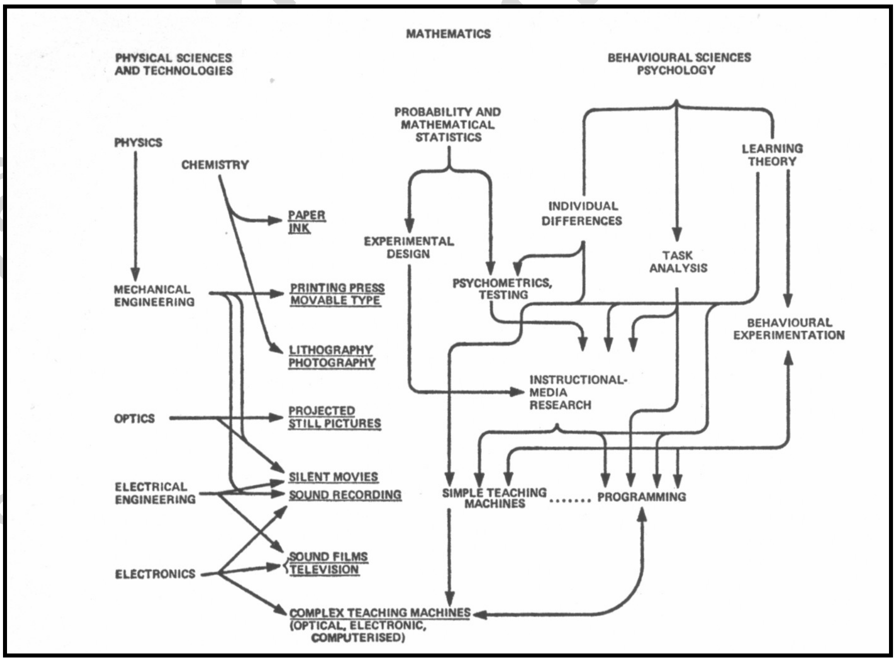


Figure 1: Converging streams of influence affecting present concepts and practices in Educational Technolo&1 (Courtesy: Lumsilaine, 1964)

2. Educational Technology refers to the application of scientific principles to instruction. This is the meaning that Skinner (1968), Gagne (1965) and Pask (1969) give to educational technology, and for them instrumentation is a presentation problem, The converging streams of influence which have given rise to this position, as presently practiced in programmed instruction, are illustrated in Figure 2. Thus this view of educational technology emphasizes objectives and performance, in the sense that the teacher or program ixier commits himself to bring previously specified behaviors up to a previously specified level. Furthermore, these behaviors arc concrete rather than abstract, arc measurable and observable, and consist of knowledge, skills and attitudes actually wanted and desired by the teacher. Such a concept of educational technology is essentially problem orientated, and brings to education the badly needed skills of craftsmanship and scientific technology. These two meanings of educational technology, the first concerned with teaching aids like teaching machines and the second with learning aids like programs, are obviously functionally interrelated to each other. Instrumentation can afford a more efficient and effective control over a learning situation, as well as providing interest, meaning and enrichment to the whole experience. In the same way, techniques of shaping behaviors can, and are being applied, to the material used on television, radio, records and the cinema so as to increase their overall impact in terms of the learning that takes place.

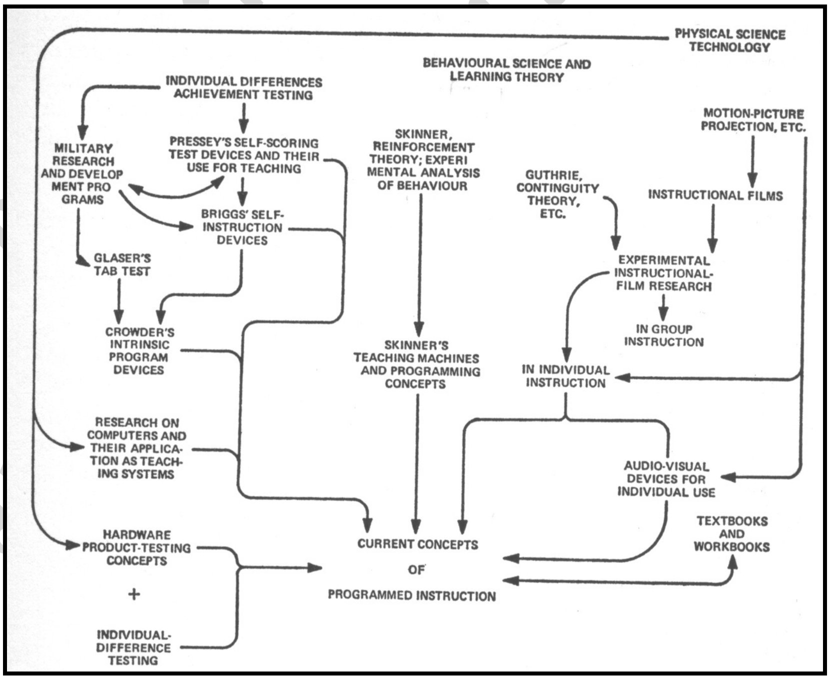


Figure 2 Converging streams of influence affecting present concepts and practices in Educational Technology2 (Courtesy: Lumsdaine, 1964)

It is highly unfortunate that these two very different meanings of educational technology should have arisen, since they create unnecessary barriers to conceptualization, understanding and development as well as do little to further the concept involved. It may well be that some teachers have regarded mechanization as incompatible with true craftsmanship, while others have delighted in the joy of developing some new form of mechanical or electrical aid. However, if the idea of an educational technology is to be useful (i.e. prescriptive) as well as descriptive, then it must be capable of reconciling these two views. Polarization of argument has tended to be characteristic of the literature dealing with developments and innovation in education, probably because educators have grown used to thinking in dualistic terms like 'good versus evil', 'traditional versus progressive', 'teacher-dominated versus child-centered', 'hardware versus software' and 'teacher-teaching versus learner-learning'. A sequential, emerging and transformational view of change (see McBeath, 1969) has rarely been clearly depicted in the literature of education, and therefore patterns of change, such as are discernible in Table 2, have not been available to serve as a rationale for decision-making. For this reason a new, more embracing view of educational technology is now necessary.

Table 2: A Model Depicting Change as Sequential, Emergent and Transformational.

Stage I	Stage II	Stage III
	Developments in Technology	
wheel	motor	jet propulsion
manpower	machine power	electronic controls
cottage industry	mechanization	automation
structures and functions	functions in structures	structures for functions
units	networks	constellations
explore	exploit	conserve
	Developments in Science	
certainties	confusion	probabilities
absolutes	relative absolutes	relatives
metaphor	towards models	functional models
linear	regular patterns	emerging patterns
closed system	open system	open systems
static	dynamic (in flux)	dynamic (evolving)
	Developments in Education	
Principles		
active mind	reactive mind	transitive mind
unity (dualism)	unity (monism)	pluralism
autocratic	laissez-faire	democratic
Practices		
teacher dominated	permissive	inquiry centered
do things to	do things for	do things with
subject emphasis	method emphasis	discipline emphasis
product oriented	process oriented	performance oriented
extrinsic manipulation	random reinforcement	meaningful involvement
standards grouping	age grouping	readiness grouping
class teaching	group teaching	independent study
fixed stimulus	multiple stimuli	organized stimuli
limited access	random access	systematic access
limited resources	multiple resources audio-visual	instructional systems instructional
teaching aids	techniques	technology
Outcomes		

Table 2: A Model Depicting Change as Sequential, Emergent and Transformational. (Continuous)

Stage I	Stage II	Stage III
Practices		
fixed response	varied response	response mastery
convergent thinking	convergent thinking	convergent and
and rote memory competitive	plus free expression	divergent thinking
inner directed	cooperative	adventure
	other directed	self actualizing

Source: COURTESY: MCBEATH, 1969

The New Educational Technology

The distinctive qualities of modern organization theory ('its conceptual-analytical base, its reliance on empirical research data, and, above all, its synthesizing, integrating nature', Scott, 1967) are all framed in an overall philosophy that believes that the only meaningful way of looking at organization is to study it as a system. Such a view is largely new to education. All too often we have been accustomed to think of things as existing apart from what they actually do or accomplish. We tend to think of the chalkboard, the language laboratory and the teaching machine as well as the teacher as something quite separate from each other and from the system of which they are but a part. A more meaningful approach is to take a whole view, both task and human, of the learning system, and to determine how each of the many constituent parts interact with each other.

The Systems Approach

Isolated parts can rarely provide adequate information about a system, but a system can provide valuable information about the functions which can or must be fulfilled by each component. Such an approach is nothing more than an application of the Gestalt concept that the whole is more than a simple summation of its constituent parts. Just as an atom can only be described in terms of activity, so the resources of an educational environment can be described in terms of what they do and the roles they fulfill in realizing the system's objectives. Systems analysis also has its own overall but particular point of view, which involves asking a series of interrelated key questions not seriously considered by the Theory X and Theory Y views of organization. All these questions concern the operation of the whole system:

The reason such questions are asked is not only to discover principles or universals of organization, but also to help predict the likely effect that any change may have—not only within the system itself but also in the environment within which the system operates. It is interesting to note with regard to this, that the systems concept as applied to education in the United Kingdom has tended to be misunderstood; systems have been used, with little or no quantified data, for descriptive purposes usually as a master plan for research or investigation, rather than as a means of predicting the repercussions of change, innovation or even stagnation. Yet probably the most important argument for a systems concept of organization is that the environment, within which the system exists, is becoming increasingly unstable as a result of the rapid growth of technology and changes in social and political mores (Schein, 1965). Goodman (1965) commented that 'not one of our new universities will escape architectural and educational obsolescence in five years from now.

The systems approach to education enables the teacher, research worker or administrator to isolate out meaningful problems, select appropriate strategies for dealing with them, and then determine the effects that these strategies could or do have on the working of the overall educational system. Lange (1967) has demonstrated how the introduction of progressive but isolated educational changes can cause imbalance in the overall system. He cites the case of programmed instruction, and shows how the effects of its introduction can cause a linkage of change in a school organization—each link of change, of course, bringing its own concomitant problems and conflicts—not all of which may be welcome. In the past schools have tended to adapt rather than to adopt innovation, but this strategy is becoming less and less useful as the twin concepts of specificity of behavioral objectives and empirical testing become more and more characteristic of everyday educational practices. The changes may be unpopular, but the systems approach undoubtedly introduces a new type of professionalism into education and training, in which the teacher is seen not only as a learning resource but also a manager of learning resources including himself. At the same time he is able to balance and reconcile the conflicting task needs of the curriculum with the personal and group needs of his students.

A Theory of Teaching

Educational technology will be concerned with the concept of Education as 'the nurture of personal growth' (Jeifreys, 1954). It incorporates both Educational Technology1 and Educational Technology 2, and concerns itself with a modern organization theory approach to the achievement of educational objectives through the application of optimal strategies incorporating both teaching and learning resources. It builds a bridge between educational theory and practice. As a result, there is beginning to emerge an associated general theory of teaching, a guide to pedagogy, so that we are no longer overly dependent upon a theory of learning. It is true, of course, that any adequate theory of behavior should be able to encompass both teaching and learning, but such a view can only apply if teaching is regarded as the 'dependent variable' or the condition to be explained. The kind of theory that modern views of organization suggests, regards teaching as an 'independent variable' or the condition to be manipulated—a series of strategies at the behest of the teacher. This very simple change in approach makes it possible to deal with a whole class of educational phenomena which up to now has been neglected by learning theorists, and makes possible a science and an art of teaching with a technology of its very own.

Bruner (1966) characterizes such a theory of teaching as one that sets forth rules concerning the most efficient way of bringing about a desired change in knowledge, skill or attitude. He also considers that these rules can be derived from a much more general view of learning. Looked at in this way, a theory of teaching can be regarded as both prescriptive and normative, in the sense that it ought to be able to prescribe what strategies to use as well as yield a yardstick for evaluating the success of the venture. It will follow from this, that such a theory of teaching will enable one to:

1. Control the learning environment so as to best realize the stated objectives.

2. Describe ways of sequencing and structuring a body of knowledge so that it can be most readily grasped by the student.

3. Suggest and explain why a particular teaching strategy is likely to be more effective than another.

4. Distinguish between, and suggest, optional or enrichment audio-visual media under the control of the teacher, and basic or essential audio-visual media necessary to learning the topic.

At the same time, it would be hoped that such a theory of teaching, stemming from Educational Technology3, would suggest ways of stimulating and motivating a student so that then he is willing, eager and able to learn. Such a theory would then lead directly to a theory of motivation, as well as to an educational theory of personality growth. In this way the real aim and purpose of Education would be related to actual teaching practices in the classroom. The work of Gagne perhaps provides the most explicit example of this approach so far.

Education, as we have seen, is concerned with change; we are living in an environment that is creating constant problems of obsolescence. Unfortunately, the patterns of organization that it has tended to accept in the past have introduced a degree of rigidity and lack of flexibility that have made changes difficult to introduce or bring about. Changes that have been made have tended to create new educational, social, status and political problems, and new developments have been characteristically separated from the rest of the organization instead of incorporated within it. In some ways, it is almost as if organization exists for its own sake. Modern organization theory and its associated systems concept, on the other hand, views change innovation and growth as the natural result of a concerted response to a new situation. Although debate and conflict may still be present, they are recognized as healthy organizational symptoms; not something to be suppressed but faced. Hence the importance of the conceptual framework of Educational Technology 3. Work within this framework will help to ameliorate the problems that stem from the needs of the educational system to develop the capacity to adapt to and manage change.

A Technology of Instruction

Situation 1: On a College Campus

Comments by two college students as they leave a classroom after completing the final examination for a course:

"I'm glad that's over. We don't have to sit through any more pointless lectures."

"Dr. Brown didn't tell us that Chapter 12 would be covered on the exam!"

"I really have no idea what I've learned in much of this course."

"I wonder how he'll grade us."

Situation 2: At a Community Hospital

In the Learning Center, a nursing education student starts her study of a new module as preparation for her clinical practicum later in the week. Here are some of her thoughts: "I think I can complete the activities for these objectives in about 3 hours." "I like this module approach to learning. The content is logically organized. I'm asked to apply the information as well as study the nursing principles." "I certainly work hard, but after testing myself on the objectives, I feel confident I've learned."

Situation 3: In a Business Company

Tom, the instructional designer in the training department of an electronics company, is reviewing results of a new safety course with two instructors. Here are the observations they make: "The number of accidents in handling chemicals has already decreased over 30 percent since our technicians completed the course."

"On the feedback evaluation, most employees tell us they like the course. Some say they learned things they are even using at home."

"This course should pay for itself within a year. Management would be pleased to hear this."

Situation 4: In a School Administrative Office

A statewide curriculum coordinating committee is reviewing a report relating goals, curriculum, and achievement in 200 schools. The results, which dismay the committee, show that:'

"Less than 50 percent of the schools have established a set of goals."
"For those schools with identifiable goals, there was little relation between what was taught and stated goals."
"Achievement tests emphasized only basic skills (reading, mathematics, and language), which represented only a portion of what was being taught."

Situation 5: At a Television Production Facility

The television producer has been meeting with a potential client who is organizing a continuing education program for the professional members of a national association. The program will utilize a teleconferencing format. Each session will treat a different topic and will be introduced with a videotape presentation by a recognized expert on the topic. The client is shopping for a company to handle arrangements for producing the videotapes. The television producer has asked these questions:

"What is the overall purpose of the educational program?"
"What is the background of the people who will be the audience?"
"Where will the viewing take place?"
"What activities will comprise the instruction besides viewing a videotape each week?"

The client is impressed with the sequencing and directness of the questions being asked. He decides to further explore this company's capabilities to produce the video presentations. Each one of these situations is related directly to the matter of instructional planning. Situations 2 and 3 illustrate satisfactory results of careful planning, while number 5 is the starting point for potential success. On the other hand, situations 1 and 4 reveal unsatisfactory results primarily because of poor planning. From your own experiences, you no doubt can relate a number of other successful and unsuccessful incidents as the outcome of satisfactory or unsatisfactory instructional planning. Traditionally, plans for instruction have been based largely on ambiguous purposes and casual subjective judgments. The more one works in education or training, the greater is one's realization that the instructional process is complex. It is composed of many interrelated parts and functions that must operate in a coherent manner in order to achieve success. For an instructional program to be successful, the following should occur:

• Satisfactory learning takes place so that participants have acquired necessary knowledge, skills, and attitudinal behavior patterns, and after training, perform productively in their assignments.
• The learning is accomplished with due regard for reasonable expenditures of money and time.
• The learning experiences are meaningful and interesting so that students are motivated to continue with their studies.

• The planning and implementation of an instructional program proves to be a satisfactory set of experiences for the instructor and the support staff.

Technology of Instruction

In order to relate all elements of the instructional process in building a successful program, an approach receiving increased attention is one similar to that used widely for product design, development, production, and implementation in business, industry, the military, and space exploration. This approach involves the application of an overall plan incorporating the various elements essential to accomplishing an identified goal. It is called the systems approach to problem solving. This process is based on the method of scientific inquiry, whereby a problem is identified, a hypothesis for solution is formulated, experiments are conducted, and data are gathered that lead to a conclusion about the suitability of the hypothesis for solving the problem. If it is proven to be correct, the results are used to produce or improve products or services. If not, different approaches are tried until success is realized. When the method of scientific inquiry is applied to instructional planning, a technology of instruction results. This means the systematic design of instruction, based on knowledge of the learning process, taking into consideration as many factors and variables about the particular situation as possible. Then, after necessary tryout testing and any revisions, successful learning will result.2 2For a consideration of science areas which have been identified as contributing to the

For many people, the term instructional technology means the resources of instruction—machines (computers, projectors, recorders) and materials (computer software, films, slides, recordings). This is but one meaning of instructional technology another, more important understanding of the term is as the process of systematic planning. This process establishes a way to examine instructional problems and needs, sets a procedure for solving them, and then evaluates the results. Instructional design is the procedure used to implement this process. The management of personnel, budgets, and support services to improve instruction within an organization or institution is called instructional development. Thus, the instructional development procedure is used to direct and control projects, while the instructional design procedure is used to plan courses.

Background for The Instructional Design Concept

The concept of instructional design can be traced back to military training efforts during and immediately following World War II. At those times, the work of psychologists was revealing important new information about how human learning takes place, including the importance of specifying details of a task to be learned or performed, and the need for active participation by the student or trainee to ensure learning. At the same time, audiovisual specialists were developing ways to utilize the recognized learning principles in designing effective films and other instructional materials. In the early 1950s much interest was being shown in educational applications of the learning theory known as behaviorism. B. F. Skinner, the psychologist, developed a stimulus-response (S—R) model based on the principle that learning takes place through a series of small steps in which the learner must actively participate. With success in learning, the student is immediately rewarded. The application of the psychological concepts of feedback and reinforcement (see page 103) leads to what is called operant conditioning. This theory led to the "programmed instruction" movement in the 1960s which established useful guidelines for organizing individualized, self-paced instruction in precise ways so that learning would take place successfully. Of all the developments in recent years, the theoretical view of learning proposed by Skinner and its applications through programmed instruction have been most influential for the emergence of the instructional design process. During this period, practitioners identified a number of elements that require attention for designing comprehensive instruction. These include: writing objectives (see Bloom, Krathwohl, Mager, Popham); organizing subject content, analyzing tasks, encoding and decoding information, and setting conditions for learning (see Gagne, Glaser, Travers); recognizing contributions of audiovisual media and other forms of technology for instruction (see Dale, Finn,3 Hoban, Allen); devising self-paced and individualized learning methods (see Postlethwait, Keller); and evaluating learning (see Bloom, Stufflebeam, Popham).

As the importance of all these features is recognized. We become better prepared to answer the question: "What is the best way to plan instruction so that the goals of a program can be met effectively in the shortest period of time?" The answer is to integrate, in a systematic manner, the many elements that require attention. This leads to the use of a comprehensive instructional design plan.

How would you answer this question: “If you were about to start planning a new unit in a course or training program, to what matter would you trust give attention? Here is how various individuals might answer: Primary grade teacher: “I think first about the children. How important is the topic for them? Then, how well prepared are they to study it (physically, emotionally, intellectually)?” High school teacher: “I’d start by writing down what I want to accomplish in teaching the unit. This becomes the goal around which I’ll plan the instruction.” College professor: “My approach is to list the content that needs to be covered relative to the selected topic. This would include the terms, definitions, concepts, and principles that I feel need to be communicated to my students.” Industrial trainer: “It’s important to start by listing the competencies I expect trainees to have after receiving instruction on the topic. These would be the outcomes or objectives to be accomplished.” Media specialist: “I always try to determine to what degree the topic might be treated with television or another media format. By doing this, I will be prepared with a suggestion if the instructor calls me for assistance.” The foregoing replies represent a sampling of possible approaches that might be taken as different individuals initiate their instructional planning. There could be other replies to the question. For example, one community college instructor always starts by writing the final examination for a new unit! He believes that passing the final exam is the students’ greatest concern. Therefore, he writes questions which indicate what should receive emphasis in his teaching. His reasoning seems plausible. As you read the above replies to the question, as well as formulate your own answer, two conclusions should become apparent. First, a number of different considerations appeal to educators and trainers as each one starts planning. Second, each of us selects an order or sequence of our own in which to treat these elements.

The Instructional Design Process

Key Elements of The Instructional Design Process

Of the planning elements identified in the quoted statements above, four are fundamental in the instructional design process. You will find them treated in almost every planning model. They can be represented by answers to these questions:

1. For whom is the program being developed? (Characteristics of learners or trainees)
2. What do you want the learners or trainees to learn or be able to do? (Objectives)
3. How is the subject content or skill best learned? (Teaching/learning methods and activities)
4. How do you determine the extent to which the learning has been achieved? (Evaluation procedures)

These four fundamental elements—learners, objectives, methods and evaluation—form the framework for systematic instructional planning These elements are interrelated and could conceivably comprise an entire instructional design plan. In actuality, there are additional components which should require attention and which, when integrated with the basic four, form a complete instructional design model. The following section introduces ten elements of the instructional design process necessary for a comprehensive design plan.

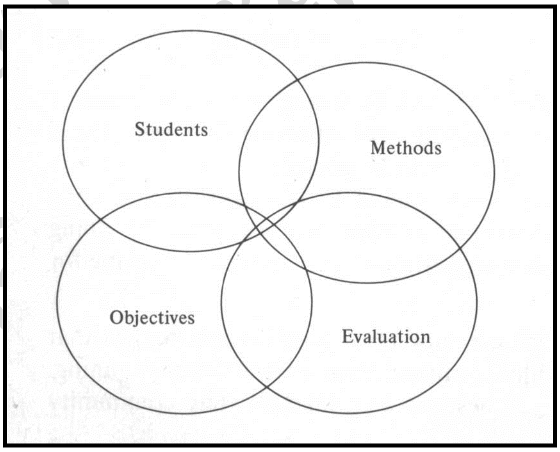


Figure 1: Diagram of four fundamental elements

The Complete Instructional Design Plan

These ten elements should receive attention in a comprehensive instructional design plan:

1. Assess learning needs for designing an instructional program; state goals, constraints, and priorities that must be recognized.

2. Select topics or job tasks to be treated and indicate general purposes to be served.

3. Examine characteristics of learners or trainees which should receive attention during planning.

4. Identify subject content and analyze task components relating to stated goals and purposes.

5. State learning objectives to be accomplished in terms of subject content and task components.

6. Design teaching/learning activities to accomplish the stated objectives.

7. Select resources to support instructional activities.

8. Specify support services required for developing and implementing activities and acquiring or producing materials.

9. Prepare to evaluate learning and outcomes of the program.

10. Determine preparation of learners or trainees to study the topic by protesting them.

Figure 2: The ten elements of this instructional design plan can be illustrated by the diagram shown

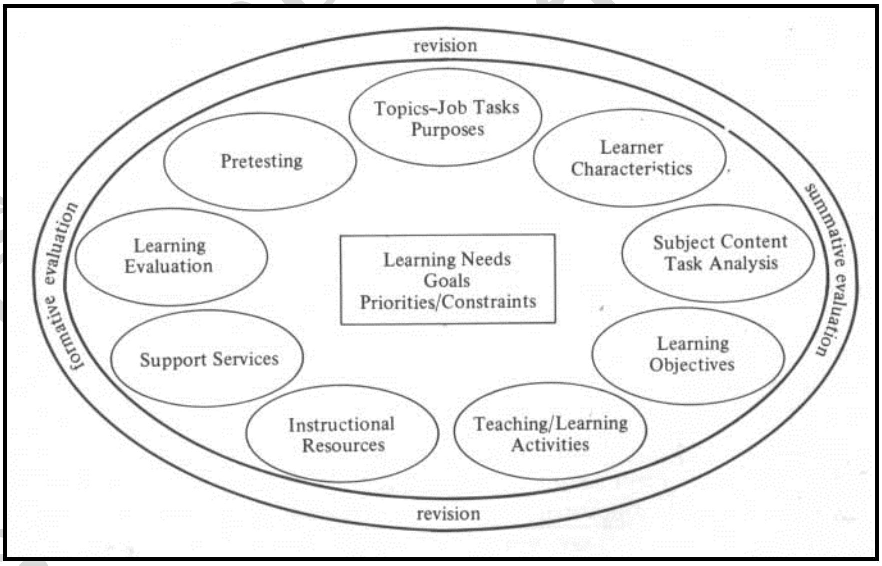


Figure 2: Ten element of instructional design process

The starting place for instructional planning should be to decide if an instructional design is appropriate for a potential project. Thus, in the diagram you find the first element placed at the center of the model.

Although the list of ten elements forms a logical sequence as illustrated, the order in which you address the individual elements is not predetermined. It is for this reason that the oval pattern is used. An oval does not have a specific starting point. Recall the various answers to the question asked at the beginning of this chapter. Each person may proceed through the instructional design process in his or her own preferred way, starting with one element or another, and following whatever order is felt to be logical or suitable. In the above diagram, the elements are not connected with lines or arrows. Connections could indicate a sequential, linear order. The intent is to convey flexibility in the way the ten elements may be used. Also, in some instances you may find it unnecessary to treat all ten elements. For example, in some programs assessing learning needs, protesting, or listing subject content may not be considered necessary.

Another reason for using the oval form is that there is an interdependence among the ten elements. Decisions relating to one may affect others. As learning objectives are stated, items of subject content may be added or reordered. Or, while selecting teaching/learning activities, the intent of a learning objective may become clearer than as initially stated and require revision. Consequently, the procedure recommended permits and encourages flexibility in the selection of elements and in the order of their treatment. This procedure allows for additions and changes as the instructional design plan takes shape.

Many instructional design models identify and use features similar to those described in this book. Such models are often represented by a diagram with boxes and arrows as a series of steps in a sequence, as shown in Figure 3 The intent of this type of model is to establish a l—2--3 sequential order. In actual use, the process often does not take place in such a linear way. The open, circular pattern seems more appropriate and useful. As you gain experience with using this instructional design plan, you no doubt will establish your own arrangement of components for the design of a course. But even when following a sequence with which you are comfortable, adjustments will have to be made. Be prepared for them and handle them in stride. The word “element” is used as a label for each of the ten parts of our instructional design plan. This is preferable to the terms step, stage, level, or sequential item, which are expressions in keeping with the linear concept.

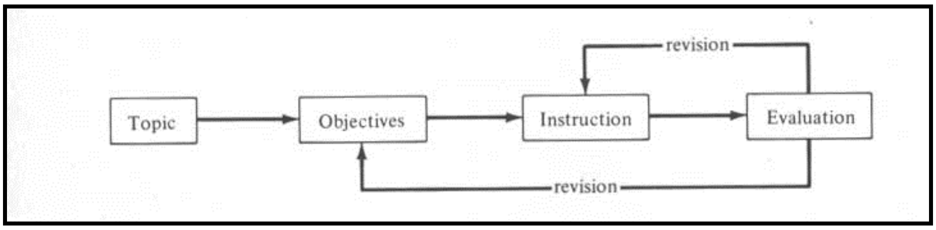


Figure 3: Instructional Design Process

Another part of our diagram is the indication of revision around the elements. This illustrates the feedback feature which allows for changes in the content or treatment of elements at any time during development. The treatment of elements may require revisions when, for example, data about learning are collected during instructional tryouts (called "formative evaluation") or at the end of a course offering (called "summative evaluation"). If you want learners to be successful, which means their accomplishment of learning objectives at a satisfactory level of proficiency, then you will want to improve any weak parts of the program as they are discovered. Various expressions have been used to label or title systematic instructional planning. In addition to the term instructional design (often abbreviated as I.D.) used in this book, you will find reference to the following in the literature:

- Instructional systems
- Instructional systems design
- Instructional systems development
- Learning systems design
- Competency-based instruction
- Criterion-referenced instruction
- Performance technology

Premises Underlying The Instructional Design Process

In order to understand the process and to apply it successfully, a number of basic premises should be recognized. These premises can influence both your thinking and your treatment of the instructional design plan.

Premise 1: The instructional design process requires attention to both a systematic procedure and specificity for treating details within the plan.

Systematic refers to an orderly, logical method of identifying, developing and evaluating a set of strategies aimed at attaining a particular instructional goal. This is accomplished by utilizing the ten interrelating elements which comprise the instructional design plan. The treatment of each element requires exacting mental effort. Application of each element of the plan should take place by giving attention to precise details. This means being specific. For example, a learning objective is a statement that includes a particular verb which both guides a learning activity and indicates how achievement will be evaluated. The details of a learning activity—with the description of certain required student participation— chosen to accomplish an objective are another indication of the specific treatment required when implementing the instructional design process. Attention to detail is critical for the success of any instructional design work. By applying systematic procedures and being attentive to specific details, you can provide for effective learning.

Premise 2: The instructional design process is most applicable at the course-development level.

Decisions about curricula and broad goals for a school or training program precede the design of specific courses. Although instructional designers can help administrators, managers, and committees to make decisions about the purposes, directions, and emphasis of a program, instructional design work usually starts with an identification of the instruction or training needs to be served. Then what follows is the selection of units or topics comprising a course. This is followed with the development of instructional components relating to the various planning elements.

Premise 3: An instructional design plan is primarily developed for use by the instructor and planning team.

Some people believe that all details developed during planning (like for a lesson plan) are to be given to learners, often in the form of a study guide. This is not true. Many of the items written as elements in the plan will be used by the learners, but not always in the form or order in which they are being developed and stated. While learners should be given a list of the learning objectives for a unit, they do not necessarily receive the subject content outline or sequence steps that were important to the planning team while deriving the objectives. Also, the order in which elements are being treated during planning may differ substantially from the order in which they are eventually used with the learners. For example, a pretest might be developed after the final examination has been devised (as shown in the diagram of the plan on page 11), but students will complete it prior to the start of instruction.

Premise 4: In the instructional design process, the goal is to devise a procedure which enhances learning.

Traditionally, teaching has been the most important activity in an instructional program. An instructional design plan allows the instructor to devise methods for successful learning, while learners must take major responsibility for accomplishing the goals of instruction. Learning is accomplished individually by each learner or trainee. Therefore, whether learners are taught in a class or individually, activities should be so designed that each person is actively engaged in the learning process.

Premise 5: The instructional design process is more effective when major attention is given to designing instruction for individual use rather than for group instruction.

This premise follows directly from premise 4 above. While there are times when lectures and other presentations to classes and opportunities for small group activities may be necessary, plans for individualized, learner-paced methods, like the development of self-study modules, should receive major attention. Consideration needs to be given to the use of various nontraditional approaches to instruction. This is one reason why flexibility in planning is so important.

Premise 6: While planning, every effort should be made to provide for a level of satisfactory learning for all students.

A study was made which concluded that up to 95 percent of all public school students can accomplish what is required of them if each individual has suitable academic background, appropriate instruction, and sufficient time for learning (Bloom, see footnote on page 16). It has been documented that if a student is prepared to learn and puts forth the effort to study, but is unsuccessful in learning, the shortcoming can be overcome if attention is given to a more careful design of the instructional plan. This justifies the need to test a plan before its implementation, as indicated by the outer revision oval shown in the instructional design model.

Premise 7: There is no single "best" way to design instruction.

By applying the instructional design process, a reliance on intuition or trial-and-error in planning can be reduced. Yet the instructional design process has not reached a level of scientific exactness. Many paths can be conceived to reach the same goals and objectives. Instructors and designers are unique individuals, just as learners are unique. Each designer will formulate activities and apply elements of the instructional design plan in an individual way. The proof of the success of an instructional design plan will be whether a satisfactory level of learning is achieved.

Benefits of An Instructional Design Process

In order for any enterprise to be successful, those who are involved in the endeavor must derive some benefit. In a business operation this means that the owner makes a profit, the customer is satisfied with the price and quality of the product or service, and the worker or craftsman receives sufficient pay while feeling a sense of pride in workmanship. For those of us associated with teaching and learning, there must be equal benefits:

• The administrator or program manager wants evidence of effective and efficient learning within an acceptable cost base. (The time is past when we could say, "It looks like a good program" or, "It's acceptable because the students certainly enjoyed the course." We need hard evidence of success.)

• The instructional designer wants evidence that a satisfactory program has been designed. The best indication is the accomplishment of program objectives by learners within an appropriate time period.

• The teacher or instructor wants to see learners gain the required competencies and also wants personally to develop a positive relationship with learners.

• Learners want to be successful in their learning and also to find the experience of learning to be a pleasant, satisfying one.

When the design of an instructional program follows the procedures outlined in this book, or those of another suitable model, these benefits can be realized. In other words, by employing the instructional design process, your goals can be accomplished. The acceptance of the instructional development function as important to an organization will be recognized only when satisfactory results like those specified above are reached. Additional evidence in support of the benefits for systematic planning comes from Bloom.1 After analyzing numerous research studies conducted over a 20-year period that were designed to test various ways of improving instruction in schools, he reached this conclusion:

It is possible for 95 percent of our students to learn all that the school has to teach, at a satisfactory level of accomplishment. The level of learning of a student is determined by the student's learning history (prior level of achievement and affective behaviors) and the quality of instruction received.

The implications of Bloom's conclusion is that successful learning will result for the great majority of learners if the instructional program is carefully designed and factors relating to individual learner characteristics are taken into consideration. This can be equally true for either an academic or a vocational training program. Finally, attitudinal benefits for learners may be of equal importance to measurable, material results. Here are statements made by college students when they were asked to express their opinions after completing a new, self- paced learning program (audio-tutorial method) in general biology that had been designed in a systematic manner:

"I appreciate the opportunity given by this course to finally learn at my own pace."
"I thoroughly enjoy the atmosphere, as well as the approach to learning, here. If there were more like this instructor, students might really learn to like learning for their own benefit and not just for the grade."
"1 probably wouldn't even bother studying this stuff, but the way the material is presented is a very good incentive to study."
"I really think this whole setup is great I feel as if I am contributing to my learning instead of passively sitting in a lecture and falling asleep."
"I really learn here. Not just for the tests. I remember and understand what is covered."

Applying the Process to Both Academic Education and Training Programs

An instructional program designed as a course for vocational preparation or on-the-job training requires a different emphasis from that required in an academic course—elementary, secondary, or college level. For vocational or specific job training, the program must stress the teaching of knowledge or skills required for the performance of specific tasks. The anticipated outcomes are easily identified and may be taught directly. On the other hand, an instructional program for academic education encompasses knowledge and skills for which the end point, or final application, may be uncertain. Learners are being prepared to use whatever they may learn for any number of personal, social, or possible future vocational needs. Regardless of the goals of a course, instructional planning requires the same overall thought process with attention to similar design elements.

The identical principles of learning apply to structuring experiences for individuals whether one is to study history or to become a qualified carpenter. While the emphasis, certain details, and terminology differ, both situations treat similar elements of the instructional design plan. Thus, the procedures presented in this book can be effective for either an academic or a training situation. Where particulars differ, special explanations and examples will be included in either the academic instruction or the planning for training.

Who Is In The Instructional Design Process

As you prepare to study the instructional design process, you will want to view it from your own perspective. What will be your role in planning? What specific responsibilities might you have? What relationship do you have with other persons in your organization who are involved in aspects of teaching or training? These are all matters you should keep in mind as you study the elements of the instructional design process. We will examine in detail the roles and responsibilities of those persons engaging in instructional planning, development, implementation, and evaluation. However, at this point, you should recognize that there are four essential roles to be performed during instructional planning. You may be expected to fill one or more of these positions.

• instructor—A person (or member of a team) for and with whom the instruction is being planned; well-informed about the learners to be taught, the teaching procedures, and the requirements of the instructional program; with guidance from the designer, capable of carrying out details of many planning elements; responsible for trying out and then implementing the instructional plan that is developed.

• Subject specialist—A person qualified to provide information about content ad resources relating to all aspects of the topics for which instruction is to be designed; responsible for checking accuracy of content treatment in activities, materials, and examinations.

• Evaluator—A person qualified to assist the staff in developing testing instruments for protesting and for evaluating student learning (post testing); responsible for gathering and interpreting data during program tryouts and for determining effectiveness and efficiency of the program when fully implemented.

Answering The Critics

"Doesn't the instructional design process discourage creativity in teaching?" "Isn't it actually a mechanistic rather than a humanistic method of instructional planning?" These and similar questions are frequently raised and need to be realistically answered. You should make up your own mind about how to answer them after completing your study of this book. Here is the author's position in answering these questions.

If creativity means formulating, developing, and expressing new ideas and original thoughts as ways to solve problems, then the instructional design process allows for creativity. The process is flexible, meaning that the elements can be developed in many different orders or arrangements. Numerous opportunities are available for expressing one's own ideas and independent thinking in unique ways while planning. Creativity can apply to both the planning that takes place while designing instruction and the selection of learning activities. In this process, you can be as creative as you wish, even to the extent of providing open-ended learning experiences for learners.

A humanistic method of instruction is one that recognizes the individual learner (student or trainee) in terms of his or her own capabilities, individual differences, present ability levels, and personal development. It should be apparent that these matters do receive attention in the instructional design process. Elements of the process include an examination of learner characteristics and an identification of. Readiness levels for learning. Furthermore, the application of systematic planning for designing various forms of individualized or self-paced learning also can allow for various individualized styles of learning.

Philosophically, as the planning starts, the instructional designer or instructor should mentally say this:

"I am designing a program of learning experiences for learners so that together we will be successful in accomplishing the stated goals and objectives. While it is important for each person to learn, it is equally important for me that the learner becomes proficient."

Therefore, the approach taken should be one of cooperation among learners (and with the instructor) rather than of competition. Grading is determined by accomplishment against a standard set by the objectives.

The ideas expressed above certainly are unconventional. Many persons in education and training would react strongly to such statements. Both present beliefs and past experiences would cause these persons to deny the argument. Only when an individual becomes dissatisfied with present practices (or results) and starts to identify the need to change might the criticism cease. Only by expressing either an interest or a readiness to try something new can the door be opened to experimentation. Then the person can be informed of potential benefits for applying the instructional design process, with its many options.

By providing explanations and offering opportunities, as described in this chapter, criticism of the instructional design process can be countered. Then receptivity to this method of instructional planning might be encouraged.

Summary

An instructional course or training program consists of a number of topics and/or job tasks. Topics are knowledge-based, while tasks are physical-skill- based. The latter may also require the learning of information for satisfactory performance of the skill. Along with each topic or task, it is desirable to write a statement of what the instructor hopes to accomplish. This becomes a general purpose, expressed from the instructor's point of view. Once a list of topics and job tasks, along with the general purposes for each, has been drawn up, these become the framework within which the instructional program can be designed. A number of items of content and several learning objectives should be listed for each general purpose.

When plans are to be made for classroom or group instruction, obtain general indications of the academic and social characteristics of potential and actual learners. This range of capabilities, interests, and needs can guide the planning decisions relative to the selection of objectives for a topic or task, the depth of treatment of the topic, the number and variety of activities to be recommended, the examples and resources needed, and other pertinent considerations. Special attention should be given to the unique characteristics of no conventional learners, such as individuals from ethnic groups, learners with disabilities, and adults.

For designing individualized learning programs, data about each learner can further aid in the selection of alternative activities, resources, and the most appropriate study environment. In planning for individual learners, the matters of learning styles, including brain hemisphere dominance, preferred learning conditions, and cognitive learning can all profitably receive attention.

A listing or description of the subject content relating to a topic is an important aspect of instructional planning. The content should be organized in some logical, sequential way. The three levels described by Gagn or a diagramming method can be used. When examining a task, the "detailing" method of Mager and Beach or flow charting can be used. These methods should include all steps or elements that comprise the task along with decisions, choices, or judgments that need to be made and their implications. The value of specifying subject content and analyzing a task will be recognized when other elements of the instructional design are planned. Subject content and task analysis can be used as the basis for stating objectives, as content for audiovisual materials and other instructional resources, and for designing testing instruments to evaluate learning.

We are considering a procedure for systematically planning instruction in which the specification of learning objectives plays a key role. The objectives indicate what a learner should be able to do after completing a unit of instruction and are expressed in precise, unambiguous terms. In order to do this properly, we have given attention to these essential matters about learning objectives in this chapter:

• Objectives can be important to both learners and instructors. They help learners plan their study and prepare for examinations. They are used by the instructor as guidance for planning instruction and devising tests.
• Objectives are grouped into cognitive, psychomotor, and affective domains within which increasingly higher levels of intellectual aptitude,
skill ability, and emotional behavior are recognized.
• The domains are closely related, since a single major objective can require learning in more than one area.
• Objectives consist of an action verb and subject content reference; they may also include a performance standard and/or conditions.
• Objectives on higher intellectual levels are more difficult, and yet more important, to specify
• Objectives can be identified only indirectly in the affective domain by inferring learner acceptance of an attitude from behavior that can be
observed.
• Objectives can be organized and sequenced by various methods to ensure that the more advanced objectives receive suitable attention.

The subject matter relating to learning objectives as treated in this chapter provides the essential information to guide you in developing your own objectives and in assisting a subject specialist to write learning objectives.

The three patterns we have examined—presentation to class, self-paced learning methods, and teacher/learner interaction activities—provides the framework within which experiences for learning can be planned. As you consider the selection of methods, the following important questions should be asked:
• Is there subject content or other material that can best be uniformly presented to all learners at one time?
• Is there subject content that learners can better study on their own, at their individual paces?

• Are there experiences that would best be served by discussion or other group activity, with or without the instructor being present?
• Is there need for individual learner/instructor discussion or consultation in private?

In considering these questions, the planning team should realize that there needs to be some degree of balance among the three teaching/learning patterns. Some enthusiasts recommend that self-paced learning, for example, is the proper method for all instruction. This method is getting increased attention as the use of computers becomes more widespread. Other persons believe that suitable opportunities also must be available for teacher/learner contact and group interaction. A major trend is to reduce the time spent in presentations by giving learners increased responsibilities for self-paced learning, but also to provide for interaction experiences as well. In many situations, there are no clear cut divisions among the three patterns. A presentation to a regular-sized class can incorporate questions and discussion. A self-paced learning period may be supplemented periodically with tutorial interaction as one learner helps another or as the instructor replies to a trainee's question. This is how it should be. Employ each pattern for its best service to learning. One or more resources are required to support the teaching/learning activities that have been chosen to carry out the instruction. Resources can be selected from specific items within six categories. A selection procedure has been described in this chapter which can assist you to make the most appropriate choice for your situation.

Once the actual instruction—teaching/learning activities and resources—has been planned, then attention should be given to any of a number of services necessary to support the instruction. Six specific areas are outlined in this chapter: budget, facilities, materials, equipment, support personnel, and time schedules. Without taking them into consideration, the successful development and implementation of the program can be jeopardized.

Through evaluation, success in learning can be determined. When developing tests, give attention to the following:

1. Relate test items directly to learning objectives.

2. Use an objective-type test when you want learners to recognize or select an answer.

3. Use written-answer tests when you want learners to plan answers and express them in their own words. Grading is much more difficult, but higher learning levels can be tested.

4. Evaluate performance in terms of either process or product, or both. Select from three instruments to measure performance.

5. Plan to gather evidence relating to feelings, values, and beliefs affected through the instructional program. Recognize that affective objectives can only be measured indirectly. Use one or more of four methods for gathering attitudinal data.

6. Early in planning, decide on the standard that will he used for measuring learning—relative among learners in the class, or against
an absolute standard as specified in the learning objectives.

7. Give attention to both the validity and reliability of test items to he certain they properly fulfill their functions.

8. Provide opportunities for learners to evaluate their own learning prior to the testing by the instructor.

9. Consider a formative evaluation to judge the success of program components as they are prepared. This can determine if any revision is needed to ensure better success of the program when implemented.

10. Plan for a summative evaluation to determine the success at the conclusion of instruction during regular use.

A pretest determines how well prepared a learner is to start an instructional program or a specific unit. This procedure includes the measurement of necessary background knowledge and skills (prerequisites) and any competence the learner has with learning objectives for the course or unit.

The Seel & Glasgow ISD Model (ADDIE Model)

Using an ISD Process

Overview *Instructional systems design (ISD)* is base on the premise that learning should not occur in a haphazard manner, but should be developed in accordance, with orderly processes and have outcomes than can be measured. Basically, ISD requires defining what is to be earned, planning an intervention that will allow learning to occur, measuring learning to determine if objectives were met, and refining the intervention until objectives are met.

ISD procedures and their application have evolved through practice as well as through research and expansion of theory. Many models of the ISD process have been developed. The Instructional Development Institutes (IDI) model for public school personnel was developed under the auspices of the U.S. Office of Education, and a number of scholars in the field (Gagn Briggs, & Wager,1 992; Kemp, Morrison, & Ross, 1994; Dick & Carey,1 996) have developed models.

Although there are many ISD models, a generic model can be extracted from their common features (Gibbons, 1981; Hannum & Hansen, 1989). No matter what the configuration, all of these models include the processes of analysis, design, development, implementation, and evaluation, which can be defined as follows:

- Analysis—the process of defining what is to be learned.
- Design—the process of specifying how learning will occur.
- Development—the process of authoring and producing the materials.
- Implementation—the process of installing the instruction in the real world.
- Evaluation—the process of determining the impact of instruction

Several disciplines contributed to the development of the field, including psychology, communications, and general systems theory. As the field grew, roles for researchers and practitioners evolved. A generally accepted premise is that ISD should have a research base.

ISD has been formally adopted by large organizations such as the military, industries, and universities. It is used in a variety of settings, from the baking industry to schools and hospitals. ISD can be used to develop a sophisticated curriculum for a large school system or on a micro level to improve a one-hour presentation. Its benefits are that it is a systematic process that helps the instructional designer make decisions about the nature and scope of instruction.

The generic instructional design model The generic model is so simplified it is unlikely to be used without modification or elaboration. As shown in Figure 1.1, each stage is driven by a set of questions, the answers to which are the basis for the next stage and a new set of questions. As the instructional designer discovers the answers to the "driving questions," decisions are made about the type and scope of instruction needed for the particular circumstances at hand. An instructional situation can range in scope from a module, lesson, or experience to an entire curriculum, environment, or course. Four important characteristics of ISD are as follows:

1. Content selection based on data from the field.

2. Instructional strategies based on research and theory.

3. Assessment based on standards of performance.

4. Technology used to optimize effectiveness, efficiency, and cost (Campbell, 1980). The following discussion elaborates on the processes of analysis, design, development, implementation, and evaluation.

Analysis There is a great deal of uncertainty at the start of an ISD effort. The client agency may be uncertain about its needs and have unrealistic expectations of what can and cannot be done given the allocated resources. The subject matter may be new to the designer, who is faced with trying to make sense of the many ambiguities and contradictions associated with this new information. The designer's job is to make sense of these inconsistencies, to work with others such as *subject matter experts (SMEs,),* to develop a coherent solution to the problem, and to gain the client's acceptance of the proposed solution.

These responsibilities are accomplished by data about the performance requirements of the job or content about the context in which the job is performed or the content used, and about the people who perform the job or use the content. The data is then analyzed to answer the questions of the analysis phase, sometimes referred to as front-end analysis because it occurs first in the ISD process.

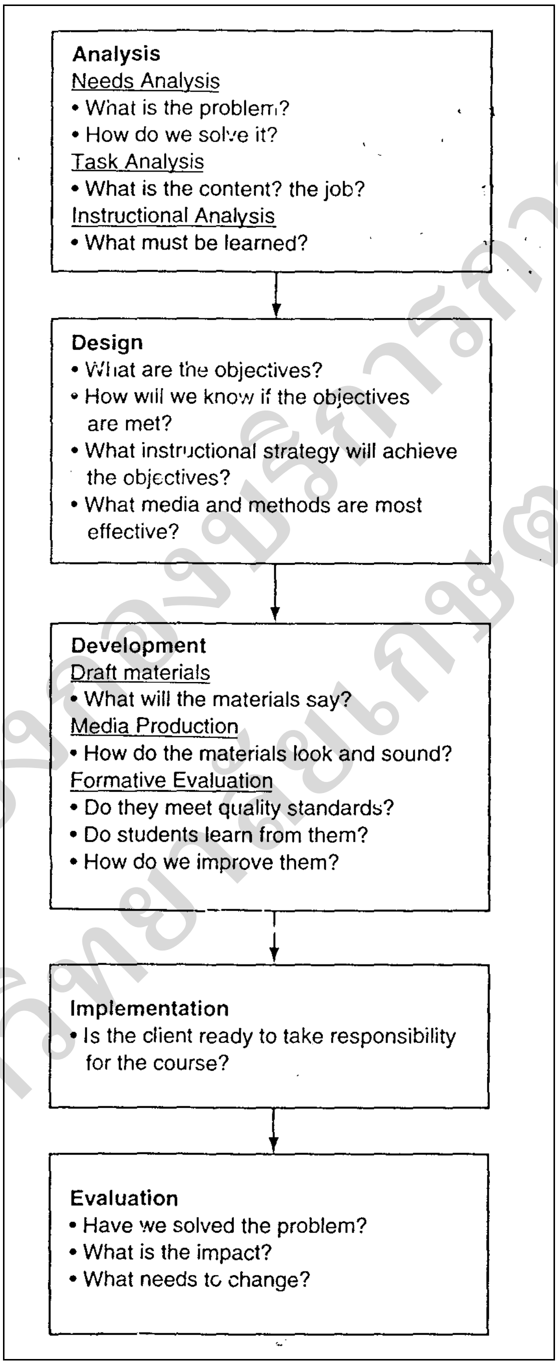


Figure 1: Generic ISD Model Elaborated with Decision Questions

In this text, we distinguish three types of "front-end" analyses: *needs analysis, task analysis,* and *instructional analysis.* The different types of analyses are distinguished more by the questions they answer than by the techniques they use. For example, the analyst may interview job holders when performing needs analysis as well as when performing task analysis. Although interviews are used to collect information in both instances, the purposes are quite different. Each type of analysis requires a different :rental set of the instructional designer.

Needs Analysis. Needs analysis is a method of determining whether the instruction the client called for is really needed and, if so, determining how much instruction is needed. It asks, "What is the problem?" and "How do we solve it?" A needs analysis involves getting the answers to specific questions that will circumscribe the precise nature of the problem. Many times instruction is seen as a solution to a performance problem when it is not. Mager and Pipe (1970) distinguish between competence "can do") and performance ("does do"). They advise the instructional designer to ask, "Could the potential students perform the task if their lives depended on it?" If the answer to the question n is yes, then the poor performance cannot be attributed to a lack of competence. The analyst should look for non-instructional solutions such as introducing incentives or removing "obstacles" that keep people from performing adequately.

If there is an instructional problem, the designer wants to define the discrepancy between what the target audience already knows and what members need to know to achieve "acceptable performance The designer must get a general overview of the performance requirements for the job or content and the context in which performance takes place, identify including educational 1eveI attitudes, and value systems that might affect learning, and describe the instructional environment in which the new instruction will take place.

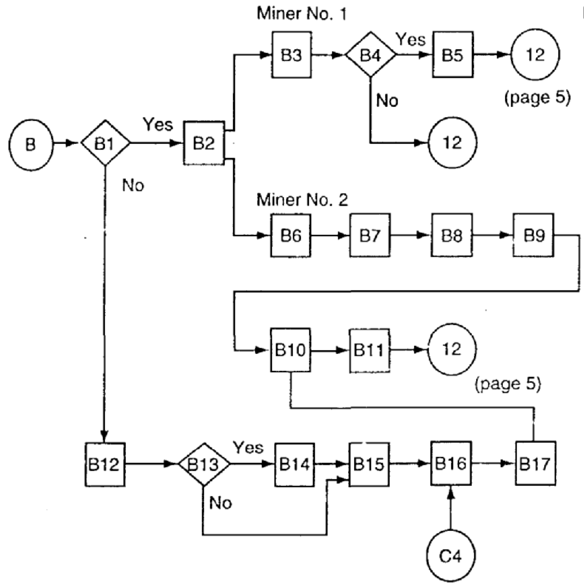
A general solution to the problem is proposed as a goal. To this end, the designer collects information to determine whether there are adequate available for developing and delivering the needed instruction. Although much remains to be established about the new instruction, general estimates are made about the level of effort, time frames, and cost of developing the needed instruction. At this point, the designer and the client determine what is feasible and practical given the available resources and the size of the performance discrepancy. Task Analysis once the parameters of the problem and its solution have been defined, the designer begins defining the job or topic to be learned using the techniques of task analysis. Task analysis asks, “What is the job?” or “What is the content?”

During needs analysis, content or duties to be learned are defined at both a global and a general level. In task analysis, tasks or content are defined more specifically. The designer may review relevant documents, observe proficient performers doing the tasks to be learned, and consult with experts in the field.

When the content or job is well defined, the analyst can usually rely upon accepted practices and procedures in order to document the tasks and the conditions and circumstance under which they are performed. When experts disagree5iihe content or job is poorly defined, the analyst’s job is to work with experts and help them define the behavior or content. Often, expert performers are unable to describe what they do; it is second nature to them. The success of the analysis will depend on the designers skills in focusing the SMEs on the instructional goal and extracting the relevant information about what tasks or content must be learned in pursuit of that goal.

The analysis is performed until the instructional designer arrives at an appropriate level detai1 for the target audience given the knowledge or performance discrepancy Figure 1.2 shows an analysis of a task associated with fighting small fires i0 underground mines. No standardized procedures existed when the project began. The designer worked with a team of three SMEs to define the sources of small fires in underground mines and to develop the specific procedures for fighting them.

Instructional Analysis. When the task analysis is complete, a database exists that describes the job or content in detail. Next, the designer uses techniques of instructional analysis to determine what must be learned.



Fires Involving Electrical Equipment With Trailing Cables

B1. If at least two miners are present at the fire site, go to Step B2. If not, go to Step B12.

B2. Miner No. 1 (probably equipment operator) performs Steps B3 through B5. Miner No. 2 (probably equipment helper) performs Steps B6 through B11.

B3 Shut off equipment power switch.

B4. If the equipment has automatic fire suppression gear, go to Step B5. If not, go to Step 12 of General Procedure.

B5. Activate automatic fire suppression gear. Go to Step 12 of General Procedure.

B6. Shut off all section power at power distribution boxes.

B7. Report fire to Section Foreman.

B8. Alert other nearby miners to fire.

B9. Call for mechanic.

B10. Return to fire site with dry chemical extinguisher.

B11. Go to Step 12 of General Procedure.

B12. Shut off equipment power switch.

B13. If the equipment has automatic fire suppression gear, go to Step B14. If not, go to Step B15.

B14. Activate automatic fire suppression gear.

B15. Shut off all section power at power distribution boxes.

B16. Tell other miners to report fire to Section Foreman.

B17. Call for mechanic. Go to Step B10.

From *Development of a Training Program for Fighting Small Fires in the Mining Industry: Task Analysis Report* (Contract No. J0395060), 1981, by W. Laird, S. Bhatt, T. Bajpayee, Z. Glasgow, and D. Scott, Bruceton, PA: U.S. Department of Interior, Bureau of Mines.

Figure 2: Flowchart for the Procedures Miners Should Follow

The designer analyzes each task or content area to determine what the student must know in order to perform this task or learn this content. In this way, the prerequisite competencies are identified. Then, the designer compares the prerequisite competencies needed to perform the task or learn the content with the competencies the learner already. The between the two determines how much instruction is needed to learn the new material. If there is great variability among the members of the target audience, some students will need more and different instruction than others to reach the same goal. A knowledge of learning theory and research is necessary to define the competencies arid their prerequisite relationships.

Design Information from the analysis phase forms the foundation for the design phase. During analysis, the designer made decisions about what will be taught. Now, decisions are made about how it is taught. The design phase is driven by a search for the answers to the following questions:

- What are the objectives?
- How will we know if they are met?
- What teaching strategies will achieve the objectives?
- What delivery systems are most cost-effective?

The purpose of the instruction is to improve performance on the job or improve competency in some subject area. With these aims in mind, the instructional designer must devise a strategy based on research, about how people learn given the type of learning involved. The strategy should be designed to help the learner bridge the gap between the performance required by the learning and the performance required on the job or in the real world outside the classroom. This is accomplished by replicating in the instructional setting situations that reflect relevant job situations aid real-world contexts. Information gained from the earlier needs and task analyses is the springboard for devising authentic learning experiences.

The designer must be familiar with the research on which instructional methods, media, and strategies are most effective given the types of learning involved and the characteristics of the target audience. Practical concerns about cost-effectiveness, resource availability, and the staffing needs for course development come into play.

Development In the development phase, the materials are authored reviewed, produced, and validated. The activities carried out during development will depend on the instructional media to be produced. The driving question during production is, “How will the materials look and sound?” The physical features of the material are produced during this phase, and it is the designer’s job to ensure that the principles of learning are incorporated into the materials as specified during the design phase. Depending on the media requirements, the instructional designer may work closely with writers, film or video producers, directors, actors, editors, artists, photographers, and computer programmers.

Material development also involves a process of formative evaluation whereby the materials are tried out. Formative evaluation answers the questions, “Do the materials teach?” and “How doe improve them?” Evaluation e information is gathered in two ways. First, SMEs and

ISD colleagues review and critique the materials in draft form. An SME reviews the materials to determine whether the materials are accurate, while instructional design colleagues review the materials to determine whether the materials are developed in accordance with ISD standards. Secondly, the materials are tried out on students typical of the target population before they are finalized. The tryouts are aimed at finding out whether students learn from the materials. It may take several levels of tryout to achieve the desired level of learning. In this way, materials are revised until objectives are met.

Implementation The ultimate success of a course depends on whether it is implemented as intended. To ensure this, the designer must develop guidance for administrators and ther1order to prepare them to carry out their prescribed responsibilities.

During the early stages of implementation, there are often a number of problems as people learn to use the new materials. If the materials are highly complex or the course uses unfamiliar methods and media, it takes some time for people to learn to accept them and use them effectively. Users may need a great deal of support until they are familiar with the new way of doing things. As people gain a better understanding of how the new version of a course works, the need for support drops off. The driving question for the implementation phase is, “Is the client ready to take responsibility for the course?”

Evaluation The evaluation phase is driven by a search for the answers to following the questions: Have we solved the problem?

- What is the impact?
- What needs to change?

The evaluation in this phase is called *summative evaluation,* and differs from *formative evaluation* carried out during the development phase. Formative evaluation is used to identify deficiencies in the materials while they are being formed in order to correct deficiencies. Summative evaluation is intended to help the client agency assess the impact of the new materials in a broader sense. Summative evaluation is often carried out by an independent evaluator, not the instructional designer who is closely connected to the finished product and, therefore, may be less objective. Ideally, it takes place after the implementations phase, when the novelty of the program has worn off and bugs are worked out.

Once the course has been implemented, summative evaluation helps the client determine how well the problem was solved and the value of the solution to the organization. Depending on the size and nature of the organization, summative evaluation of instructional systems can be quite complex. Questions asked to assess organizational impact are:

What does it cost? How long does instruction take? How are job performance and/or graduation rates affected? What is the impact of learning the new material on the organization? To assess instructional effectiveness, measures are taken periodically to determine if standard, are slipping, learning objectives are still being met, and materials are being used correctly as well as whether the course is still timely, or the content is obsolete.

Outputs

The ISD process is as important as the product, because confidence in. the product is based on the process. To be confident of the product, the phases of the generic ISD model must be followed. For each phase a series of tasks must be performed and specific output generated, as illustrated in Table 1.1. Whatever job you assume, you may be responsible for any of a variety of products. The products of ISD can vary in scope and sophistication. Scope encompasses variation in size or content, while sophistication encompasses variations in curriculum or media. At the smallest level of scope are lesson plans and modules. The next level includes courses, programs, workshops, and units. Courses, curriculum, and environments would be examples of large-scope products. At the highest level of sophistication are interactive learning delivery systems, such as interactive video, while the lowest level of sophistication is paper and pencil, with audiovisual materials in the middle.

Table 1: Tasks and Outputs of the Instructional Design Process

Phase and Definition	Sample Tasks	Sample Outputs
Analysis—the process of defining	Needs analysis	Problem statement
what is to be learned	Task analysis Instructional analysis	Behavioral task statements Learner entry level
Design—the process of specifying	Write objectives	Measurable objectives
how it is to be **leaned**	Develop tests Plan instruction	Criterion-referenced tests Design specifications
Development—the process of	Work with media production staff	Storyboard
authoring arid producing the	Develop instructional materials	Script
materials	Tryout materials	Exercises Revisions based on student performance
Implementation—the process of	Train teachers and administrators	Teacher and administrator guides
installing the project in the real	Plan resource allocation	Systems for tracking student
Phase and Definition	***Sample Tasks***	***Sample Outputs***
world context	Develop maintenance system	progress Procedures for monitoring resource consumption
Evaluation—the process of	Survey graduates	Recommendations for change
determining the impact of the	Review administration, maintenance	Project report
instruction	and costs	

As Table 2 shows, products can fall on any coordinates of the scope and sophistication dimensions.

Table 2: Dimensions of ISD Products

Project Scope	**Technological Sophistication**		
Large:	**Low**	**Moderate**	**High**
Curriculum	Correspondence	Telecourse	Computer-based
Efforts	Course		Self-instructional
			Course
Medium:			
Programs	Programmed	Mediated	Videodisc
Units	Instruction Unit	Workshop	Simulation
Workshops			
Small:			
Modules	Workbook	Videotape	Computer
Lessons	Exercises	Presentations	
Presentation			

Analyzing Tasks

Overview Needs analysis precedes task and task analysis precedes instructional analysis. But the instructional designer will find that he or she moves back and forth among the different types of analysis, because analysis is an iterative process. It consists of collecting information for specific purpose, analyzing data and making decisions based on that data. The data collection and analysis process moves from the general to the specific. It begins with the needs analysis step that involves getting the answer to specific questions that will circumscribe the precise nature of the problem. Once it is clear that some sort of instruction is the solution to the problem, it moves to the task analysis step to answer increasingly specific questions about what is the job or content. Finally, the instructional analysis step answers questions about the students' competencies with respect to the job or content and what must be learned.

Figure 3 shows how the three types of analyses relate to each other. Although conceptually distinct, they do not have clearly defined beginning and end points. Task analysis begins when the needs analysis is completed. Data collected during the needs analysis, however, will be relevant to subsequent task analysis; therefore, needs and task analyses overlap. Early on, the evidence from the needs analysis may indicate that instruction is needed to overcome a particular performance problem. But the data are usually still too general and diffuse for task analysis. Ordinarily the data tell you only what the next set of questions should be to answer questions about how tasks are performed. As the answers to initial task analysis questions are uncovered, new questions arise and additional information is collected. This process continues until, in the judgment of the designer, sufficient data exist as a basis for beginning the instructional analysis process. Task and instructional analysis also overlap in that task analysis provides some of the answers to the questions posed during instructional analysis.

The analysis process is akin to discovery learning. Information is gathered and examined. On the basic of this information, new hypotheses are formed and tested. As an understanding of the instructional problem evolves and relationships among tasks and content become clear, answers slowly emerge regarding what is to be learned to bridge the gap between the student entry level and the learning outcome to be accomplished.

The focus of this chapter is task analysis. Needs and instructional analyses are covered in Part II of this text. The task analysis step introduces many of the competencies you will need to perform effectively. These include the ability to collect and document evidence about jobs and content that are he goal of instruction. The object of task ana1yis is to identify the subtasks, information flow, inputs, an decisions required to perform task as objectively and explicitly as possible. The designer uses a number of methods and techniques to collect task data and reveal the relationship among task elements.

Developing a clear description of the topic or job to be learned helps the designer understand the subject or job. In turn, during subsequent steps of the ISD process, i understanding helps him to establish clear-cut instructional objectives, select the most suitable instructional techniques, and evaluate instructional effectiveness of the completed coursed. A task analysis is also a way to verify with others the designer’s understanding of the job or topic.

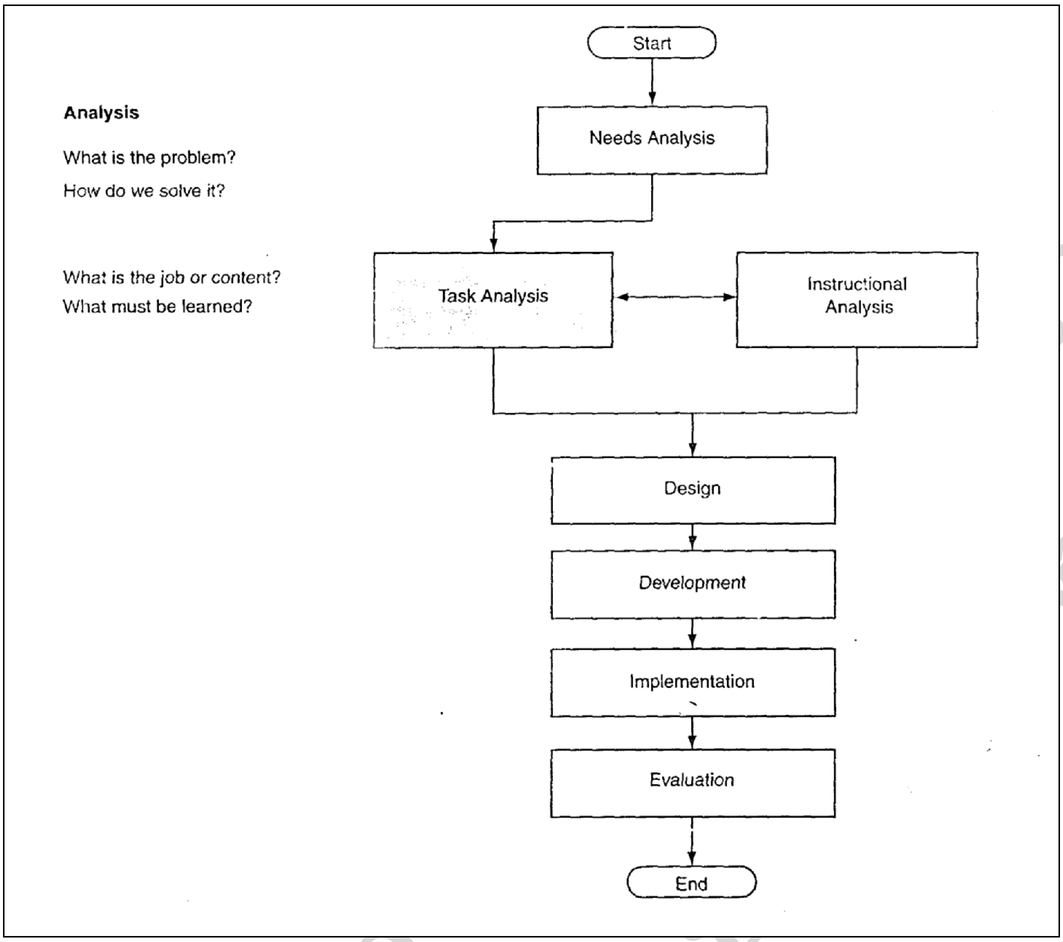


Figure 3: Expansion of the *Analysis* Phase of the ISD Process (Seels & Glasgow ISD) Model I: For Novices)

When instructional designers are expert in the field to be taught, they draw on the own knowledge to define the answer to the question: "What is the job or content?" Usually, however, instructional designers are faced with the job of analyzing tasks in an unfamiliar field. Under these circumstances, designers must gather information from expert sources and translate it into a behavioral form. To do this, the designer must select from a repertoire of data collection methods those appropriate to the situation. The ability to work with unfamiliar subject matter is an essential prerequisite for virtually all designers

What task analysis and is not Task analysis answers the question: 'What is the job or content?" Its purpose is to determine the opertiona1components of a job, skill, or subject matter in order to describe what expert performers do and how they think.

Task analysis may be the most confusing aspect of ISD to those entering the field. One reason for the confusion is that it is performed in many different ways depending on the type task being analyzed the designer’s training and experience, and the resources allocate do the process by management. Another reason for the confusion is the imprecise use of temino1ogy. Many writers blur the distinction among needs, task, and instructional analysis by using the term “task analysis” to describe all three. Most likely this is because analysis is an iterative process. The designer moves back and forth among the different types of analysis so that the distinctions blend together in practice although they are conceptually distinct.

Jonassen, Hannum, and Tessmer (1989) contend that most of the confusion is the result of uncertainty about what the process of task analysis involves. Table 3 shows the distinction between task analysis functions and instructional analysis functions as they are defined in this text. Task analysis defines the job or content, while instructional analysis answers the question, “What must be learned?” Not everything about a job or field of knowledge must be learned. Employees may already know how to do some tasks and will not need instruction on them. Likewise, in an academic field, students may bring to the course a background of knowledge of basic facts or concepts that the new instruction will build on.

Table 3: Task Analysis Functions Versus Instructional Analysis Functions

Task Analysis: What is the job or content?	Instructional Analysis: What must be learned?
Task inventory lists the general duties or topics that make up the job or content.	Selecting tasks eliminates the tasks that are NOT the object of instruction from further study.
Describing tasks elaborates the duties or topics to identify the tasks, subtasks, information flow, and knowledge base required to perform a job or use the content.	Analyzing task and content levels determines the types of learning to be acquired. Sequencing tasks or content determines the order in which learning will occur

Writing task statements Task analysis moves from the general to the specific. First, the general topics or duties of a topic or job are inventoried, then the tasks are defined. Next, tasks are described Describing tasks is the process of elaborating the tasks to identify the subtasks, information flow inputs, and decisions required to perform a task as objectively and explicitly as possible. The analysis continues until the designer arrives at a level of detail appropriate to define the task relative to the target audience. Difficult tasks will require more levels of analysis than easier tasks.

When information is related to a specific job or task, it isn't difficult to write statements of observable actions. In school settings, however, knowledge is not always directly related to an observable task. The goal of instruction is to instill knowledge and/or teach mental operations. When the behavior is covert, your job is to specify behavior that p. vides evidence that the knowledge or mental skills have been learned (e.g., "Interprets sentences with clauses at the beginning or end by paraphrasing them").

In some settings, the instruction you develop will concern behavior associated with attitudes and values. For example, you may wish to teach radiology technicians to maintain a professional relationship with their patients. It will be your job to define these behaviors, which you can do in observable terms by getting good information during the task analysis about. What technicians do when they demonstrate a professional relationship with patients. Most likely, the analysis will reveal several ways technicians exhibit this relationship and you will write several corresponding statements to make the behavior explicit so that it can be taught.

Types of Information Contained in Task Statements The object of the task analysis is to document in behavioral terms what the competent performer does in response to the various conditions of performance. Documentation includes describing as objectively as possible all inputs to the performer, actions take by a simplified diagram of task statement broken down into three components: inputs, actions, and output Constructing inputs, actions, and outputs charts is an effective tool that the designer can use to make the task to be analyzed explicit. It is an especially effective tool when analyzing tasks in an unfamiliar area. Inputs can be classified into fours: (a) cues that prompt performance, (b) resources during performance, (C) organizational inputs affecting performance, and (d) environmental conditions affecting performance. starts the performance of a task (e.g., a supervisor's or teacher's directions, completion of other tasks, other verbal, visual, or auditory signal). Resources a performance aids or references, such as dictionaries, calculators, computers, meters, look-up charts, or tables used to guide performance. Resources also include the equipment or tools used to perform a task. Organizational inputs are the polices and_ practices, standard operating procedures, chains of command, and management directives put in place by an organization that directly affect task performance. Organizational inputs may facilitate or impose constraints on performance. Environmental conditions are physica1 and pychologica1 factors include weather, lighting, time of day, temperature, noise levels, etc., when these conditions are relevant to performance of the task. Psychological conditions that may affect performance include fatigue, stress, and anxiety.

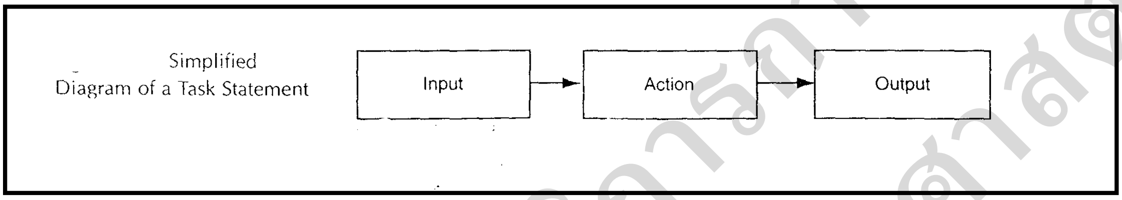


Figure 4: Simplified diagram of a task statement

Actions are what the performer does. They include the overt actions that we can plainly see or hear and the covert actions that take place internally. Action statements describe how the job or function is done and in what sequence subtasks are performed. Puts are produced as a result of an action. Outputs may take many forms and include products as diverse as a written report, a painted surface, a speech, a typed letter, a completed project, or a correctly spelled word. Two characteristics of outputs are the following:

1. Indications or cues to the performer that mark the end of the tasks. (How do you know when you are done?) In some instances, task completion is self-evident. But for many tasks, what constitutes a satisfactory outcome must be learned. For example, a cook must learn when a sauce is at the right consistency, a woodworker must know when a wood finish is correct, and an instructional designer must be able to determine when one step is adequate before moving on to the next step in the design process.

2. Standards of acceptability. (How well must the task be performed?) The answer to this question will influence the standards of the instructional objectives. Sometimes standards of acceptance may be easy to set (e.g., a typist's words-per-minute rate), but sometimes they are

difficult to define (e.g., aesthetic criteria for a work of art). Often you will find that standards for a job or tasks do not exist and that poor performance may have resulted from the performers' not knowing what was expected of them. If this is the case, instruction may not be the best solution to the performance deficiency. The establishment of a clear standard may solve the performance problem. If after you have investigated the problem instruction remains the solution, you will have to arrive at a standard acceptable to the people involved.

An output is usually the input for the next step in a task, as shown in the example in Figure 4 Tasks in the task inventory will almost always be too broadly written to adequately describe performance. You will have to break the task down into subtasks and subtask.

Repair Task When a blue light flashes, the repair person replaces the XYZ component. When a red light flashes, the repair person turns off the equipment, calls the supervisor to report the problem, and requests a senior repair person to handle the job components.

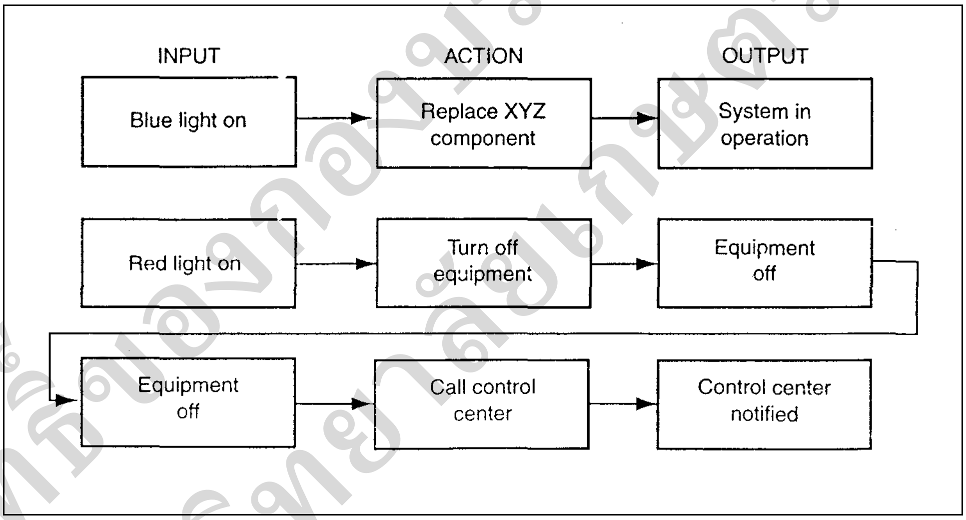


Figure 4 Diagram of a An instructional designer observes the following on a job study for maintenance tasks.

The breakdown should continue until the task is adequately described at a level appropriate for the target audience.

Task analysis also involves identifying the underlying knowledge base associated with each sub task. There are two types of knowledge bases: (a) knowledge that is associated with a specific task, and (b) general job or content knowledge that applies to a number of tasks. Task knowledge is concerned with act about the task such as why and when to do it (e.g., “the sound made by a malfunctioning component is associated with the specific repair task”); nomenclature (e.g., “uses correct names of tools” ; categories (e.g., “mammals are classified as either herbivores or carnivores”); and rules that guide performance of the task (e.g., “if/then”). Job or content knowledge is concerned with the “jar-gon” of the job or field and with general rules and principles.

Example of a task analysis Table 4 presents the results of part of a task analysis for a photography course for amateurs. Table 5 presents the inputs, actions, and outputs for the sub-subtask “select lens.” Due to space limitations, the complete analysis for each subtask component is not shown.

Table 4 Analysis for the Task, "Take a picture with a manual 35mm single-lens-reflex camera

Subtasks and Sub-subtasks	*Task Knowledge*
Subtask 1. Prepare camera	
a. Select film with appropriate speed	Rule: For bright lighting conditions, use low-speed film; for low lighting conditions use high-speed film.
b. Select lens	Terms: Focal length, depth of field Fact: Subject magnification is dependent upon focal length. A short focal length shrinks the image, a long focal length enlarges the image. Classes of lens: Wide-angle lens (20mm to 35mm), Standard lens (50mm), telephoto lens (70mm or higher). Rules: The shorter the focal length, the wider the angle view; the longer the focal length, the narrower the angle view. The shorter the focal length, the greater the depth of field.
c. Check battery	
d. Detach and attach lens	
e. Load film	
f. Connect flash	Rules: Use for indoor shots. Use flash for outdoor shots with low lights. Use flash when you want to capture detail of subject in front of another light source (e.g., person in front of outdoor light from a window)

Subtasks and Sub-subtasks	*Task Knowledge*
g. Mount on tripod	Term: Camera shake Rules: Use when a subject is very dark and shutter speed is slower than 1/30. Use for B (Bulb) shutter speed setting.
Subtask 2. Set exposure adjustments	
a. Set shutter speed	Fact: The higher the number, the faster the shutter speed. Rule: Increase the shutter speed as the speed of the moving subject increases.
b. Set lens opening	Terms: f-stop, aperture Facts: The lower the number, the wider the lens opening. Depth of field becomes progressively greater as the lens opening becomes smaller.
Subtask 3. Shoot picture	
a. Compose picture through viewfinder	
b. Focus lens	Fact: The distance at which the lens is focused affects depth of field. It increases as you get further away from the subject.
c. Shoot picture	
d. Advance film for next picture	
Subtask 4. Rewind and unload film	
a. Recognize indicators that all shots are used	Fact: All shots are used when film does not advance or exposure indicator displays number corresponding to film capacity.
b. Rewind and remove film	

General knowledge for task:

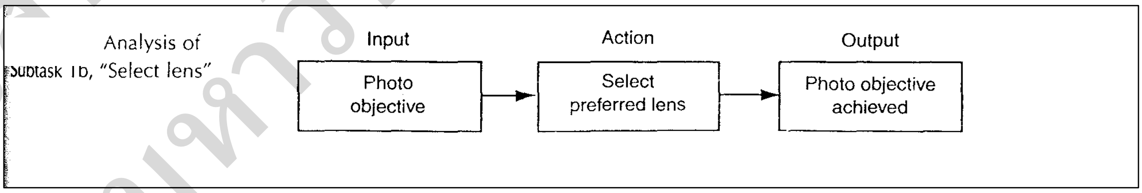
Names and locations of camera parts.

Dynamic relationship among film speed, shutter speed, lens opening, and focus adjustment.

Table 5 Task Analysis for Subtask 1b, "Select lens"

Input: Photo Objective		*Action: Select lens*		*Output: Objective achieved*
Architecture or a panoramic scene	→	Select 24mm	→	Photo with correct angle for photo objective
Large groups, interiors, or scenery	→	Select 28mm	→	Photo with correct angle for photo objective
Natural viewing—perspective of the human eye in close quarters	→	Select 35mm	→	Photo with correct angle for photo objective
Natural viewing—perspective of the human eye	→	Select 50mm	→	Photo with correct angle for photo objective
Portrait in available light	→	Select 85mm	→	Photo with correct angle for photo objective
Distant subject, such as a cathedral, little background desired	→	Select 120mm	→	Photo with correct angle for photo objective
Portion of distant subject, such as the roof of cathedral	→	Select 135mm or 150mm, depending on level of detail.	→	Photo with correct angle for photo objective
Detail of a distant subject, such as a gargoyle on a cathedral	→	Select 200mm or higher, depending on desired level of detail.	→	Photo with correct angle for photo objective

Figure 5 displays the general conditions and actions for subtask 1b, "Select lens." Table 5 sets forth the specific inputs, actions, and outputs to be taught in the course. The table clearly defines the range of possible photo objectives and the proper lens for each objective in order to produce a photo with an acceptable angle.



Writing Objectives

Learning is a relatively permanent change in attitude, behavior, or cognitive schema due to experience. The goal of the instructional designer is to plan the experiences that will change current behavior or cognition to some new, as yet unlearned behavior or mental processing. The designer begins by identifying the nature of the learning. Human capabilities can be divided into three domains: cognitive, psychomotor, and affective. The *cognitive domain* deals with mental tasks, such as remembering facts and the intellectual skills involved in thinking; the *psychomotor domain* deals with physical actions, such as manipulative skills and gross motor skills ; and the *affective domain* deals with feelings and emotions , such as attitudes, interests, and values. Consider the job of the coach of a Little League baseball team. To prepare the team to play baseball, the coach must have the team develop capabilities in all three domains. Hitting the ball, running, and catching are the psychomotor skills the players will need to develop. Knowing the rules of the game and making judgments about when to attempt to steal a base are two of the cognitive skills of baseball. The coach will also have to motivate the players to put forth the effort necessary for winning. Not all learning if product of instruction. In fact, most learning occurs without the benefit of any deliberate instruction. We learn how to behave socially from our parents, then later from sources such television and our peers. Emotional learning, which includes our attitudes, values, and beliefs, comes from the same sources. Experience from very day life is constantly shaping and molding our behavior in unpredictable ways. These changes are also defined as learning.

Instructional design brings with a defined learning goal that represents a domain of learning (or more than one domain). It concludes with a plan to reach that goal. This plan specifies the instructional events and materials that will provide the conditions for learning. "Instruction" is planned by instructional designers, teachers, students, or other mediators. While instruction is intended to provide the conditions for learning, it never provides learning. "Learning" is done by students; it is an internal phenomenon. Instruction, however, is an external phenomenon. Thus, what a designer can do is limited to the choice and arrangement of external conditions that will help the internal process of learning to occur. Out of theory and research, a substantial body of knowledge has evolved about how to establish conditions that will enhance the likely hood that learning will occur.

An underlying premise of ISD is that the behavior to be leaped must be made explicit in order to design instruction that will achieve objective, and to know when these objective have been achieved. Figure 3.1 expands the decision-making model by elaborating on questions that must be answered during the step of writing objectives.

The purpose of an instructional objective is to make clear what evidence of learning required or how le in will be measured. Describing learning outcomes in observable and measurable terms. Whenever possible, tasks are consolidated before objectives are written. Then, a format is chosen, and tasks are written to match the task analysis. At some point during the process of writing objectives, the design must distinguish between enabling objectives (EOs) and terminal performance objective (TPOs). Finally, the objectives written are critically reviewed by the group, using criteria for judging the adequacy of objectives written for a design product or learning process.

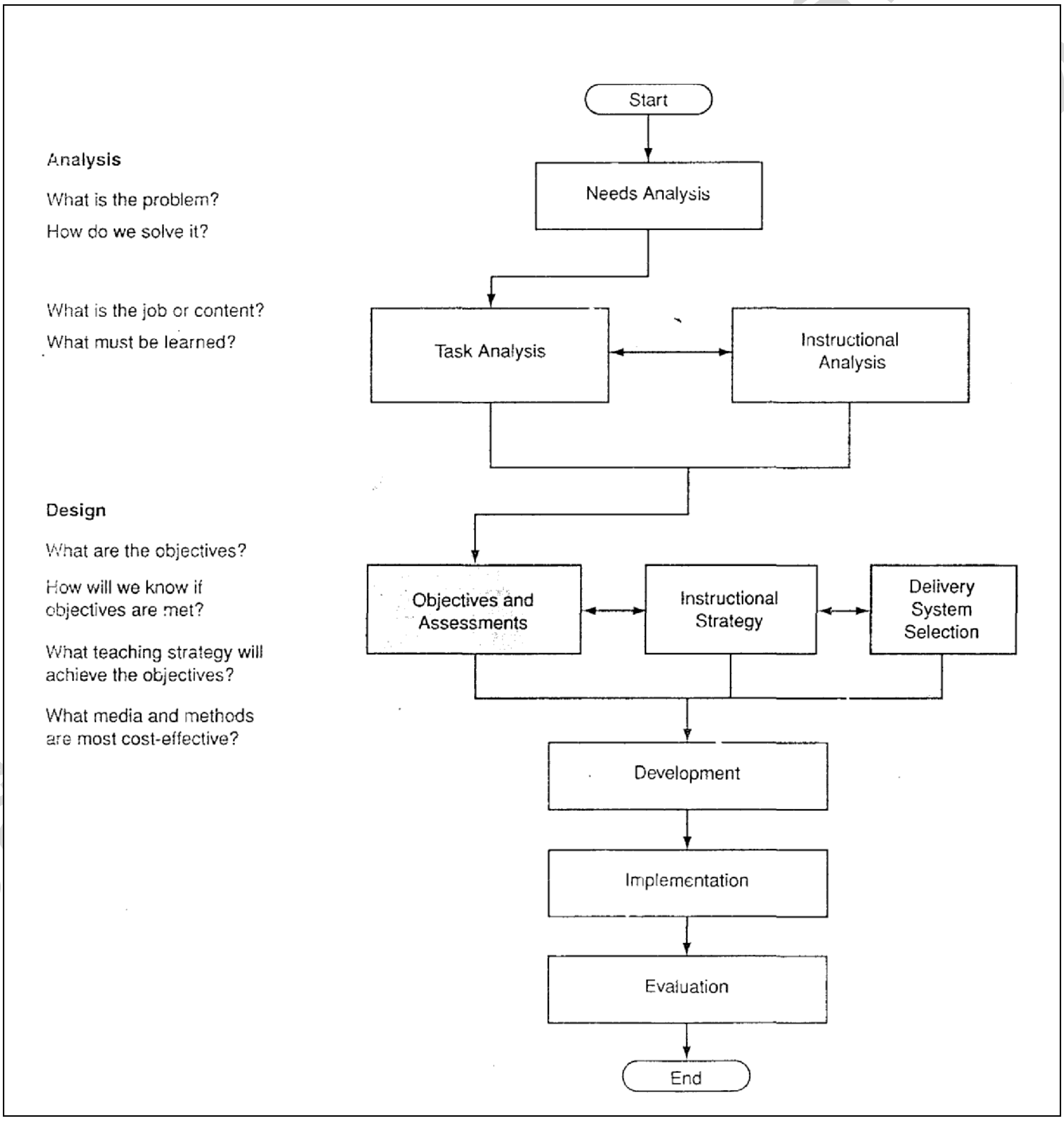


Figure 6: Expansion of the design phase of the ISD process

Instructional objectives We all have been students. Think back to those courses in which you misunderstood what the instructor wanted. The instructor lectured on one thing and tested on another. Or remember the course you registered for based on the course description. Partway through it, you realized that it was headed in a direction different from where you had intended to go. The course description had not clearly described the course's goal or purpose. These and similar problems you encountered as a student are the very ones that as instructional designers you should strive to avoid. In order to design instruction, you need to define learning outcomes precisely. Kemp, Morrison, and Ross (1994) state that objectives perform three important functions: (a) they guide the instructional design process; (b) they provide a framework for evaluation; and (c) they guide the learner.

In education and training, the term "objective" connotes something external, extrinsic, and explicit When you write objectives for instruction you are putting your internal ideas or goals into external form so that you can share them with others. You are going to visualize the purposes of instruction by writing them so precisely that all who use them perceive the same meaning. By writing goals specifically, you will later be able to determine whether the learner reached them. To develop an instructional design plan, start by turning your task statements into objectives. To do this, identify the domain of learning that you need that you will use for writing objectives. You start by identifying domains of learning because (a) there are many resources to guide a designer in developing objectives for different domains, and (b) adjustments may need to be made depending on the domain. For example, psychomotor and affective objectives are often paired with cognitive objectives. and the condition statement may need to be personalized in an affective objective. After you write objectives, the instructional systems process requires that instruction be developed, media selected, implementation planned, and evaluation data collected.

Identifying domains While we can distinguish three domains of learning theoretically, in practice the relationship among them is not clear. How much difference is there between what we know and what we feel about a subject? What is the cognitive component of a psychomotor task? Actually, all learning involves the three domain to varying degrees. Attitudes consist of a cognitive component and an affective one. The *cognitive component* an attitude refers to the perceptions and information one has about the attitude object. The affective *component* refers to ones feelings of liking or disliking the attitude object. Similarly many psychomotor outcomes have a large cognitive component. When performance is highly proficient, the domains become so integrated that they are no longer distinguishable. Thus, when we classify a learning outcome as being in one of the three domains, we do so on the basis of its primary focus and intent.

Educators have developed classification schemes for defining the types of ‘earning within each domain. These schemes, called taxonomies, are organized from the simplest to the most complex type of learning. This hierarchical organization means that the lower level skills must be learned before one can acquire the higher level skills. While taxonomies share certain general characteristics, it is difficult to make comparisons between any two of them. No two learning theorists break learning down into the same number of categories or the same types of learning. Despite these difficulties, taxonomy (a) assist the designer in determining the type of learning which is to be the object of instruction, (b) are useful for sequencing learning when the learning outcomes are known, and (c) reduce the work associated with planning the conditions of learning by grouping learning outcomes into similar types of capabilities.

Cognitive Domain A number of educators have developed taxonomies for the cognitive domain (Bloom, Englehart, Furst, and Krathwohl, 1956; Gagnd, 1977; Gerlach & Ely, 1980; Merrill, 1983), Jonassen and Hannum (1995) compare taxonomies of learning in a chart. The simplest level is usually some type of associative learning, such as naming, and the highest levels are complex intellectual tasks, such as might be performed by a debater in preparing to argue a position or an instructional designer attempting to solve a learning problem Bloom’s taxonomy for the cognitive domain is one of the best known and is summarized in Table 6.

Table 6 Taxonomy of the Cognitive Domain KCAASE

Type of Learning	*Definitions and Examples of Behavior*
6. Evaluation	Making judgments about the value of ideas, works, solutions, methods, materials, etc. Judgments may be either quantitative or qualitative. critical Examples: To argue, to decide, to compare, to consider, to contrast.
5. Synthesis	Putting together elements and parts to form a new whole. Examples: To write, to produce, to plan, to design, to derive, to combine.
4. Analysis	Breaking down material or ideas into their constituent parts and detecting the relationship of the parts and the way they are arranged. Examples: To distinguish, to detect, to employ, to restructure, to classify.
3. Application	Knowing an abstraction well enough to apply it without being prompted or without having been shown how to use it. Examples: To generalize, to develop, to employ, to transfer.
2. Comprehension	Understanding the literal message contained in a communication. Examples: To transform, to paraphrase, to interpret, to reorder, to infer, to conclude.
1. Knowledge	Remembering an idea, material, or phenomenon in a form very close to that in which it was originally encountered. Examples: To recall, to recognize, to acquire, to identify.

Adapted from *Taxonomy of Educational Objectives: Handbook I: Cognitive Domain* (pp. 201–207), by B. S. Bloom (Ed.), M. D. Englehart, E. J. Furst, and D. R. Krathwohl, 1956, New York: David McKay Co.

Table 6: Taxonomy of the cognitive domain

The cognitive taxonomy was published in 1956, and its purpose was to develop a classification system to describe behavior and therefore enable educators to communicate about test items, educational goals, and testing procedures. The behaviors are divided into six categories with corresponding subcategories. The categories art arranged hierarchically from simple to complex, the simplest being recollection of specific bits of information, and the most complex being judgments about the value of some object, idea, or process.

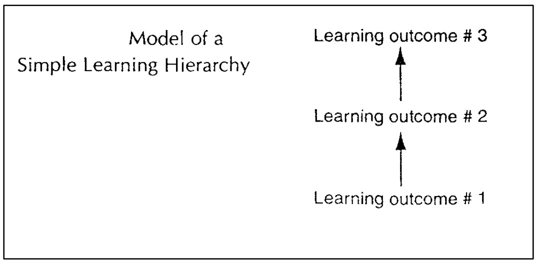


Figure 7: Model of a simple learning hierarchy

Martin and Briggs (1986) summarize the studies to validate the psychological assumptions and hierarchical relationship of the taxonomy. Results of studies are mixed and inconclusive. There is fairly strong support for the hierarchical structure of the lower levels of the taxonomy, but less for the upper three levels. Criticisms of the taxonomy reported by Martin and Briggs are that (a) the categories are not mutually_exclusive; (b) there are problems of consistently classifying behavior due to the vagueness of the descriptors; (c) although useful for formulating learning outcomes, structuring learning sequences, and assessment procedures, it is of little value for curriculum_development; and (d) the taxonomy is weighted toward knowledge rather than the higher mental pro. Postlewaite (1994) goes even further in criticizing the taxonomy. He claims that (a) distinctions between any two levels may be blurred; (b) it is more a set of categories than a hierarchy; and (c) the lockstep sequence based on complexity or difficulty which underlies the taxonomy is naive. Nevertheless, he believes that the cognitive taxonomy spurred educators to emphasize higher order objectives rather than the learning facts, as was done in the 1960s and 1970s. Therefore, it allowed both curriculum and evaluation to expand their use of objectives beyond simple knowledge.

Table 7: Taxonomy of the affective domain

Table 7 Taxonomy of the Affective Domain

Type of Learning	*Definitions and Examples of Behavior*
5. Characterization by Value or Value Set	Acts consistently in accordance with the values he or she has internalized. Examples: To revise, to require, to be rated high in the value, to avoid, to resist, to manage, to resolve.
4. Organization	Relates the value to those already held and brings it into a harmonious and internally consistent philosophy. Examples: To discuss, to theorize, to formulate, to balance, to examine.
3. Valuing	Willing to be perceived by others as valuing certain ideas, materials, or phenomena. Examples: To increase measured proficiency in, to relinquish, to subsidize, to support, to debate.
2. Responding	Committed in some small measure to the ideas, materials, or phenomena involved by actively responding to them. Examples: To comply with, to follow, to commend, to volunteer, to spend leisure time in, to acclaim.
1. Receiving	Being aware of or sensitive to the existence of certain ideas, material, or phenomena and being willing to tolerate them. Examples: To differentiate, to accept, to listen (for), to respond to.

Adapted from *Taxonomy of Educational Objectives: Handbook II: Affective Domain* (pp. 176–185), by D. R. Krathwohl, B. S. Bloom, and B. B. Masia, 1964, New York: David McKay Co.

Affective Domain The best known of the affective taxonomies was developed by Krathwohl, Bloom, and Masia (1964). It is summarized in Table 3.2. Affective lye capabilities are difficult to translate into behavior that reveals the learned capability Since attitudes, interests, and values are not easily defined in behavioral terms, it is difficult to know when an attitude or interest is acquired. On top of this, it takes a longtime, perhaps years, to achieve this type of learning. Martin and Briggs (1986) distinguish between long-term and short-term objective for attitude learning. They note that an objective such as willingness to receive information on a fairly non-controversial, limited topic (e.g., soccer as a hobby or as an elective physical educational activity) may be quickly established. On the other hand, taking a studied position on a complex, highly controversial topic, such as abortion, may require a long period of information learning, debate, soul-searching, and position-taking. Krathwohl et al, (1964) note that instructional objectives are rarely set at the highest level of the taxonomy.

The taxonomy is ordered according to the principle of *internalization.* Internalization refers to the process whereby a person's affect toward an object passes from a general awareness level to a point where the affect is internalized and consistently guides or controls the person's behavior. Validation studies reported by Martin and Briggs (1986) indicate that the categories seem to be correctly ordered. But, as with the cognitive taxonomy, the support is stronger for the lower categories of receiving, responding, and valuing, with tenuous support for the higher categories. Criticisms of the taxonomy cited by Martin and Briggs are that it is too general and abstract, overly dependent on cognition, and limited in scope because it fails to include the affective constructs of self-development (self-concept, self-esteem) and motivation.

Psychomotor Domain The psychomotor domain is organized on the basis of the degree f coordination required. The lowest level is simple reflexes and the highest levels are tasks requiring complex neuromuscular coordination. The best known taxonomy is Harrow's (1972). She classifies six types of capabilities and corresponding subcategories in the psychomotor domain. The classification scheme includes involuntary responses as well as learned capabilities. The categories and examples of corresponding behaviors are presented in Table 8 Reflex movements in category 1 are not learned capabilities; they are functional at birth. Harrow (1972) includes them because they are prerequisites for the development of higher-order movement patterns learned during the first year of life. Obviously, instruction is not developed for reflexes. While the movements included in category 2, basic fundamental movements, are learned capabilities, they unfold as the child matures, rather than being taught. Instructional designers do not usually develop instruction at this level either, unless a child is having problems in this area. Categories 3 and 4, perceptual abilities and physical abilities, are developed through maturation and learning. Structured learning programs facilitate the acquisition of these abilities. Category 5, skilled movements, builds upon the student's perceptual abilities and stage of physical development. Skilled movements, in turn, are the prerequisites for the aesthetic movements patterns in category 6, no discursive communication. A proficiency continuum exists in both categories 5 and 6; that is, there are degrees of excellence that a learner may attain.

Table 3.3 Taxonomy of the Psychomotor Domain

Type of Learning	***Definitions and Examples***
6. Nondiscursive communication	Communication through bodily movements ranging from facial expressions through sophisticated choreographics. Examples: Body postures, gestures, and facial expressions efficiently executed in skilled dance movement and choreographics.
5. Skilled movements	The result of the acquisition of a degree of efficiency when performing a complex task. Examples: All skilled activities obvious in sports, recreation, and dance.
4. Physical activities	Endurance, strength, vigor, and agility, which produce a sound, efficiently functioning body. Examples: All activities that require (a) strenuous effort for long periods of time; (b) muscular exertion; (c) a quick, wide range of motion at the hip joints; and (d) quick, precise movements.
3. Perceptual	Interpretation of various stimuli that enable one to make adjustments to the environment. Visual, auditory, kinesthetic, or tactile discrimination. Suggests cognitive as well as psychomotor behavior. Examples: Coordinated movements such as jumping rope, punting, catching.
2. Basic fundamental ent Table 8	Inherent movement patterns that are formed by combining of reflex movements and are the basis for complex skilled movements. Examples: Walking, running, pushing, twisting, gripping, grasping, manipulating.
1. Reflex movements	Actions elicited without learning in response to some stimuli. Examples: Flexion, extension, stretch, postural adjustments.

Adapted from *A Taxonomy of the Psychomotor Domain* (pp. 100–150), by A. J. Harrow, 1972, New York: David McKay Co.

Table 8: Taxonomy of the psychomotor domain

TPOs and EOs All objectives are derived from goals. After you derive an objective, you can break it down into sub-objectives. Thus, objectives at each stage become goals from which a more specific level of objective is derived. A *terminal performance objective (TPO)* is a final performance goal stated in behavioral format; it represents the most complex behavior to be demonstrated. *Enabling objectives (EOs)* are sub-objectives; they are the prerequisite learning stated in behavioral format. This is a TPOs:

Given an extemporaneous topic, speak for five minutes on that topic following the principles of rhetoric summarized in a ten-point checklist. You must score an average of eight or more on the checklist of three trained observers. Either or both of these could be an EO:

1. Given a topic for a ten-minute speech, orally outline what you would say about the topic including introduction, major points, and conclusion.

2. Given a rule of extemporaneous speech, orally provide one illustration of following that rule in a speech.

In both cases the implied criterion is mastery; the learner either performs the task completely and correctly or he doesn't. The designer must be careful not to describe instructional activities as enabling objectives. Instruction can occur through a variety of activities, but usually methods of assess are specific to an objective. If you ask the question, "Does this objective describe some that could be done in other ways?" and the answer is yes; then the objective may describe activity, not an enabling objective. This principle is illustrated by comparing these objectives.

1. Given a videotaped presentation, the student will discuss the causes of the Civil shown in the tape.

2. Given an essay question, the student will explain the causes of the Civil War. The must cover the points raised in the videotape "Roots of the Conflict" and meet the criteria given in the Peters Middle School Writing Manual.

Sometimes there is also more than one way to determine the achievement of an enabling objective. When this happens the question "Could this be done in other ways?" confi more than illuminates. In this case, the designer can ask, "Is this something that needs be assessed, or is it part of the instruction that enables to student to master the objective.

When the relationship of a TPO and EQs is diagrammed, the TPO is shown at the top of a hierarchy and the EOs form levels beneath. An example of such a relationship is show in Figure 7. Both TPOs and EQs should be written in behavioral objectives format. If EQs are not written as measurable observable behaviors, the designer may be unable to determine whether all the objectives were achieved through instruction and whether all of the objectives were necessary for instruction. If the TPO is not achieved, measuring EQs makes it clearer where instruction fell short.

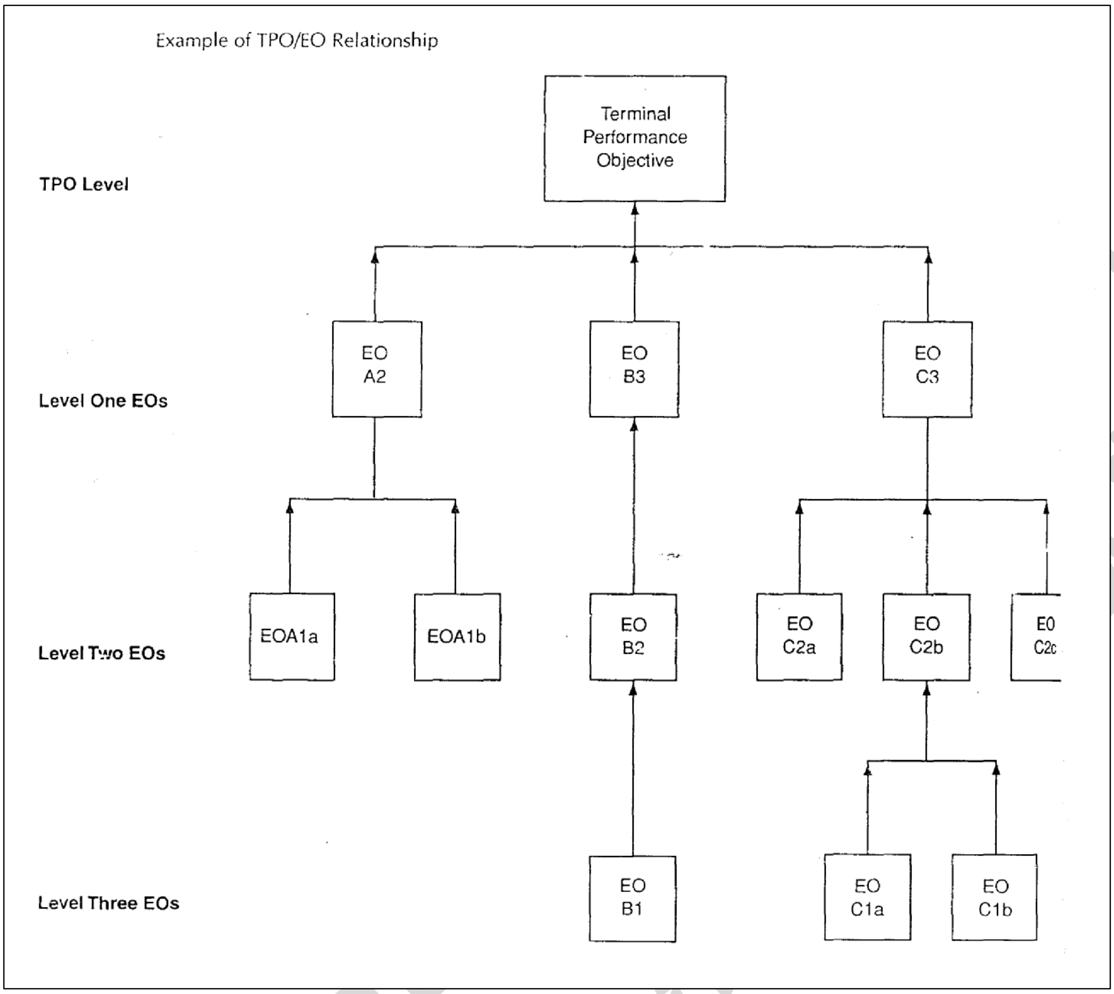


Figure 8: Example of TPO/EO relationship

Level of Objectives Objectives are described by their function. Thus, there are levels of objectives. The most which describe competency goals for a curriculum area or a program, such as a writing program. Course objectives, on the other hand, describe more specifically. They describe planned outcomes of courses in terms of major objectives. Unit objectives are even more specific and describe sub-objectives that must be achieved in order for course objectives to be achieved. Next, there are lesson objectives which are sub-objectives for parts of units. All these objectives should relate to the goals identified for instruction (Yelon, 1991). As you move from task analysis to objectives, you may find some tasks represent one level of objectives, and some tasks another level. Keep tasks at different levels of objectives separate. In other words, associate tasks with the level of objective they represent. Here is an example of a design plan calling for different levels of objectives:

Curriculum Objective. Be able to write cohesive, grammatically correct paragraphs.

Course Objective. Be able to write paragraphs which have **a** topic, beginning, middle**,** and end.

Unit Objective. Be able to use words of transition in paragraphs.

Lesson Objective. Be able to edit paragraphs so that they make sense. There are TPOs and EOs within each level and for across all levels. In the latter case, lesson and unit objectives become EOs, and course objectives become TPOs.

Criteria for Objectives Thiagarajan (1973) identified several criteria for determining whether objectives as a group are written correctly:

- Objectives should be related in several ways.
- The objectives should be complete in that each subtask necessary to the final goal should be listed.
- Only objectives that are necessary to achieving the final goal should be listed.
- Objectives that are stated differently but that are basically redundant should be eliminated.
- Trivial objectives such as those that identify pre-entry skills, especially very basic ones, should not be included.
- The language used should be clear, fluent, and unambiguous.
- The major components of a behavioral objective should be included: condition, behavior, and criterion (even if it is a personalized criterion).

The criteria suggested include relevance, completeness, clarity of language, necessity, and avoidance of unnecessary triviality, fragmentation, or redundancy.

The use of behavioral or performance objectives can result in problems such as proliferation and fragmentation of objectives, overemphasis on lower-level tasks, and inattention to affective goals. The instructional systems design approach can prevent these problems by (a) examination of the design based on these criteria, (b) examination of the design based on logical consistency and clarity, (C) emphasis on interrelationship of objectives with other parts of instruction, and (d) use of formative evaluation to determine effectiveness of instruction.

Current concerns about the use of behavioral objectives focus on the limitations on construction of knowledge imposed by predetermining goals for students and on the resulting emphasis on teaching or delivery, as opposed to learning in the sense of student exploration. Some educators take the position that these problems cannot be resolved when an ISD approach is used; others believe alternate versions of the ISD paradigm which will solve these problems are evolving.

Assessing learning

Each of us assesses many times during a day. We assess our likelihood of finishing a task, the competency of a colleague, and our own productivity. When we assess, we estimate or judge the value of a person, activity, or situation. When we approach assessment from this point of view, it becomes easier to understand that assessing learning is not equivalent to grading. While one function of assessment can be to provide a basis for grading, that is not its primary function. Methods of assessment can serve multiple functions. The most obvious of these functions are measuring, diagnosing, or instructing. Assessment that serves a pedagogical function enhances learning by creating awareness, cuing attention, or providing practice. In ISD, assessment serves all these primary functions: measuring, diagnosing, and instructing. The information gained may then be used for secondary functions, one of which is evaluating ISD; another might be grading.

Research documents that tests are learning events. Ideally, learners clearly understand when a test is being used for diagnosis or instruction, when it is being used for grading, and when it is being used for more than one of these purposes. The reason for this is that learners can be inhibited from making errors when they think they are being graded. Since making errors can be an important part of learning, they will be deprived of this opportunity (Druckman & Bjork, 1994). Portfolios, for example, differ depending on the purposes for which they are intended. "A portfolio system that promotes self-assessment and self-confidence in students as readers and writers, for example, will look very different from a portfolio that provides a valid and reliable basis for a statewide evaluation of student performance in literacy”

Approaches to assessment differ depending on what is being assessed. Cognitive learning is often assessed with paper and pencil tests. Performance, or demonstrations of the ability to apply learning, are assessed through observation or examination of products often through checklists. Attitudes can be determined through inventories or self-reporting instruments. However, sometimes attitudes are determined through observation that yields indicators of valuing. Psychomotor objectives can be assessed through all three approaches. Paper and pencil tests can be used to determine knowledge of the cognitive component of a psychomotor skill. Attitude inventories can determine feelings towards regular performance of the skill. Performance measures can be used to collect data on ability to execute the skill.

Basic principles of measurement In order to develop assessment plans that include testing instruments, you-need to understand the concepts of criterion-referenced testing, reliability; and validity. Instruction is designed to bring about learning, and tests or other means of assessment are used to determine whether learning occurred. Tests that measure what a person has learned to do are called *achievement tests.* There are two types of achievement tests: criterion-referenced tests (CRTs) and norm-referenced tests (NRTs). The same concepts can refer to methods of assessment in general, not just tests

CRTs Criterion-referenced assessment uses the term “criterion” to refer to the relationship between the objective and method of assessment and to the level of performance. To determine whether a test item is criterion-referenced, determine whether the performance required is congruent with the behavioral objective and whether the level of proficiency required is specified. CRTs are sometimes called content-referenced or objective-referenced tests. A test is criterion-referenced when its score can be translated into a statement about what a person has learned relative to a standard; a CRT score provides information about a person’s mastery to the objective and reflects that person’s mast of. A person who passes a state’s automobile driving test can be said to have the competencies set as a standard for driving in that state. Success on a CRT means being able to perform specific competencies. Usually, a cut-off score is established, and everyone reaching or ding the score passes the test. There is no limit to the number of test takers who can pass a CRT.

NRTs On an NRT the score tells where the person stands relative to other persons who have taken the test. The Scholastic Aptitude Test (SAT) is an NRT; its score tells where a person to other potential college entrants.

Success on an NRT is defined as being ahead of most of the other test takers. NRTs are designed to "reliably" select the best performers. NRTs seldom provide specific information about mastery of a specific skill, because they are designed to measure a person's relative standing in a group with respect to some broadly defined capabilities.

When assessment is used Assessment techniques can be used for pre-assessments, embedded items, and post assessments. Sometimes the same or similar items are used in each. The difference is on is given before instruction, one during, and one after.

Pre-assessments can serve multiple functions. They can diagnose which entry skills need remedial attention. They can provide a baseline that allows comparison with post-test scores, thus providing gain scores. Pre-assessments, such as pre-tests, can affect learning b cuing, providing practice, or creating awareness. In the ISD example in chapter 1 on "Commercial Loan Documentation," a written pre-test on basic concepts was given in order to establish the level of those entering. Even after that level was determined, the pre-test was continued because it had a self-awareness effect. Participants tended to enter believing they knew more than they did. The pre-test created self awareness that was motivational.

Care must be taken in the presentation of pre-assessments, because poor performance on them can demoralize employees and affect instruction. Pre-assessments, then, can measure entry level or mastery of the objectives that will be taught. They can provide the basis for recommending inadmissibility remedial instruction, or bypassing parts of the instruction.

Embedded Items are used throughout the instruction to determine whether enabling objectives have been achieved. It should be remembered that achievement on embedded criterion items does not necessarily mean that the learning will be retained or transferred. These embedded items can also serve a motivational function by creating self-awareness through feedback. They can ensure that learners do not progress to another objective until they have achieved a prerequisite objective.

Post-assessments If achievement of enabling objectives hasn't been reliably determined earlier, then post- assessments, such as post-tests, should cover both enabling and terminal objectives. If this is not done, learners may be successful on the terminal objectives, but the designer will not know if all the enabling objectives were necessary. Perhaps the learners would have been successful with less instruction. On the other hand, students might be unsuccessful because they had not achieved some enabling objectives, and the designer would not know which enabling objectives had been achieved.

Assessment techniques are not limited to one part of the assessment process. Portfolios can be used for both pre- and post-assessment, as can objective tests. Observations are appropriate before, during, and after instruction.

Matching assessment to objectives What information is collected as evidence of learning achievement will depend on the nature of the competency being measured.

Cognitive Tests For learning requiring acquisition of knowledge, the appropriateness of paper and pencil tests is self-evident. Verbal chains may be measured by recitation. Knowledge of facts and other types of information may he assessed by test questions that require the student to make mastery explicit. Intellectual skills are assessed by having a student solve problems, apply rules, or classify objects. Unobservable cognitive tasks are usually made visible by some form of a written test. There are six types of tests that apply to cognitive tasks: multiple-choice, true-false, fill-in, matching, short answer, and essay of these tests will be discussed in detail later in the section on constructing tests.

Performance Tests In contrast to tests that measure cognitive abilities, performance tests measure a student's ability to do something. For example, a student's ability to perform a motor task is evaluated by observing and judging 1J.s behavior. In the test, the student is directed to perform a task and his performance is evaluated against some predetermined standard. If the output is a process, performance is evaluated as it occurs. Tasks evaluated this way include actions performed by athletes. Performing artists, and equipment operators. Because performance tests directly measure capability, they are inherently valid than written tests. But because performance tests usually require judgment by examiner, they tend to be less reliable than most cognitive tests. There are several types 01 performance assessment, and they are easily remembered because they all start with the letter "p" (see Figure 4.1). They include process and products, and two forms of product—1 portfolios and projects. If you visualize a splayed hand with a "p" at the tip of each digit standing for "product," "process," "portfolios," and "projects," and on the thumb for "performance," you will find it easy to remember these forms of tests.

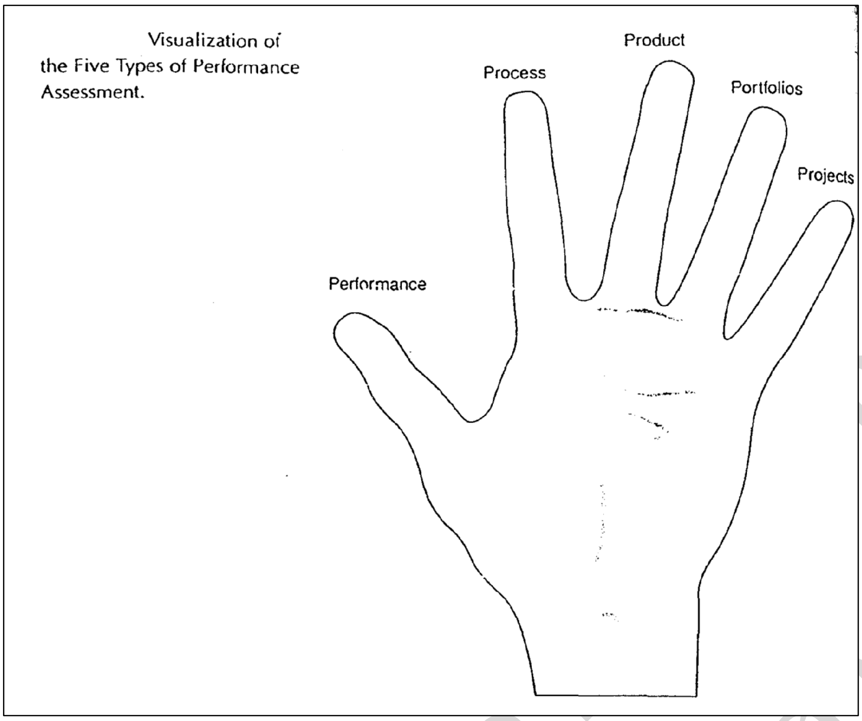


Figure 9: Visualization of the five types of performance assessment

Before each form is discussed, the concept of authentic assessment will be introduced because it is generating great interest currently in areas such as science a mathematics.

Authentic Assessment. The concept of authenticity in assessment means that employee performance is examined directly on “real” tasks. The opposite of authentic assessment a paper and pencil test from which learning must be inferred. Wiggins compares authentic assessment with more traditional means of assessment:

- Authentic assessment achieves validity and reliability by emphasizing and standardizing the appropriate *criteria* for scoring such (varied) products; traditional testing standardizes objective items and, hence, the (one) right answer for each.

- “Test validity” should depend in part upon whether the test simulates realwor1d tests of ability. Validity on most multiple-choice tests is determined merely by matching items to the curriculum content (or through sophisticated correlations with o test results).

- Authentic tasks involve “ill-structured” challenges and roles that help students rehearse for the complex ambiguities of the “game” of adult and professional life.

Traditional tests. are more like drills, assessing static and too-often arbitrarily discrete or simplistic elements of those activities.

The major problem with this type of assessment is that it is very labor intensive and therefore costly. Wiggins places the cost at $2 per employee, as compared with one cent per employee for a multiple choice test. He argues, however, that the increased gains more than offset the increased costs. Process, product, portfolio, and project assessments can be ways to assess authentically. Process. Objectives can be process objectives. This means that students are expected to learn ways of doing things, such as problem solving and discussing. Problem-based learning, uses process objectives. In other words, students are expected to learn procedures for problem solving. Johnson (1996a) discusses Socratic seminars in which students are judged on the extent to which they develop the ability to articulate issues and participate with others in conversation about these issues. To assess such outcomes, criteria are established and applied, sometimes through rubrics and sometimes through observation checklists.

A rubric is a table, list, or scale used for scoring performance on assigned tasks. It can be designed to allow comparison between levels of achievement or aspects of a task. Figure 4.2 is an example of rubrics used for participation in a seminar. Another form of process assessment is using checklists to determine whether the employee can execute a procedure or demonstrate applying a rule.

Products. The outcome of a procedure is a product which is evaluated against a standard. Products may take many forms. A sample of the student's handwriting may be compared to an ideal sample of correct penmanship, or an apprentice cabinetmaker's work may be evaluated against certain workmanship standards. A learner may demonstrate the ability to do double entry bookkeeping by recording debits and credits from paper records such as check stubs and invoices. The product can be in the form of written language, such as a report; or it can be in graphic form, such as a chart; or it can be in edible form, such as a cake; or it can be a dramatic performance or a speech. Criteria are established to facilitate feedback on the product. Products can take many other forms, such as athletic performance. Whatever the form, assessment of performance can require more time and resources than administering written tests when there are many learners to assess. One teacher can administer a written test to 30 students with no help. To give a performance test to 30 students, the teacher mat need help to fit all the assessments in the time available or to teach other students while one is observed.

Portfolios. One of the alternate assessment practices increasingly *used* is portfolios. They have the advantage of providing a basis for both process and product review. Portfolios are a product because they contain examples of work that can be examined. An example of an objective for a portfolio might be: Given 3 months and a research topic and resources, the student will be able to write a formal paper that demonstrates mastery of the topic, including original interpretations and thoughts. The paper will meet standards summarized in a rubric, and the portfolio will include evidence of growth and collaborative reflection on the experience and will meet standards set forth in a checklist.

The portfolio concept has been used before by models, artistic, and even instructional designers. Paulson and Paulson (1991) define a portfolio as follows: A purposeful, integrated collection of student work showing student effort, progress, or achievement in one or more areas. The collection is guided by performance standards and includes evidence of students' self-reflection and participation in setting the focus, selecting contents, and judging merit.

The key phrase in this definition is 'guided by performance standards." How does one set standards for portfolios, which are works in process and involve both process and product approaches to performance assessment?

One way is to set standards for parts as they evolve and to use these standards in addition to review of the portfolio as a whole and evidence of involvement and reflectivity Many problems arise from this approach: (a) personal standards must be integrated with criterion-referenced standards, (b) assignments must be relevant to the individual student, (c) time for evidence of growth and achievement must be provided on an individual basis, and (d) time for collaborative reflection is required (Seely, 1994). These problems require flexibility and emotional investment beyond the usual, but can yield rich assessment data and instruction, but as with any assessment practice, portfolios can also distract from instruction and yield superficial data. The latter sometimes happens when portfolios become a collection of products rather than a reflection on growth.

Portfolio generation is a process, not just a simple procedure. It requires many procedures, from decisions about what will be included, to when it will be reviewed periodically, and how reflection and feedback will occur. The questions that are generated for each stage and procedure are very important. Often rubrics are used. Rubrics present criteria in a graphic form that allows an evaluator to give feedback that stimulates reflection. Teachers and students should define standards and rubrics collaboratively. The teachers have to develop many forms, rubrics, lists of questions or considerations to be used during their process. They have to continually reflect on how well the process is working. Because the portfolio assessment process is subjective, there can be problems with reliability. Students can question the fairness of feedback unless the relationship of student and teacher criterion-referenced standards is negotiated and communicated clearly.

Task/Objective/Criterion Charts Each objective must be examined for a correct match between the means of evaluation and the type of learning or behavior. Criterion-referenced measures define achievement on the basis of a pre-established standard stated in an objective. Students either reach this standard or they don't. Criterion items are those on which the student must demonstrate mastery by performance. Table 9 shows a good way to check the validity of your objectives by matching the task on your instructional analysis with its objective and criterion item. If the chart indicates discrepancies across columns, then rewrite the objective.

Table 9 Type of Item Most Appropriate for a Learning Domain

KEY
Very Appropriate For
C Cognitive
P Psychomotor
A Affective

Type of Item	*Domain Most Associated with*	*Comments*
Objective		
True False	C	Efficient for items with only two logical responses
Completion	C	Natural for brief responses
Multiple-Choice	C	Use when answer is long—reduces effect of guessing, so can have fewer items
Matching	C	Efficient but not for higher level learning tasks
Essay		
Essay	C	Score systematically
Extended Report	C	Clarify required components
Activity		
Lab Reports	C	Type of learning used for depends on content and structure
Exercises	C, P	Separate use for testing from use for instruction
Projects	C, P, A	Good for multi-domain learning
Observation		
Checklists	P, A	Excellent for procedural knowledge and practice
Rating Scales	P, A	Self or observational, degrees of subjectivity
Anecdotes	A	Subjective
Interviews	A	Revealing, can have degree of objectivity
Application		
Problem Solving	C, A	For higher level of learning
Product	C, P, A	Especially for interactive domain learning

Selecting and Developing Delivery Systems

We are not going to deal with the step of instructional strategies. As we explained in the Preface, this textbook presents the essential steps for an ISD approach first. After these essential steps are learned, we elaborate by presenting additional steps. Thus, we take the position that the design step of the ISD process can be completed at a novice level by basing decisions about instruction on the learning situation and channels, and by taking learner characteristics into account. *Delivery systems* are ways to carry information from a source to a receiver or vice versa for the purposes of instruction. The term can be used to describe older technologies, such as traditional media, or newer technologies, such as distance education technologies, or a combination of both. Learner characteristics, objectives, resources, and constraints must be identified before delivery systems are selected. Selection and justification should be based on an ISD model developed for delivery system selection. Instructional designers may select from print technologies, audiovisual technologies, computer technologies, and integrated technologies. The instructional designer determines delivery system options, then identifies whether commercial materials can be adopted or adapted, and initiates the development phase.

With computer-based and emerging technologies, the designer's role varies greatly. For example, the designer might (a) stop after the analysis and design steps, (b) continue and develop prototype segments, or (c) become part of the development team and be involved in scripting and storyboarding. The client or the designer may select the delivery system, often in consultation with the developer. The designer may also be the developer, or he or she may work with a development team chosen by a project manager. Generally, however, the designer selects the delivery systems and then works with a development team. Because it is the designer's responsibility to monitor development to ensure that materials and instructional strategies reflect design decisions, you need to be familiar with the production process.

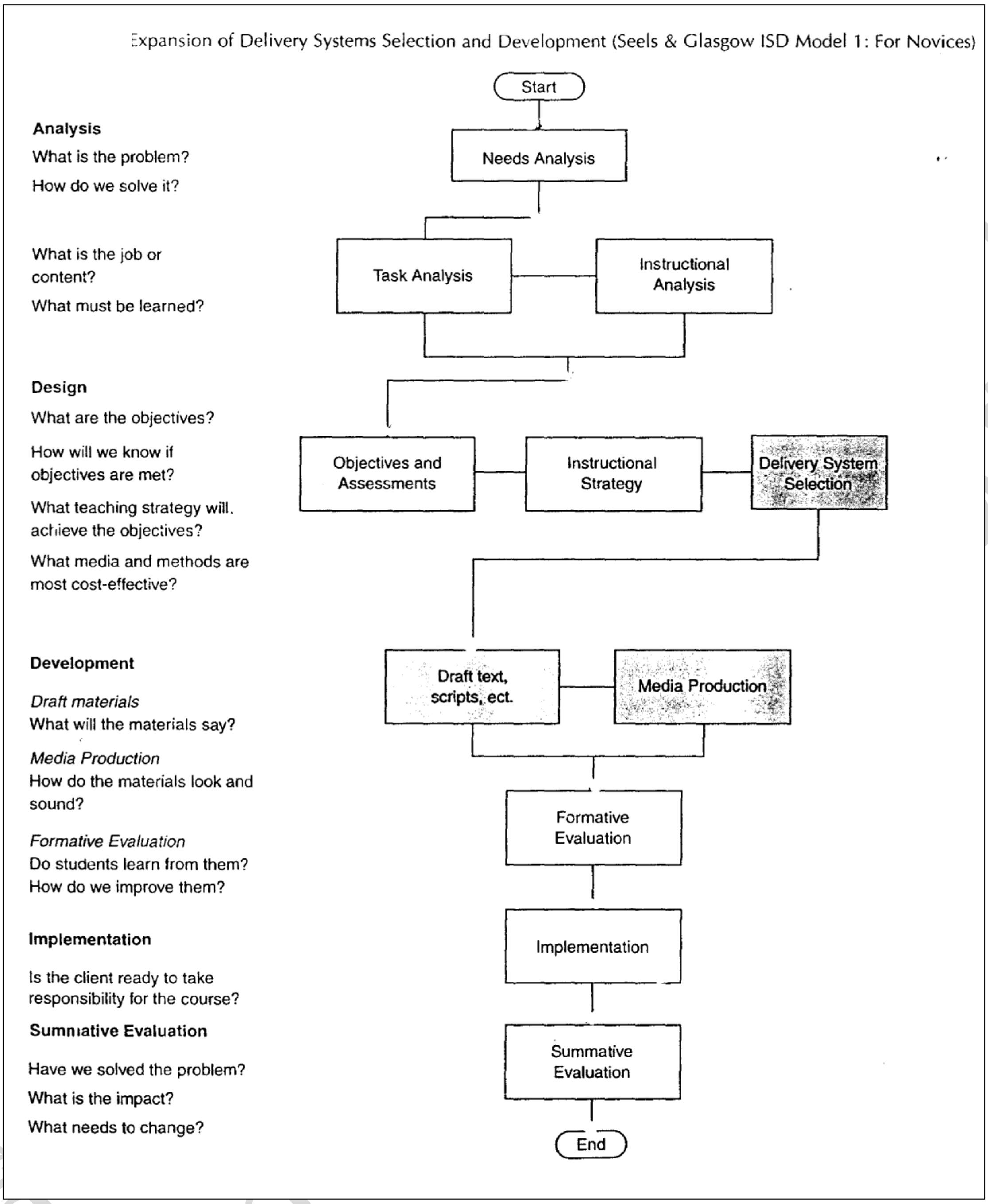


Figure 10: Expansion of delivery system selection and development

Delivery system options in the past the word "media" was adequate to describe delivery systems. Media are ways to carry information from a source to a receiver through a channel. With the advent of computerized systems and distance education, however, the word "media" was supplemented with phrases such as "technologies for instruction" and "delivery technology." Media were still used as vehicles for materials, but emerging technologies, such as the World Wide Web and interactive video, presented materials through support systems and had new capacities for interactivity The combination of media and support systems came to be called delivery systems. Moreover, today when media for instruction are described the term "technology" is often used instead.

A system consists of components that are integrated to work as a whole. Delivery systems are integrated components that facilitate communication by carrying information through channels. Delivery systems are defined as "ways to carry information from a source to a receiver, or vice versa, for the purposes of instruction." The term can be used to describe older technologies, such as traditional media, or newer technologies, such as distance education technologies, or a combination of both.

Delivery system options are grouped by technology areas in order to facilitate discussion and study of these options. The technology areas discussed in this chapter are the subcategories of the Development Domain proposed by Seels and Richey (1994): print, audiovisual, computer, and integrated technologies. These technology categories are given in historical order. Print technologies developed before audiovisual technologies, which developed before computer technologies, which in turn gave rise to integrated technologies. Of course, there were periods of overlap as one technology evolved into another form; for example, motion picture production procedures were used at the beginning of television production. Moreover, the old technologies did not disappear as new technologies evolved. They continued to be used and were often incorporated in new technologies. Thus, motion pictures change form and are incorporated in interactive multimedia.

Remember that each technology area includes production, storage, and delivery formats. Sometimes these are the same, but sometimes they differ in significant ways. For example, a dynamic visual presentation may be produced through motion picture film, stored on videotape, and delivered via broadcast television. On the other band, the presentation might be produced, stored, and delivered via videotape.

Years of practical experience and research are reported in books and articles about choosing and using these technologies. There is far too much information to be covered in this chapter. Instead, we will introduce you to the nature of these technologies and the best references to use to learn the advantages and disadvantages of technologies.

Print Technologies are ways to deliver materials, primarily through mechanical or photographic printing processes. Any medium or material produced through text, graphic, or photographic representation and reproduction falls in this area. These technologies generate materials in hard copy form. Text displayed by a computer is an example of computer- based technology However, when that text is printed in hard copy to be used in instruction, it is an example of delivery in a print technology form. The options in this category are verbal text materials, visual materials, and materials that combine both forms. Print technologies are usually static with one-way communication, but they have the advantage of allowing the user to reorganize, restructure, and control the pace of learning.

The advantages of print technologies are as follows:

- Advances in printing technology make reproducing large quantities of printed material easy and inexpensive.
- Desktop publishing makes high-quality presentations easy to create.
- Printed information is easily duplicated on office copiers.
- Printed information is easily transmitted via telephone lines by fax.
- The capacity for information is unlimited; it can range from one page to many volumes.
- Print materials do not require equipment for use and are eminently portable.

Audiovisual Technologies are ways to produce or deliver materials by using mechanical or electronic machines to present auditory and visual messages. Audiovisual machines make possible the projection of motion pictures, the playback of sounds, and the display of large visuals. Thus, audiovisual instruction is characterized by the use of hardware in the teaching/learning process. It does not depend exclusively on students' ability to comprehend words. Sounds and pictures also contribute to learning. Most audiovisual instruction uses a sophisticated combination of audio and visual cues and information. Options within this technology include films, videotapes, audiotapes, slides, transparencies, or any medium based on film or magnetic tape. When television production is combined with computer production, the medium moves to the integrated technologies category. Audiovisual technologies are often teacher centered and involve a lower degree of learner interactivity. The advantages of audiovisual technologies are as follows:

- They are usually easy to use and comprehend because they tend to be linear in nature.
- They can present dynamic (having motion) or static visuals or make static visuals dynamic.
- The designer can pre-determine the manner in which they are presented and used.
- They allow the designer to incorporate principles from both behaviorism and cognitive psychology.

Selecting delivery systems it is important to clarify the meanings of "media systems" and "delivery systems." Although these terms are often used interchangeably, they have different roots historically. The term "media" has been used for a long time to connote a means of communication, a way to carry information between a source and receiver. Another way of describing a medium would be materials used over a channel to facilitate communication. We all think of news- papers and television as mass media, and slides and photographs as media used in teaching. More recently, however, a new type of medium has evolved that uses traditional media in combination with support systems to deliver instruction. For example, the World Wide Web and interactive television (two-way video) are delivery systems because they provide instructional materials via a computerized system. Thus, the term delivery system has come into usage with the move to integrated technologies. Typically, new technologies become absorbed in the larger palette of media options and are considered just another way of communicating, in other words another media. Procedures for selecting media and delivery systems have been presented in forms of ISD models known as media selection models. Examples of such models are Kemp, Morn-son, and Ross (1994) and Reiser and Gagne (1983). Many of these models incorporate similar criteria for selection of delivery systems. The selection criteria commonly used include learner and task characteristics, grouping, and practicality or feasibility The Seels and Glasgow Model for Selecting Media and Delivery Systems presented in this chapter incorporates these criteria. Selection criteria will be discussed next.

Selection Criteria learner Characteristics. Another criterion is learner characteristics. For example, motivation or preferences can affect attention and learning. Learners who find a medium frustrating will learn less. Materials must be appropriate for the learner's level of ability. Learners need the pre-entry skills necessary for success with the media or delivery system. You can use information on learner characteristics to profile the intended learner. Such a profile can include age, sex, educational level, achievement level, socio-economic background, learning style, experience, attitudes, role perceptions, and perceived needs. In addition to providing a basis for delivery system selection, such information may also be useful when you decide on objectives or assessment strategies and when you choose an instructional strategy or design messages. For example, some research suggests that high- ability students achieve less when provided with more instructional support such as cues, structure, and provision for frequent responding. You can take this information about the learner into account when selecting instructional strategies (McGowan & Clark, 1985). If you know that the learners have low verbal skills, you will be more careful about the verbal form of your test items. You will not use all the information, but it is difficult at this point to know which information may be useful. The best strategy is to collect any information you think may be useful. If you are sure you will not need certain kinds of information, such as sex or educational level, you need not waste time collecting it. To construct a learner profile you need to find out about both individual learners and the range of learners in a class.

Task Characteristics refer to unique requirements for learning related to learning goals. They can include appropriateness to types of learning and to channel requirements. Using concrete objects when physical discriminations have to be learned is an example of choosing a medium appropriate for the type of learning. "Channel" refers to the sensory mode in which the instruction is delivered. A learner has a choice of audio, grouping. The choice of media depends on whether instruction is to be by a large group, small group, or independent study method. A television tape prepared for a large group lecture can differ from one prepared for a small discussion group. A filmstrip can be suitable for independent study but generally not for a large group lecture. A decision about grouping determines whether the instruction will be in a large group, small group, or independent study situation. This decision has important implications for the use of technology. The technologies appropriate to each situation differ as does the way a technology should be used. Large group presentations demand different uses of technology than small group or independent study situations. A series of slides used for large group instruction is probably going to be presented in a lecture. The same slides used for self- instruction will probably be incorporated through a manual or computer program. Projected visuals are an important technology for large group instruction. In a small group the only technology needed might be an experienced teacher or group leader. In other words, technology might not be needed. On the other hand, maybe an audio conference is warranted, and microphones and speakers are required for a discussion group.

Table 10: Learner profile chart

Table 10 Learner Profile Chart

Characteristic	*Representative Learner*	*Range for Learners*
Age		
Sex		
Educational Level		
Achievement Level		
Socio-economic Background		
Learning Style		
Verbal Ability		
Relevant Experience		
Attitude		
Interest		

Practicality. A final critical consideration is practicality. If there is no time for production or no resources to produce a medium, do not select it. The most expensive or time-consuming medium is not always the best. If the equipment necessary for production or development, for delivery, or for storage is not available and there are no funds for rental of such equipment, then the delivery system is not feasible.

A Model for Selecting Delivery Systems

The model for selecting media and delivery systems shown in Figure 11 assumes that one set of decisions should be based on another set of decisions.

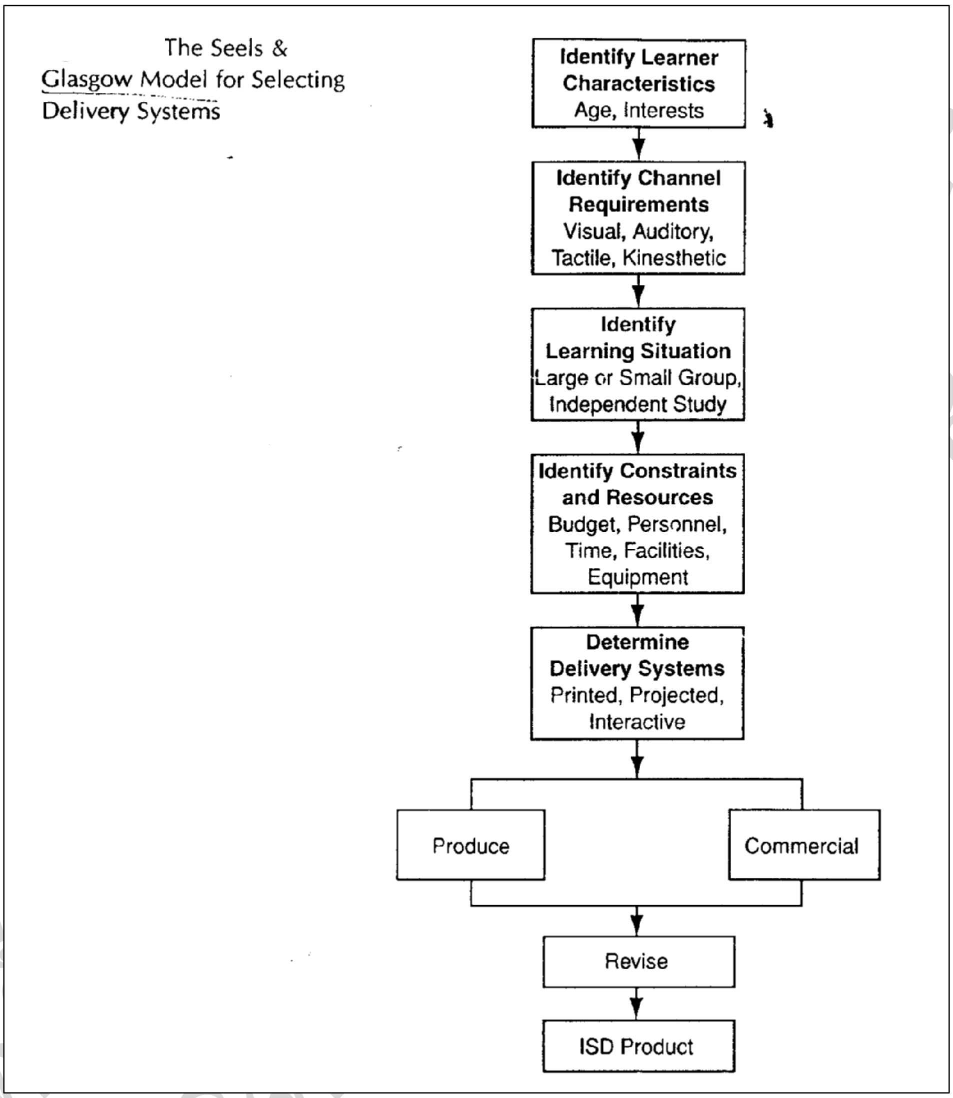


Figure 11: The Seel & Glasgow model for selecting delivery systems

Identify learner Characteristics. It is good to begin by identifying relevant learner characteristics, such as age, attention span, language ability learning style, preferences, and interests. This criterion encompasses demographic characteristics, such as age, maturity, socio-economic background, and geographic region; cognitive style characteristics, such as sequential/global, sensory/intuitive, inductive/deductive, active/reflective, and field dependent/independent; ability characteristics, such as language, attention span, intelligence, interpersonal skills; and attitude characteristics, such as preferences, interests, and motivation.

Learning style refers to traits that characterize how a learner prefers to learn. A student may find one perceptual channel more comfortable than another. Generally, we speak of tactile, visual, and auditory learners. Learner characteristics may be psychological, physical, or sociological. Each characteristic has implications for media selection. Psychological characteristics, such as ability, motivation, and learning style, should be used to determine the desired difficulty and appeal of the material. Physical characteristics, such as need for mobility, can influence the decision about which media will be most effective. Sociological characteristics, such as socio-economic background, may have a bearing on entry level skills.

Identify Channel Characteristics. It is important to identify channel requirements early in the process of selection. The channel is the perceptual modes needed for presentation, practice, and feedback. Usually, the same modes are used for each, but sometimes they differ. For example, a student may study music theory from a book, practice it on a piano, and respond to an audiotape when being assessed. It is best to assess in the same media used for instruction. Perceptual mode requirements come from objectives and learning characteristics. The designer can select from audio, visual, audiovisual, kinesthetic, tactile, or olfactory sensory inputs. If the task is to discriminate visually, use the visual channel. If the learner prefers to learn visually, that is another reason for using the visual channel through a medium that offers pictures.

Identify the Learning Situation. You can identify the learning situation based on whether instruction will be large or small, group or independent study. A textbook may be effective in independent study, but not in a large group presentation where group pacing is required. Each of the technology categories (print, audiovisual, computer-based, and integrated) offers options for each grouping. However, some categories have more affinity for one type of grouping. For example, print technologies are more likely to be appropriate for independent study. Computer-based technologies are also often most appropriate for independent study. Audiovisual technologies, on the other hand, are easily adapted to all three grouping situations. Audiotapes are most useful for independent study. Slides and videotapes can be used for each of the grouping situations. Integrated technologies can be projected, but are usually used in independent or small group situations. Still, it is not the technology option, but whether it can be designed for the purpose of the grouping situation, that should be the basis for selection.
Identify Constraints and Resources. Constraints are limitations or parameters that must be taken

into account in the design specifications. Resources give you the flexibility necessary to take constraints into account. This information allows you to determine options for production, storage, and delivery. Resources are determined by the expertise, equipment, and budget available.

Determine Delivery System Options. After options appropriate for the learner characteristics, channel requirements, learning situation, and constraints and resources are identified, then the type of media or delivery systems to be used are selected. Remember that feasibility is an important criterion when you select options.

Obtain or Produce Materials and Revise. Because media and delivery systems require materials, you must determine whether commercial materials are available and, if so, whether they need revising. If not, you must determine what materials will be produced. These materials can be produced locally or obtained commercially. Sometimes they are even produced non-locally. Often, a combination of locally produced and commercially available materials are used. To determine what is available, searches of indexes, source- books, and catalogs are done.

The information gathered through steps 6 through 8 may lead you to choose another medium or delivery system or to modify your plans. Decisions about modification should involve a!! stakeholders including clients, designers, producers, evaluators, and users. Nevertheless, the designer continues to be responsible for the integrity of the design and to bear the major responsibility for monitoring the design through the ISD process.

If you decide to use commercial materials, be sure you follow any provisions of the copyright law that affect your use of them. This means you must obtain permission to include or adapt the materials in the final product. A good source on copyright provisions for utilization of commercial materials is Heinich et al. (1996). This book also has lists of comprehensive and specialized information sources on commercial materials. The specialized sources are divided by type of media or delivery system.

It is the designer's job to determine what materials if any can be obtained to be used with a delivery system. This means that (a) you decide what materials would be appropriated ate, (b) you search for commercially available materials, and **(C)** you identify what materials could be produced and/or purchased.

Make Final Selections. The media selection process is completed when final media and delivery system decisions about an ISD product are made. This model is useful only when you can connect decisions to media characteristics. The ability to do this comes from broad experience with using media. An instructional designer should try to obtain such experience. A lengthy discussion of this topic, however, is beyond the scope of this book.

The decisions you have made so far enable you to specify delivery systems and media at this stage. Sometimes you have to defend your decisions orally, sometimes in writing, and sometimes not at all. Regardless, to be sure of the quality of your decisions, it is best to write a delivery system justification explaining your choices of delivery system, media, and materials. This justification or rationale is based on the process you just followed Explain the constraints and resources you identified and how they relate to possible options and materials. Then, explain why you narrowed the options to the ones you are recommending, for example, on the basis of feasibility within timelines. Relate the choices to cost and need. Traditionally, written justifications are used in ISD as a way to increase the possibility of budget approval. In summary, this model provides a rationale for media selection; the rationale illustrates how a systematic process was followed to determine appropriate media and delivery systems. Thus, a designer can justify decisions because the connections between parameters and media or delivery systems are made logically. The systematic process the model provides ensures the logic will be complete and consistent.

Evaluating ISD Decisions

Overview one of the tenets of a systems approach to instructional design is that the instruction is submitted to an evaluation during its development. That is, the instruction is tried and revised until objectives are met. The term “formative evaluation” was coined by Scriven (1967) to describe the kind of evaluation performed during the developmental or “formative” stage of the instructional design process. Originally, the term applied to the tryout of materials to answer the question: “Do students learn from them?” However, nearly 30 years of experience have broadened the meaning beyond learning effectiveness to involve feedback regarding other issues, such as content accuracy, technical quality, user acceptability, and issues associated with implementing the instruction. Formative evaluation provides feedback that is used for improvement of the products at all stages of the ISD process.

Outputs of each phase of the ISD process are reviewed for accuracy and adequacy by SMEs, the client, media specialists, end users, and other instructional designers working on the project. The purpose of these internal reviews depends on what is being reviewed and who is doing the reviewing.

If complex and expensive media are being considered, a prototype may be developed to test the cost-effectiveness of the proposed delivery system and to determine the appropriateness of the new medium for the target audience. Prototypes are developed during the design phase. Lessons learned from prototyping are incorporated into a document that serves as the blue print for the development phase.

During the development phase, the instructional materials are tried on representatives of the target audience to determine how well they learn from the instruction. Elements of the instruction that are deficient are revised and tried out again. The tryout and revision cycle continues until the instructional objectives are met.

Student tryouts of instruction have been used for nearly 30 years and are included in nearly every ISD model, yet there is little research on the topic. The limited amount of research evidence, however, shows that instruction revised on the basis of formative evaluation results in better student performance than unrevised instruction (Flagg, 1990; Tessmer, 1993). improvements were found for all types of instruction. Dick (1 980) cites as barriers to research on formative evaluation outcomes the lack of funding, the complex problems associated with conducting research on one phase of the

ISD process, the difficulty in obtaining a sufficient pool of equally skilled design available to work on the same instruction in a comparative research study, and the fact that in large organizations where systematic design is taking place, there is no time] or interest in such research.

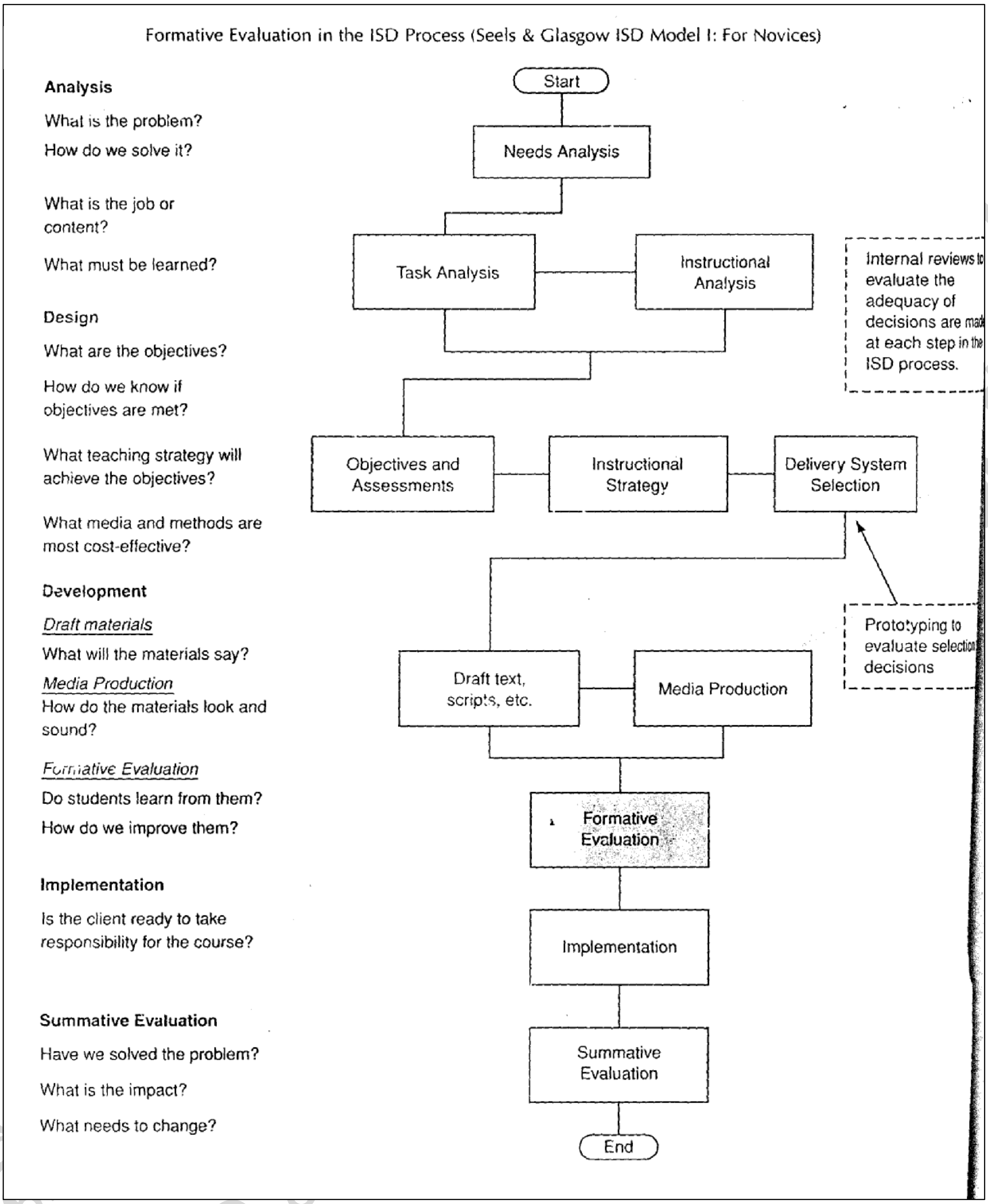


Figure 12: shows how formative evaluation takes place in the ISD process.

Internal reviews the instructional designer enlists the assistance of other instructional designers or a supervisor, SMEs, sponsors, and other knowledgeable people who review the instruction and provide comments and criticism. The internal review maybe done by one person or a team. Internal reviews start with the problem definition and task analysis phases of the process and continue until the final product is turned over to the organization responsible for accepting and implementing the program.

Internal reviews can serve two functions. They provide an opportunity to spot and correct technical inadequacies and flaws early, and they serve as a mechanism for gaining acceptance of and commitment to the new materials. Geis (1987) suggests a number of different experts who might be involved in an internal review. Table 11 summarizes the areas of expertise and the functions performed. Internal reviews should include potential users and sponsors who have a stake in the outcome of the project as well as people who, because they have no involvement in the specific program, provide a disinterested review. They should also be concise and constructive critics.

Depending on when the particular area of expertise is needed, expert reviews may occur at any point in the instructional design process. Sponsors and SMEs, for example, maybe involved in every stage of the process, while others, such as media consultants, will be brought in during the design and development phases only.

It is often helpful to structure the review to focus the reviewer on what it is you want evaluated. Geis (1987) suggests at least three questions for reviewers of all draft materials:

1. Where does something appear to need fixing?

2. What appears to be the cause of the problem?

3. What might be done about it?

Table 11: Expert reviewers and the functions they serve

Table 11 Expert Reviewers and the Functions They Serve

Subject Matter Experts	Master performers who supply the content for instruction, SMEs attend to questions of accuracy and emphasis. They indicate whether the knowledge and skills to be taught are the ones used on the job and whether the examples are representative. They are most critical in the analysis and development phases.
Instructional Designers	Peers or supervisors who evaluate the prototype material for formal features (e.g., is there an introduction?) and functional features (e.g., is there adequate opportunity for practice?).
Media Specialists	Graphic artists and specialists in audiovisual presentation who can comment on the physical features of the message design (e.g., layout, color, clarity of display, and aesthetic elements).
Audience Specialists	Instructors or teachers experienced with teaching the content to the intended audience can comment on suitability of the chosen strategy for the target audience. Additionally, materials that are to be instructor-delivered can be reviewed for acceptability, practicality, ease of use, and likelihood of adoption by teachers.
Gatekeepers	Representatives of the community or organization regarding acceptability on social, ethical, legal, and moral grounds. In educational settings, they might include parents, religious leaders, ethnic leaders; in work settings, they would include decision makers and/or those responsible for insuring adherence to policy. Input would come during the analysis, design, development, and implementation phases.
Sponsors	Sponsors' reviews often serve all of the functions listed in this table. In addition, they may be directed toward matters of cost, implementation, and deadlines.
Former Students	Those who have already taken the course in another form may provide special insights about the new version, having had to learn the same content in another environment.

After "Formative Evaluation: Developmental Testing and Expert Review" by G. L. Geis, 1987, *National Society for Performance and Instruction, 26*(4), pp. 1–8. Copyright 1987 by NSPI. Adapted with permission.

Prototype development of multimedia instruction The purpose of formative evaluation is to assess the strengths and weaknesses of instruction in order to revise the materials so that objectives are met. Altering intricate computer programming and/or authoring systems, graphic or animated sequences, and motion and still video in multimedia instruction is expensive and time consuming. Where multimedia instruction is involved, waiting until a version of the product has been created to gather tryout data ensures that major modifications cannot be made. Even when formative evaluation reveals major problems, the intricate programming and/or authoring, graphic and animation creation, and motion and still video development are difficult to modify substantially due to the substantial costs involved (Northrup, 1995).

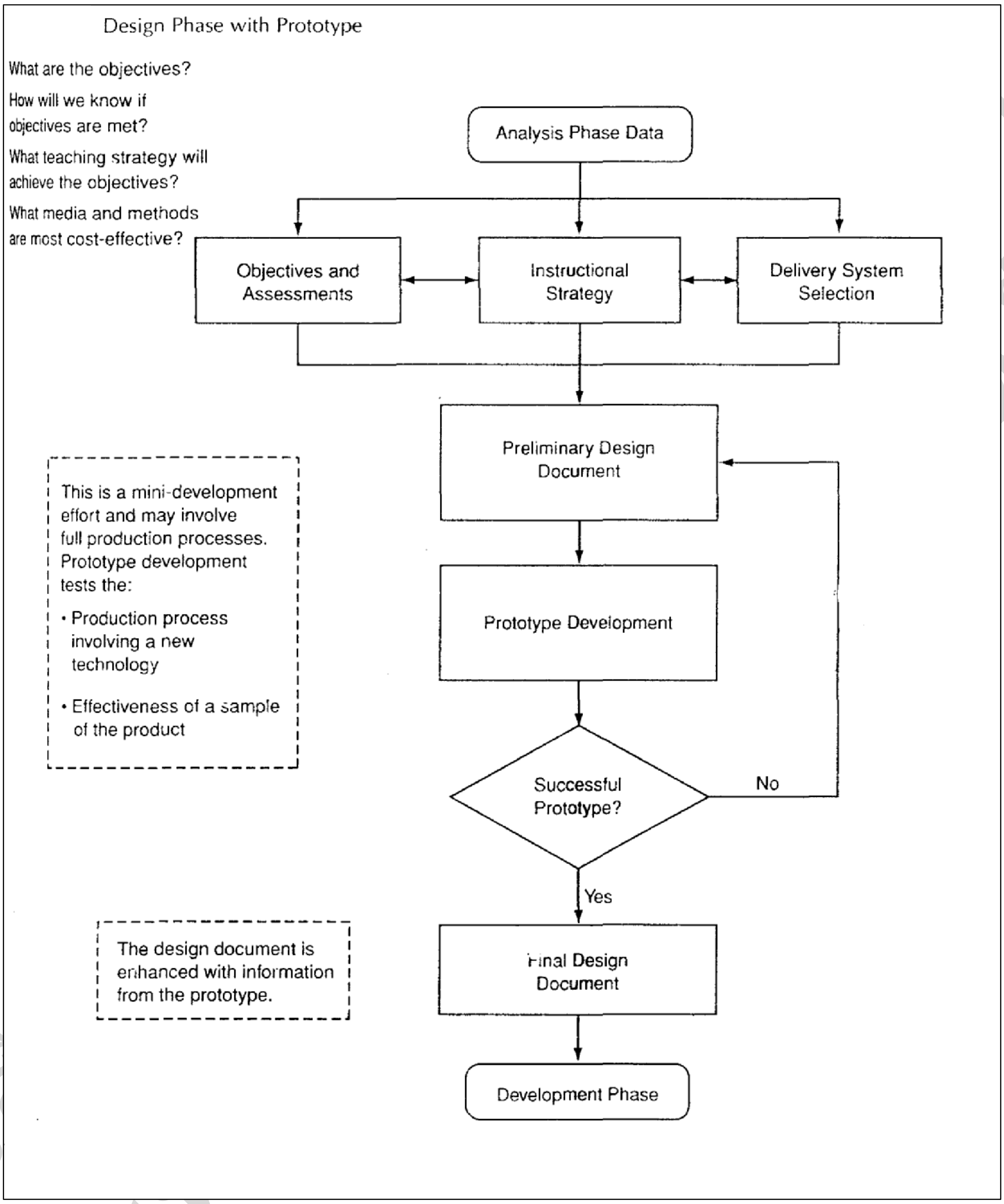


Figure 12: Design phase with prototypes

To overcome the difficulties of making expensive post-production modifications, prototyping has emerged as a way to test design approaches and user interfaces before full scale production. Prototyping is defined by Tessmer (1993) as a hybrid of formative evaluation and design activities. As Figure 12 illustrates, prototype development takes place during the design phase of the ISD process. Flagg (1990) refers to prototyping during the late design phase as "pre-production formative evaluation." When the design phase is completed, the decisions made at each step are documented in a design document. The final document reflects the lessons learned from the prototype. In the development phase the materials are authored, reviewed, produced, and validated. The physical features of the material are produced during this phase. The design document guides the production team to answer the driving question of the development phase: "How will the instruction look and sound?"

Why Develop a Prototype? There are two reasons for developing a prototype. First, the designer may have questions about the students' ability to learn from and use the new system. Secid1y, when a new technology is involved there may be questions about the design team's experience with new way of doing things. Prototype development allows the client to assess the cost effectiveness of the new system and all the design team the opportunity to learn new skills in an environment where the consequences are less expensive.

Compatibility with Target Audience Entry Level. The intent of the prototype is to test approaches on the target audience. Northrup (1995) notes, "The prototype may emphasize the general flow, screen design, button placement, use of a metaphor, color, font, learner control, general interactivity, user interface, and how multiple media, including text, graphics, animation, audio, and/or video impact" (p. c). A full blown production effort is not necessary in order to evaluate an approach. The prototype may incorporate story- boards, paper and pencil mockups, rough videos, etc. Detailed content is not needed. Northrup recommends that the prototype contain only enough descriptive information for a design team member to work one-on-one with a student to test the general approach while interacting with the prototype.

Choices of media and interactive strategies should be tested with the target audience, rather than relying on the professional experience and personal preferences of the production staff. Prototyping to answer design questions is sometimes called "rapid prototyping," because it allows quick construction of an approach in order to evaluate its effectiveness before full scale development. Flagg (1990) identifies a number of questions about user friendliness in an interactive learning environment that can be evaluated by a rapid prototype.

Cost Effectiveness. A second reason for developing a prototype is to evaluate the cost effectiveness of the approach. Development costs, budgets, and development time are among the factors considered in media selection. If the technology to be used is untried and untested in the setting where it is to be used, or if there are concerns about its cost effectiveness, a prototype may be developed.

Table 12: Criteria to evaluate user friendliness of interactive strategies

Table 12 Criteria to Evaluate User Friendliness of Interactive Strategies

Accessibility	Was the information easily accessible? Did users understand what to do next or how to proceed through a decision-making process?
Responsiveness	Was the program responsive to the users' wishes? Did users receive timely feedback appropriate to their needs? Did users find all the tools that they wanted?
Flexibility	Could users change the parameters in the program to suit their own needs? Could users go back and change their responses after an initial decision? Could users go back and review previous content?
Memory	Could users retrieve and examine their past decisions and performance to the extent desired? Are hard copy printouts from selected portions available for later study?

Adapted from *Formative Evaluation for Educational Technologies* by B. N. Flagg, 1990, Hillsdale, NJ: Laurence Erlbaum Associates.

Prototyping is a mini-development effort for a sample of the larger program. The propose of the cost-effective analysis is to replicate the production process on a small scale. Prototype development provides the project team a chance to debug the production process when a new technology is involved. An instructional segment representative of the total production requirements is selected for prototyping. Then, to the extent possible, full scale production is carried out with an eye to answering the following questions:

- Are the system capabilities for graphics, interactivity, animation, etc., compatible with the objectives and instructional strategies selected? The design team's lack of familiarity with the new system may lead to misconceptions about what it can do or the level of effort required to accomplish the instructional objectives.

- What are the staffing requirements for each step in the production process? Does the current staff have the requisite production competencies? If not, can they learn them? Do we need to add new staff Can we subcontract the work? etc.

- What are the time lines for each step in the process? How can steps be performed more efficiently?

- What are the costs associated with each step costs are too high, how can we reduce costs without reducing instruction2l effectiveness?

Development costs, budgets, and development time are among the factors considered in media selection. The media selection decision process takes into account resources and constraints on the project and provides flexibility by allowing trade-offs to be made. High costs may discourage development of complex multi-media courses.

However, when considering cost effectiveness, decision makers should look to the long-term life of the training to be developed. With many high-tech, self-instructional media, up-front development costs are relatively high, but implementation and maintenance of the course is low compared to traditional classroom training, where the instructor bears the burden of delivery Furthermore, because these media deliver instruction to students in their homes or businesses, the costs of travel to a facility for instruction, if paid for by the client agency, and the overhead costs for classrooms and offices space needed for faculty and staff in traditional courses are saved. Thus, when looked at in terms of per student costs over the life of the instruction, the perception that certain media are expensive is not always supported by the facts.

Student tryouts The materials are tried out on naive learners to determine to what extent the instructional objectives are met. The designer responsible for developing the instruction collects information about where the instruction worked and where it did not. When instruction fails, the designer questions students to obtain as much evidence as possible about why the instruction failed; this evidence is the basis for revision. There are three levels of student tryouts: tutorials, small-group tryouts, and operational tryouts.

Tutorial Tryouts At the beginning of tryouts students individually go through the instruction in the presence of the designer. After a handful of students have worked through the materials, the instruction is revised and an additional group of two to five students work through the revised material. Revisions are seldom made on the basis of one student's idiosyncratic problems. Instead, the instructional designer looks for trouble spots and errors that consistently crop up. The tryout-and-revision cycle continues as long as necessary to achieve the standard specified in the objectives. The instructional designer determines the adequacy of the instruction through feedback obtained from tests, student performance during learning, and student comments.

Student Performance During Learning and on Tests. As students work through each exercise or task, the instructional designer notes difficulties and probes for the source of any failure. After the tryout, performance on pre- and post-tests are examined to determine any gain due to instruction. Analysis of the post-test will identify errors and help interpret learner difficulties. However, it may be too complicated and expensive to attempt to use a performance test on a pre and post basis. For example, the post-test in the loan documentation course in chapter 1 required students to actually document loans for typical lending arrangements. Because the test took about four hours to complete, it was impractical to administer on a pre-test basis. Therefore, a written test was developed for use as a pre-test during the tryout.

Student comments. After students complete the post-test, reactions to the instructions and suggestions for improvement are obtained.

Student Sample. Students participating i-n the tryouts should fall within the range of prerequisite abilities defined as the entry-level behavior of the target audience. Research using ninth graders as tryout subjects for math materials suggests that different aptitude groups in the one-to-one stage of formative evaluation provide different types of feedback (Wager, 1983). High-aptitude students can help analyze weak spots in the instruction and provide information about the strategies they use to overcome them. Low-aptitude students are able to identify more basic problems, but are unable to suggest revisions. Groups with mixed aptitudes provide a greater variety of feedback than either high- or low-aptitude groups. Wager reports that materials revised on the basis of the mixed aptitude group produced higher post-test scores and were more favorably received than materials revised solely on the basis of either high- or low-aptitude students.

Delivery System Requirements. The medium used during the tryout will depend on what is available and economically feasible. One of the purposes of the tryout is to uncover problems before expensive production has begun. Therefore, unless the medium of choice can be inexpensively produced in a rough version, the tryout uses storyboards, scripts, drawings, or mock-ups of the instructional materials. As discussed earlier, a prototype may be developed when highly complex and expensive media systems are used. An abbreviated version of the instruction is produced for evaluation. Thiagarajan (1978) suggests that tryouts of complex multimedia instruction be done in successive stages. For example, if the finished product is to be a videotape, formative evaluation might begin with a storyboard, then use a rough cut of the video before final editing.

Tryout Practices. Lowe, Thurston, and Brown's (1983) guidelines for conducting one-to- one tryouts are based on their experience developing vocational technology courses for students in Saudi Arabia.

- Conduct the tryout early in the development process to allow designers time to improve materials while still in development, thereby saving time and money.
- Put the student at ease by explaining that it is the instructional system and not the student that is being evaluated. take the student feel that he or she is a part of the development team.
- Prepare for the tryout in advance by reviewing all material and setting up any equipment or media before the student arrives.
- Select a quiet place with no distractions for the tryout.
- Use a checklist to ensure that all necessary materials are available and procedures are correctly followed.
- Sit close enough to the student to see what he or she is working on, hut not so close as to crowd the student.
- Do not help answer questions until the student has sought the answers in the materials. Question the student to locate the difficulty only when he or she is frustrated by a problem.

Revision Stolovitch (1982) compares 12 systems models, all of which prescribe forma tiv evaluation. None of them, however, prescribe specific revisions to counteract learn in failures. Typically the revision step in a systems approach is largely a process that draws on the designer's knowledge of the principles of learning. The designer uses post instruction test information as well as other subjective and objective data. If the materials have been subjected to an internal review and are product of an experienced designer, decisions about how to revise them are usually straightforward. For a skilled and experienced designer, usually the *"fix"* is obvious. Practice and feedback requirements may be insufficient, or step size may be too large, and so on. That is, the materials must be broken down into smaller parts with additional guidance and practice added. But with less able designers or with complex subject matter, a number of tryouts may be necessary before learner outcomes are affected. Glasgow (1974) developed guidelines for translating tryout data into revisions. Three types of student failures and associated revision strategies are shown in Table 13.

Small Group Tryouts Small-group tryouts provide an opportunity to obtain feedback about how well the course achieves the learning objectives, as well as duration of the instruction and instructor preparation requirements. The same issues applicable to tutorial tryouts are applicable to small-group tryouts.

Duration. Each learning situation fits into a larger context with schedules. By their nature, individual tryouts will not give you good estimates on the time to complete the program. Small-group tryouts consisting of eight to 10 students are useful for estimating the duration of the instruction. For individualized instruction, the median completion time is usually calculated for each unit of instruction. In group-paced instruction, every on moves at the same pace; therefore, the instructor's task during the tryout is to deter min whether the lessons can be contained within the time limits needed to meet the learning requirements of most members of the group and the practical time constraints of the organization offering the instruction.

Instructor Preparation. If instructional designers conduct the instruction themselves, they will learn a great deal from the instructor's point of view about problems with using the materials. Lessons learned from the tryout will have implications for the instructor's guides, lesson plans, and other materials and equipment used to prepare for and conduct the instruction. The instructional strategies may require instructors to assume new, unfamiliar roles. For example, an instructor used to delivering instruction by lecturing may have difficulty assuming the role of a facilitator in a course that makes use of group discussions and case studies. Findings about instructor competencies during the small tryout will influence the degree and scope of formal training necessary to prepare instructors to conduct the training and perform these new roles during the operational tryout, and later when the course is implemented.

Table 13: Type of learning failures and associated revision strategies

Table 13 Types of Learning Failures and Associated Revision Strategies

Type of Failure	*Examples of Failure*	*Revision Strategy*
Failure in retention Students correctly performed during instruction, but on the test failed to remember what they learned.	• There are many steps in a procedure. On the test, the student omits a step. • On an end-of-week test, students miss items learned earlier in the week. • Students are learning a new way of doing things. Instead, they use the old procedure on the test.	• Provide more opportunities to practice the task to be learned before the test. • Provide a performance aid, a mnemonic, or visual image to help memory. For example, "RAT" will help you remember Retention, Acquisition, & Transfer.
Failure in acquisition The student failed to learn the material during instruction and demonstrated that failure by errors during instruction and on the corresponding test items.	Despite repeated attempts to learn long division, students are unable to perform satisfactorily on workbook exercises and fail the test.	Compare the analysis data with the instruction to determine whether the instruction accommodates the: • learners' motivational problems and/or learning preferences; • prerequisite requirements; and • sequencing requirements for the types of learning. Review the instructional strategy to determine whether principles of learning are appropriate for the type of learning.
Failure in transfer The student correctly performed during instruction, but on a test failed to apply what he had learned to new situations.	Student correctly applies Ohm's Law on workbook exercises, but fails to apply law to new examples on the test.	• Range of examples used during instruction is too narrow. Include examples that are representative of the variety of applications (easy to difficult). • Students have misconceptions about application. Direct attention to relevant and critical properties of problems that call for the response.

Adapted from "Planning, Developing and Validating the Instruction," by Z. Glasgow, 1974, in *Handbook For Developing Instructional Systems: Vol. VI* (Contract No. F331615-72-C1363, USAF Human Resources Laboratory, Wright-Patterson AFB, Ohio). Butler, PA: Applied Science Associates.

The materials are tried out under conditions that simulate those of the actual instructional environment. The operational tryout provides an opportunity to work out administrative, equipment, facility, or any other implementation problems.

In operational tryouts, the instruction is evaluated as an integral part of the environ men where it will eventually reside, and it is delivered by the instructors and administrator who ultimately will be responsible for it. In addition to providing an opportunity to work out administrative, equipment, facility; or any other implementation problems, the operational tryout ascertains students' attitudes toward the course.

Satisfaction with the training is important. Although there is not always a direct connection between high satisfaction and learning effectiveness, as a rule satisfied participants will help ensure the success of a program. Some activities essential to learning may be difficult or tedious and therefore distasteful to the students. A program that does not satisfy its students will probably not continue in business for long.

A standard approach to assess student satisfaction calls for having students use questionnaires to evaluate the environment, presenters, materials, length, and organization of the program. The survey may be done at the end of training or after some time has elapsed. These indices are disparagingly referred to as "smile" or "happiness scales because they seldom have demonstrated reliability and validity.

Schwier (1982) points out the difficulties of developing effective scales as well as the pitfalls of using them. He cites four uses in a developmental context

1. as a placebo when student data are gathered but ignored;

2. as an ice breaker where the designer collects satisfaction data in response to client's concerns;

3. as a product appraisal where information about the difficulty, sequence, .entertainment value, and instructional approach are used to provide insights to problems overlooked by designers; and

4. as an instructional appraisal where evaluations are used to identify perceived weak iv nesses and strengths of the instructional staff.

A number of important issues affect student evaluation outcomes. They include the reliability and validity of the instruments and intervening variables that influence students' acceptance of the course. Variables include class size, whether the instruction is compulsory or not, personality of the presenter, and the students' actual or anticipated grade. Although Schwier (1982) points out the difficulties of developing effective scales as well as the pitfalls of using them, Schwier concludes that student evaluations judiciously used and carefully constructed can contribute to assessing an instructional package.

Debriefing is another way to assess student satisfaction. A debriefing is a discussion—sometimes with an individual but usually with a group—about the activities just experienced. A debriefing session provides an opportunity to talk about emotions, such as frustration. The debriefing approach is always used with simulation/gaming activities (Heinich, Molenda, Russell, & Smaldino, 1996). A discussion or debriefing leader asks questions about emotions and about what happened, what was learned, and the relevancy of what was learned. ("How did you feel about playing the game?" "To what extent was the game realistic?" What part does chance play in the game? How realistic is this part? What factors affect success in the game?") Notes are taken on participant's responses.

Another approach to improving instruction on the basis of student comments is the evaluation interview, which is a form of debriefing. The U.S. Department of Labor's Employment Standard Administration (ESA) has pioneered a mechanism for gathering formative evaluation data through group interviews. The mechanism allows the instructor to improve an ongoing course and collect data for future revisions. This approach employs evaluation meetings and works best for workshops and training sessions that last longer than two days. Although no formal evaluation of the approach is known, it has been used by ESA trainers for more than 10 years and by other organizations in modified forms (Stevenson, 1980; Pearistein, 1988).

Meetings generally last 30 minutes and are attended by the instructor and representatives selected by the course participants. Evaluation meetings are held daily to determine how the course is going and to air issues that, if allowed to go invented, might interfere with the course.

Topics may include pace, problems with materials, problems with t exercises or group activities, and problems with the instructors. If students are reluctant to review their real concerns, the instructor will have to probe—and be willing to accept and respond to negative comments.

Meetings are most effective if feedback will make a difference immediately. A meeting held at the end of the day should result in a change the next day. The instructor must be willing to follow through in the next session on any commitments, or students will feel that comments they make at the meetings are not taken seriously. On the other hand, changes that violate learning principles and harm the effectiveness of the course should not be made. A suggestion that cannot be acted upon can be handled by explaining that the basic course design is founded on principles of learning that are not subject to change. In other words, although learning is a cooperative venture, don't be coerced into altering the nature of the course.

Media and Instruction

Some call the present an age of media. The pervasiveness of mass media in our lives as forms of *entertainment* is obvious. Not so obvious, but nearly as pervasive, are the uses of media for *learning.* Consider these vignettes.

1. As he heads for work, a pharmaceutical salesman plugs into his car stereo the new cassette from the company sales training center. It introduces him to the distinctive features of Banvex, the new drug for respiratory infections.

2. In a quiet corner just off the shop floor at Regent Industries, Jean views a videocassette that shows the proper operation and safety features of the machine that she will be operating during her shift. Jean 'floats" among jobs as needed from day to day.

3. Flash cards are used by the therapist to teach word recognition to a mentally handicapped child at the rehabilitation center. The cards have a word on one side and a picture on the other; the "repeat" stack grows smaller as Stephanie masters each word.

4. The junior high school age Samaritan Club members are studying the meanings of the parables. They compete as teams during the after-school program at their local church. Matching the facts of the stories with the accepted interpretation is the purpose of the game.

5. Anne, a graduate student in veterinary medicine, uses an interactive video system in the university's learning center to practice responding to animal owners in stressful situations. The scenarios present situations Anne is likely to face in actual veterinary practice.

6. As he unobtrusively photographs housing conditions in the inner city, Steve, a high school senior, reflects upon what brought him here. He had volunteered to do a slide-tape report on urban problems for his social studies class.

7. A pair of fourth graders eagerly 'boot" (start up) the "Exploratorium" disc on their classroom microcomputer. They want to continue where they left off yesterday in a detective story. It challenges their logical reasoning skills in solving the mystery.

8. To learn how to take their blood pressure at home, Thelma and Harold listen to the nurse at the hospital as she guides the retired couple through a structured tutoring package. The nurse patiently answers any questions they have.

9. Dinner over, the Carter family settles into the family room to watch "This Old House." They are intrigued with the notion of buying and restoring an older house, and this television series provides them with valuable tips.

Here and now, in school and out, at home and at work, children and adults are enjoying the benefits of learning through media and the new technologies of instruction. The goal of this book is to help put *you* into this picture.

Instructional communication

Instruction is the arrangement of information to produce learning. The *transfer of* information from a source to a destination is called communication. Because new learning usually depends on taking in new information, effective instruction cannot take place unless communication takes place. It is, therefore, helpful to know something about the communication process in order to use instructional media effectively.

Communication Models

One of the first models of the communication process was developed by Claude E. Shannon of the Bell Telephone Laboratories. Because of his background and job, Shannon was interested solely in the technical aspects of communication. However, Warren Weaver collaborated with Shannon to develop a broader application of this model to other communication problems.* The Shannon-Weaver model (see Figure 1) can be used to analyze instructional situations.

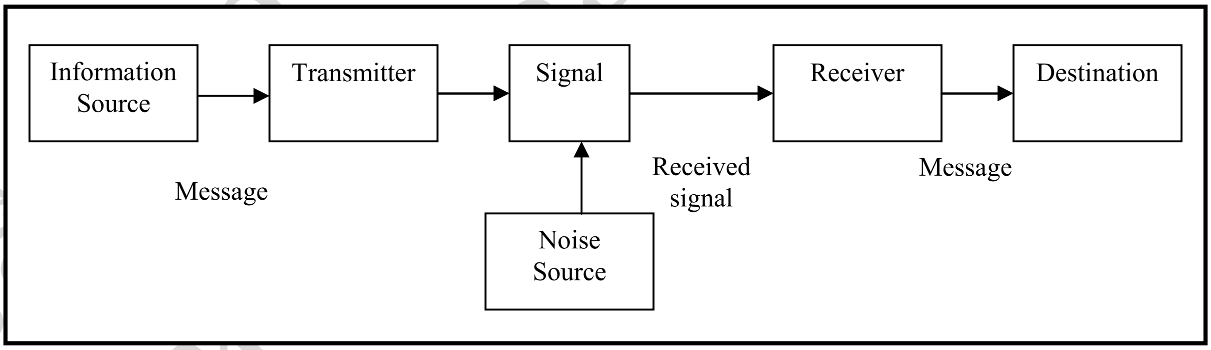


Figure 1 Shannon-Weaver Communication Model

A message, such as the structure of the human heart, is selected by an information source. That message is then incorporated by the transmitter into a signal. The signal could be spoken words, a drawing on a chalkboard, or printed materials. The signal is then received by the receiver's ears and/or eyes and transformed into a message reaching the destination, for example, a student's mind. Acting on the signal as it is being transmitted are various distorting factors that Shannon called "noise." In our example, noise could be background sounds or glare.on the chalkboard. It is important to keep in mind that "meaning" per se cannot be transmitted. What are actually transmitted are *symbols* of meaning, such as words and pictures. As authors of this book, for example, we cannot directly transfer to you the personal "meanings" we have built up in our own minds about instructional media. (We even have trouble doing so among ourselves!) The most we can do is to transmit verbal and graphic symbols from which you can evoke your own "meanings." The most we can hope for is that our skills and knowledge will enable us to encode our messages in such a manner that your skills and knowledge can be used to decode and interpret them correctly.

Field of Experience

One major purpose of instructional communication is to broaden and extend the field of experience of the learner. For instructional purposes, however, the meaning of the message and how the message is interpreted are of paramount importance. The Schramm adaptation of the Shannon model incorporates Shannon's concern with the technical aspects of communication, but its central concern is with communication, reception, and interpretation of meaningful symbols. This is at the heart of instruction (Figure 2).

As a classroom teacher, for example, you would prepare your students for an instructional film (through a preliminary discussion of the topic, an overview of content, etc.), and you would design follow-up activities to reinforce and extend the range of what has been learned from the film. Ideally, material presented to a student should be sufficiently within his or her field of experience so that he or she can learn what needs to be learned, but enough outside the field of experience to challenge and extend that field. How far the instruction can extend beyond the student's field of experience before confusion sets in depends on many factors. Perhaps the most important of these is the ability of the student. Able students can assume more of the responsibility for extending their own fields of experience than less able students.

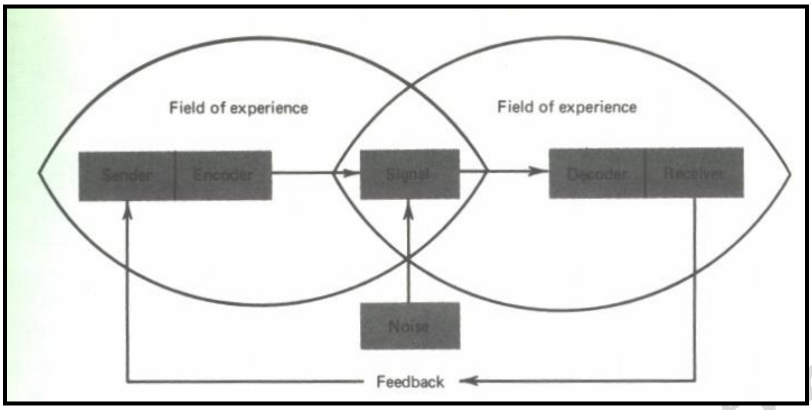


Figure 2: Schramm Communication Model

Slower students will need instructional content closer to their field of experience in order to be successful. Most retarded learners will require instruction that is almost entirely within their relatively limited field of experience. We will discuss the determination of 'specific entry competencies," with particular attention to identifying the student's field of experience as he or she enters a lesson.

There will be times when the learning task (message) may not be within the field of experience of the *instructor.* When this occurs, both instructor and student seek to extend their respective fields of experience, and the instructor should not feel peculiar about being in this position. Some of the most effective learning takes place when instructor and student must seek the answers together.

Another very important distinction between film (or any other medium) as a communication medium and as an instructional medium involves feedback from the receiver. We usually think of feedback as some form of test, but many other techniques are available to indicate to the teacher how students are receiving instruction. Facial expressions, body language, discussion responses, student conferences, homework, responses on short daily quizzes, etc., are all forms of feedback. Not only does feedback help us to ascertain whether instruction has been successful or unsuccessful, but it also tends to take the burden off the student and place it where it more appropriately belongs—on the sender of the message (the instructor). Instructors are frequently tempted to blame the student when instruction is not successful. The real problem may be that the instruction has not been designed or delivered appropriately.

If "noise" unduly interfered with your signal, you can repeat instruction under more favorable conditions. If you made an error in appraising your students' field of experience, you may need to identify a more appropriate entry level for your particular group. If the message was not encoded properly, you may need to identify more suitable materials, or you can adjust your utilization of the materials to produce more effective instruction.

Transactional nature of communication

WE emphasize that communication is an interpretive transaction between or among individuals. As noted previously, the sender of a message encodes it according to his or her skill and knowledge (field of experience), and the receiver decodes it according to his or her field of experience. In the feedback process, however, the receiver (student) does more than decode the message. He or she must also encode his or her interpretation of the signal for relay back to the sender (teacher), who, in turn, must decode it. In effect, receiver becomes sender and sender becomes receiver. And both interpret the message according to their fields of experience (Figure 3)

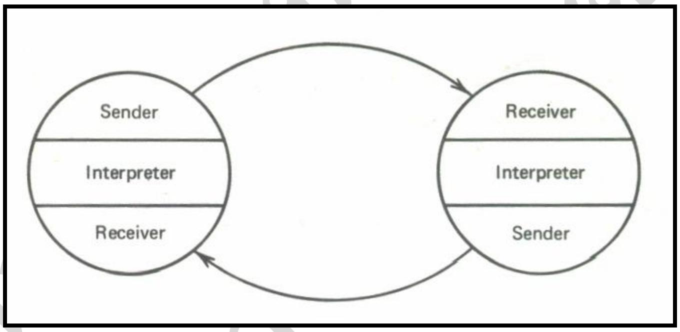


Figure 3: Transaction model of communication

This is an extremely important point to keep in mind. You must decode your students' feedback signals according to *their* interpretation of instructional content, which may or may not be the same as yours, and which will very likely differ, at least in detail, from student to student. For example, instructional information about the labor movement in the United States may be interpreted one way by the child of a business executive and another way by the child of a union member. Black students and white students may interpret a film on slavery quite differently. The limited sensory abilities of some handicapped students may lead them to interpret instructional content differently from no handicapped children. Students raised in other countries will bring their cultural assumptions with them. For example, in the United States, the owl is often used as a symbol of wisdom, but in one region of Nigeria it is an omen of evil. As an instructor, you must always be sensitive to the fact that student response to a communication signal is a product of student experience.

Media, Messages and Methods

Amedium is a channel of communication. Derived from the Latin word for “between,” the term refers “to anything that carries information between a source and a receiver.” Examples of media are film, television, diagrams, printed materials, computers, and instructors. These are considered instructional media when they carry messages with an instructional purpose. The purpose of media is to facilitate communication.

Instructional Media

The various instructional media described in this book cover a wide range of types appropriate for learners of all ages and backgrounds and for a wide variety of settings, formal and nonformal— from schools to colleges to businesses to homes . . . and places in between! The following chapter deals with sound-slide sets, multimedia kits, and other such media combinations. Film and video and other varied electronic distribution systems are covered in focus on the new technologies of instruction; these, too, often incorporate various audio and visual types of media.

Messages

In any instructional situation there is a message to be communicated. The message is usually subject-matter content, but it may be directions to the learners, questions about the content, feedback on the appropriateness of responses, or other information (see Figure 4)

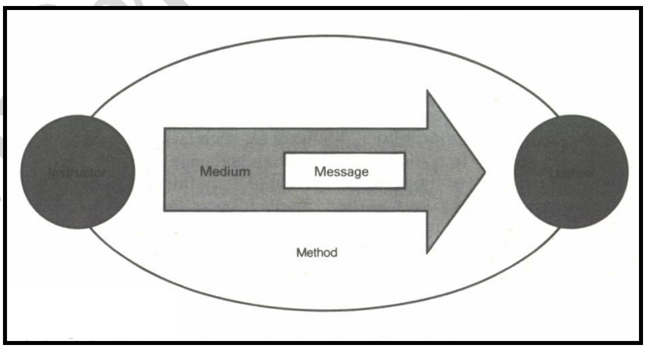


Figure 4: In the relationship between message and medium, the medium carries the message

Methods

Traditionally, instructional methods have been described as “presentation forms” such as lecture and discussion. In this text we will differentiate between instructional *methods* and instructional *media. Methods* are the procedures of instruction that are selected to help learners achieve the objectives or to internalize the content or message. *Media* (medium, singular) are carriers of information between a source and a receiver. Such vehicles are considered *instructional media* when they are used to carry messages intended to change behavior.

The eight methods described here are applicable to learners of all ages. They are presentation, demonstration, drill-and-practice, tutorial, gaming, simulation, discovery, and problem solving. Virtually any of the media described later can be used to implement virtually any of these methods.

Presentation. In the presentation method a source tells, dramatizes, or otherwise disseminates information to learners. It is a one-way communication controlled by the source, with no immediate response from or interaction with the learners. The source may be a textbook, an audiotape, a videotape, a film, an instructor, and so forth. Reading a book, listening to an audiotape, viewing a film or videotape, and attending a lecture are examples of the presentation method. For example, as part of your visit to a museum, you check out a cassette tape and player with private headphones. The audiotape and accompanying map guide you through the museum and present information about each of the exhibits and displays.

Demonstration. In this method of instruction the learner views a real or lifelike example of the skill or procedure to be learned. Demonstrations may be recorded and played back by means of media such as video or film. If two-way interaction or learner practice with feedback is desired, a live instructor or a tutor is needed. The objective may be for the learner to imitate a physical performance, such as swinging a golf club or changing the oil in a car, or to adopt the attitudes or values exemplified by someone who serves as a model. In some cases the point is simply to illustrate how something works, such as the effect of heat on a copper strip. On-the-job training often takes the form of one-to-one demonstration, with the experienced worker showing the new one how to perform a procedure, such as operating a packaging machine. This arrangement allows questions and answers to correct any errors or misperceptions.

Drill-And-Practice. In drill- and-practice the learner is led through a series of practice exercises designed to increase fluency of a new skill or to refresh an existing one. Use of the method assumes that the learner has previously received some instruction on the concept, principle, or procedure that is to be practiced. To be effective, the drill-and-practice exercises should include feedback to correct and remediate errors that the learner might make along the way. Drill-and-practice is commonly used for such tasks as math facts, foreign language learning, and vocabulary building. Certain media formats and delivery systems lend themselves particularly well to student drill-and-practice exercises. For example, learning- laboratory instruction and programmed instruction are well suited to these purposes. Audio- tapes can be used effectively drill-and-practice in spelling, arithmetic, and language instruction.

Tutorial. A tutor—in the form of a person, computer, or special printed materials—presents the content, poses a question or problem, requests a learner response analyzes the response, supple appropriate feedback, and pro vides practice until the learn demonstrates a predetermine level of competency. Tutoring most often done on a one-to-c basis and is frequently used to teach basic skills, such as read and arithmetic. Tutorial arrangements include instructor-to-learner (e.g., Soc dialog), learner-to-learner, (e. tutoring or programmed tutoring), computer-to-learner (e.g. computer-assisted tutorial software), and print-to-learner (e. branching programmed instruction). The computer is especially well suited play the role of tutor because its ability to deliver speedily a complex menu of responses to different learner inputs.

Gaming. Gaming provides a “playful” environment in which the learners follow prescribed rules as they strive to attain a challenging goal. It is a highly motivating method, especially for tedious and repetitive content. The game may involve one learner (e.g., solitaire) or a group of learners. Gaming often requires learners to use problem- solving skills and/or demonstrate mastery of specific content demanding a high degree of accuracy and efficiency.

A common type of instructional game is the business game. Participants form management teams making decisions regarding a mythical corporation. The win- fling team is the one reaping the highest corporate profits.

Simulation. Using this method, the learner confronts a scaled- down approximation of a real-life situation. It allows realistic practice without the expense or risks otherwise involved. The simulation may involve participant dialog, manipulation of materials and equipment, or interaction with a computer. Interpersonal skills and laboratory experiments in the physical sciences are popular subjects for simulations. In some simulations the learner manipulates mathematical models to determine the effect of changing certain variables, such as controlling a nuclear power plant. Role playing is another common example of the simulation method. In *Participative Decision Making* preservice teachers learn about allocating school budgets. Students assume the roles of a teacher representing the union, a principal, a school board member, a member of the PTA, a taxpayer with no children in school, and a student representing the student council.

Discovery. The discovery method uses an inductive, or inquiry, approach to learning; that is, presenting problems to be solved through trial and error. The aim of the discovery method is to foster a deeper understanding of the content through involvement with it. The rule or procedure that the learner "discovers" may be derived from previous experience, based upon information in reference books, or stored in a computer database. Instructional media can help promote discovery or inquiry. For example, films may be used for discovery teaching in the physical sciences. Students study the films to perceive the relationships represented in the visuals and then go on to discover the principles that explain those relationships. For example, by viewing something as simple as a balloon being weighed before and after being filled with air, the student discovers that air has weight.

Problem Solving. In this method the learner uses previously mastered skills to reach a resolution of a challenging problem. The learner must define the problem more clearly, perhaps state a hypothesis, examine data (possibly with the aid of a computer), and generate a solution. Through this process the learner can be expected to arrive at a higher level of understanding of the phenomena under study. One commonly used example of problem solving is the case study. For example, students in a business class are given information about a situation at a small manufacturing firm and are asked to design a solution to the problem of low production. One of the early decisions is to gather data from the case and to determine whether the solution is training or, instead, changing the environment or attitudes of the workers. In any instructional situation a variety of methods may and should be used. Most of these methods can be used to teach any content to any group of learners.

However, some methods may be better for the specific content to be taught to certain learners. Experience and trying the various methods with actual students will. Determine which method or combination of methods is most effective. Consider a variety of methods for increased interest.

Why use instructional media

Too frequently instructors use media without any reference to guiding principles of how the experiences contained in those media will be used by the learners. Without a good conceptual rationale, use of specific materials may become simply mechanical, with the hope that what is presented to the learners will eventually become meaningful to them. Instructors can develop conceptual and theoretical bases on which to choose specific materials and methods by knowing the relationships between media, learning, and instruction. Instructional media can be used to facilitate, and in some cases provide for, intellectual development. Three concepts, as outlined by Jean Piaget*, are helpful in explaining how mental development occurs. They are schema (plural, schemata), assimilation, and accommodation.

Schemata are the mental structures by which individuals organize their perceived environment. These adapt or change during mental development and learning. These schemata are used to identify, process, and store incoming information. Schemata can be thought of as categories into which individuals classify and store specific information and experiences.

Very young children learn to distinguish between mother and father. They soon separate dogs from cats and later become aware of different varieties of dogs. These differentiations based on experience lead to the development of schemata; that is, the development of the ability to classify objects by their characteristics.

Schemata as structures of cognitive development change by the processes of assimilation and accommodation, so during instruction these changes should be encouraged. Adult learners have greater numbers and more elaborate schemata than children.

Assimilation is the cognitive process by which a learner integrates new information and experiences into existing schemata. Piaget borrowed the term from biology. It is the process by which an organism eats food, digests it, and then assimilates or changes it into a usable form.

During learning, assimilation results from experience. With new experiences, the schema expands in size, but does not change its basic structure. The process of assimilation attempts to place new concepts into existing schemata.

These experiences may come from real-life experiences. Rather than waiting for experiences to happen naturally, instructors cause experiences to happen through use of media and the new technologies of instruction.

Accommodation Schemata change with experience, thus adult learners have a broader range of schemata than children, The process of modifying existing schemata or creating new schemata is accommodation. When dealing with a new concept or experience, the learner attempts to assimilate it into existing schemata. When it does not fit, there are two possibilities: (1) the learner can create a new schema into which the new stimulus is placed, or (2) the existing schema can be modified so that the new stimulus will fit. Both of these processes are forms of accommodation.

As instructors, we are responsible for providing learning experiences that will result in the creation of new schemata as well as the modification of existing schemata. Schemata develop over time with learning experiences. The role of instructional media is to provide many of those experiences.

The Concrete—Abstract Continuum The psychologist Jerome Bruner, in developing a "theory of instruction," proposes that the instruction provided to a learner should proceed from direct experience (enactive), through iconic representations of experience (as in pictures, films, etc.), through symbolic, or digital, representation (as in words).t He further states that "the sequence in which a learner encounters materials" has a direct effect on achievement of mastery of the task. Bruner points out that this applies to *all* learners, not just children. When a learning task is presented to adults who have no relevant experiences on which to draw, learning is facilitated for them when instruction follows a sequence from actual experience through iconic, to symbolic representations. As we will discuss later, an important first step in instruction is to determine the nature of any learner's current level of experience. Concrete experiences facilitate learning *and* the acquisition, retention, and usability of abstract symbols.

Instructional media not only provide the necessary concrete experiences but also help students integrate prior experiences. Many students have watched various aspects of the construction of a highway or a street. They have seen the machine that lays the asphalt down, they have seen graders at work, and they have seen a number of other stages of road building. However, they need to have all these experiences integrated into a generalized notion of what it means to build a highway. A film that can show all of these processes in relation to each other is an ideal way to integrate their various experiences into a meaningful abstraction.

Historically, improving the balance between concrete and abstract learning experiences was a key reason for using instructional media. However, current researchers question the nature of the distinctions between media made by earlier authors. The relative concreteness and abstractness of various media and methods and their comparative effectiveness in learning is not as clear cut as we once believed. Most instructional materials use a combination of presentation forms that vary in their degree of realism; for example, films (motion pictures) or filmstrips (still pictures) may be captioned or narrated (verbal symbols). In certain circumstances, line drawings (visual symbols) have been shown to be more effective than realistic photographs (still pictures). It now seems clear that a second key to effectiveness is learner response—the mental processing or overt practice conducted in response to the audiovisual stimuli. Regardless of the appeal of a method of presentation, the ultimate test is learner response and performance.

Decisions regarding trade-offs between concreteness of a learning experience and time constraints have to be made continually by the instructor. In general, as you move up Dale's Cone toward the more abstract media, more information can be compressed into a shorter period of time. It takes more time for students to engage in a direct purposeful experience, a contrived experience, or a dramatized experience than it does to present the same information in a motion picture, a recording, a series of visual symbols, or a series of verbal symbols. For example, a field trip can provide a learning experience relatively high in concreteness, but it also takes up a good deal of instructional time. A motion picture depicting the same experiences as the field trip could be presented to the students in a much shorter period of time and with much less effort. Similarly, a simulation (a contrived experience) such as the game "Ghetto" can help students relate to new situations and solve new problems, but such a simulation game does take more time than a more abstract learning experience such as watching a brief television documentary about ghetto life. In such cases, the instructor must decide whether the particular nature of the experience is worth the extra time it may take. As discussed later in this chapter, researchers have found that training directors consider contrived experiences (role playing, simulations) well worth the time they take. They often use filmed or videotaped simulations to take advantage of both “reality” and time compression.

The instructor must also decide whether or not the learning experience is appropriate to the experiential background of the student. The greatest amount of information can be presented in the least amount of time through printed or spoken words (the to of the concrete-to-abstract continuum and cone). But if the student does not have the requisite experiential background and knowledge to handle these verbal symbols, time saved in presentation will be time lost in learning. As mentioned before, the instructor finds out if the right match has been made by relying on what is perhaps *the* basic principle of instruction: learning means appropriate change in response, or performance. Because of this, emphasis in contemporary instructional research is placed c analysis of learner response as the key to choosing appropriate instructional experiences. As Dale has pointed out, a model such as his Cone of Experience, although a simplification o complex relationships, is, nonetheless, a practical guide to analyzing the characteristics of instructional media and methods and how these media may be useful.

The role of media in instruction

Media can serve many roles in instruction. The instruction may be dependent upon the presence of a teacher, referred t as *instructor-based.* Even in this situation, media may be heavily used by the teacher. On the other hand, the instruction may not require a teacher when the student is learning, referred to as *instructor-independent.* This type of instruction is often called “self instruction” even though it is guided by whoever designed the media.

Instructor-Based Instruction The most common use of media in the instructional situation is for supplemental support of the instructor. Certainly there can be no doubt that properly designed instructional media can enhance and promote learning and support teacher-based instruction. But their effectiveness depends on the instructor (as will be made clear in the chapters that follow).

Research has long indicated the importance of the instructor's role in effective use of instructional media. For example, early studies showed that when teachers introduced films, relating them to learning objectives, the amount of information students gained from films increased.* Later research confirmed and expanded upon these original findings. Ausubel, for example, developed the concept of "advance organizers" as aids to effective instruction. An advance organizer may take the form of an overview of or an introduction to lesson content, a statement of principles contained in the information to be presented, a statement of learning objectives, etc. Whatever the form, it is intended to create a "mind-set" for reception of instruction.

Advance organizers can be effective instruments for ensuring that media play their proper role as supplemental supporters of instruction. Many commercially produced instructional materials today have built-in advance organizers, which may be used as is or adapted by the instructor for specific educational purposes.

Instructor-Independent Instruction Media can be effectively used in formal education situations where a teacher is not available or is working with other students. In nonformal education, media such as videocassettes and computer- based media can be used by trainees at the work site or at home. some instances an instructor ma be available for consultation via telephone.

The use of self-instructional materials allows teachers to spend more of their time diagnosing are correcting student problems, consulting with individual students, and teaching on a one-to-one an small-group basis.

How much time the teacher can spend on such activities will depend on the extent of the instructional role assigned to the media. Indeed, under certain circumstances, the entire instructional task may be left to the media. Experimental programs have demonstrated, for example, that an entire course in high school physics can be successfully taught through use of films and workbooks without direct classroom intervention by the teacher. Successful programmed courses in calculus have been developed for use by able students whose high schools have no such course.

This is not to say, of course, that instructional technology can or should replace the teacher, but rather, that media can help teachers become creative managers of the learning experience rather than merely dispensers of information.

Distance Education is a rapidly developing approach to instruction throughout the world. The approach has been widely used by business, industrial, and medical organizations. For many years doctors, veterinarians, pharmacists, engineers, and lawyers have used it to continue their professional education. These individuals are often too busy to interrupt their practice and participate in classroom-based education. Recently, academic institutions have been using distance education to reach a more diverse and geographically dispersed audience not accessible through traditional classroom instruction.

The distinguishing characteristic of distance education is the separation of the instructor and student(s) during the learning process. The communication of the subject matter is primarily to individuals rather than groups. As a consequence, the course content must be delivered by instructional media.

The media may be primarily print (books and paper-and-pencil tests), as in the case of traditional correspondence courses. Today, a wide variety of media are used. Audiocassettes, videotapes, video- discs, computer-based instruction, and interactive video courses can be sent to individual students. In addition, radio, broadcast television, telelectures, and teleconferences are utilized for “live” distance education. The latter two delivery systems allow for interactive instruction between the instructor and the students.

Special Education Another role of media is evident in work with special students. Handicapped children in particular need special instructional treatment. Mentally retarded children need highly structured learning situations because (referring back to our communication diagram) they lack the necessary field of experience and the ability to incorporate messages within their constructs. They need much more of the message placed within the context of their field of experience in order to expand that field of experience at all. Students who have impaired hearing or impaired vision require different kinds of learning materials; more emphasis should be placed on audio for visually impaired students than for normally sighted individuals. Talking books, for example, are available for visually impaired students to use in special education programs and in the home. Adjusting instruction all of these groups requires a heavy reliance on media and materials and the appropriate selection of these materials to fit specific purposes. Although severely handicapped students need to be helped through special education classes and courses, the trend today is to “mainstream” students whose disabilities do not preclude them from profiting from exposure to regular classroom activities. Instructional media specifically designed for such students and/o classroom adaptation of media to compensate for physical and mental disabilities can contribute enormously to effective instruction of handicapped students and can help prevent their unwarranted (albeit unintentional) neglect by the busy regular-classroom teacher.

Technologies of instruction

Up to this point we have been discussing ways in which audiovisual media and methods can help improve communication and thereby improve instruction. The emphasis has been on the “things” of instruction—the *products* of technology. But instruction is more than communication alone, and technology *as a process* is a powerful tool for analyzing and solving instructional problems.

The principal definition of *technology* used in this book refers to “the systematic application of scientific or other organized knowledge to practical tasks. Adapting this definition to instruction, we may define *instructional technology* as the application of our scientific knowledge about human learning to the practical tasks of teaching and learning. A *technology of instruction,* thus, is a particular, systematic arrangement of teaching/learning events designed to put our knowledge o learning into practice in a predict able, effective manner to attain specific learning objectives.

Over the years, many such arrangements have been devised, including programmed instruction, computer-based instruction, audio-tutorial systems, modular instruction, and simulation/gaming. Some technologies of instruction incorporate audiovisual media, others do not. Some employ electronic or mechanical devices, but others, such as programmed texts and simulation games, may involve no such devices. However, they all have one thing in common: they focus on the learner and on scientific principles of human learning.

The Dimensions of Technology

In recent years it has become popular to describe applications of technology as “high technology” versus “low technology.” And the usual implication is that “high” is better than “low.” Looking at the items referred to as high technology, we find that the label derives from the sophistication of the *hardware* entailed. Focusing on the media delivery vehicles is understandable; that's the most visible feature. But from an instructional viewpoint, the hardware is seldom the source of the success of a new system.

Looking beyond the obvious dimension of hardware, we find that any new technology of instruction has a second dimension—the *pedagogical.* That is, to what extent does the system embody sophisticated methods of instruction? For example, old- fashioned 'educational" films and television programs, like old-fashioned textbooks, exemplify a primitive pedagogical view—that pouring forth masses of information is an effective means of instruction. One step higher would be a video program incorporating interesting questions and pauses to allow time for the viewer to answer them.

There is a third dimension to any technological system—the simplicity or sophistication of its *management* function. On the high end would be a system with tightly structured rules and procedures organized to adapt flexibly to different users. An example of this would be a computer-assisted tutorial program that guides a medical student through the diagnosis of an illness in a simulated patient. On the low end would be a traditional lecture, which starts when the lecturer is ready, presents a standard chunk of content at the lecturer's preferred pace, and stops when he or she is finished. There is no adaptation to individual listeners' needs.

The three dimensions of technology are illustrated by the cube. The point of this diagram is that any given system can be "high tech" on one dimension but low on the others and that its instructional value does not depend solely or primarily on its *media* sophistication. Let's look at some examples. How about a system that rates only a "1" on each dimension—a 1-1-1 system—such as a loose, rambling lecture. The teacher gives an extemporaneous talk about the causes and events of the War of 1812; only his voice is heard; no audiovisual media are used, not even the listing of key names and dates on the chalkboard. Pedagogically, we see no particular attempt to aid the learning process: no effort by the instructor to highlight key ideas, raise provocative questions, provide a summary, or involve students. The management, too, is primitive: no way for students to change the pace of delivery, review difficult concepts, or get answers to questions that occur to them intermittently throughout the lecture.

We can imagine the same situation with more sophisticated media, for instance, a 3-1-1 (media-pedagogical-management). Now the teacher shows a slide-tape presentation that illustrates scenes from the war and portraits of key individuals, and he uses the overhead projector to present important names and dates. This approach remains low on the pedagogical dimension because it is still basically a one- way message with little involvement and few opportunities for learners to practice their new knowledge. There is still no adaptation to individual differences nor any special structure to the learning episode beyond the structure of the lecture itself—a primitive management system.

What might a *5-5-5* technology of instruction look like? Imagine an interactive video setup employing high-resolution TV linked to a computer. It controls simulation program that is used by pairs of students. Together they play the role of Andrew Jackson on the eve of the Battle of New Orleans in 1815. The video program shows the scene and pauses to provide historical data about the military, political, and economic conditions. It asks the users to decide whether to engage in battle or to await news of the peace talks going on in Ghent. The results of the decision are shown visually and in the form of new political and economic data. And the process continues. Such a program exemplifies a pedagogical design that is interesting, clear, challenging, involving, discovery oriented, and collaborative. The management system is self-paced, adaptive to different student learning strategies, responsive to different choices, and modular. It could also incorporate tests to determine student mastery, sending the student forward only after she demonstrates mastery.

The point of this diagram is that the pedagogical strength and the management flexibility of a technological system are at least as important as—and usually more important than—the glitter of the media component. The intelligent evaluator of the various instructional products on the market will want to be discriminating on *all* of these dimensions. Helping users be discriminating is a major goal of this book.

Systematic Planning for the use of media

Media Selection

For years, educational researchers have been pondering such questions as: "Is there a medium or combination of media that would be best for teaching a particular subject?" and, "Can media be classified according to their effectiveness for teaching certain kinds of facts, concepts, principles, or other generalizations?" No simple answers have been forthcoming. Much of the research in learning with audiovisual materials has been inconclusive, or even contradictory. What has resulted is evidence that many learning experiences might be accomplished equally well by any of a number of media. On the other hand, it has also been shown that a medium that is well adapted for one instructional function may be unsatisfactory for a different purpose, within the same instructional sequence. This suggests that a variety of materials may have to be selected for a given program, with each one doing specifically what it can best do at a specific point in the learning sequence. There are three procedures which are generally used for selecting resources in an instructional program:

1. Selection on the basis of what is readily available. ("The department purchased video equipment, so that's what I must use.")
2. Selection on the basis of what the instructor is most familiar with or most comfortable in using. ("I like filmstrips; therefore I usually use them in each unit I teach.")
3. Selection on a more objective basis whereby some guidelines can be followed so that selection can be justified in a nonsubjective manner. ("We chose the slide/tape format as best fulfilling the criteria established for making media decisions.")

If there are limitations or constraints with equipment, services, or facilities, then possibly the first procedure described above is the only one that could be used. But do note that there are simple resources, like printed paper worksheets or study guides and audiotape, that might be considered even though a major media resource (video, for example) had been given primary attention within an organization.

It should be possible to broaden a person's sights if the second procedure has been followed. Frequently we can demonstrate possibilities and advantages for using alternative resources.

The third procedure above is the one, it is hoped, you will consider employing. It can provide a basis for making logical, educated guesses that will lead to practical resource decisions.

Here is a media selection procedure based on the specific features, sometimes called "attributes," of the various resources. The important attributes are the following:

- Situation for use—Large-group presentation, small-group interaction situation, or for self-paced learning
- Treatment required of subject—Real or symbolic/verbal
- Pictorial representation—Photographic or graphic
- Factor of size—Nonprojected or projected
- Factor of color—Black-and-white or full color
- Factor of movement—Still or motion
- Factor of language—Oral sound or printed words
- Sound/picture relationship—Silent picture or picture with sound

By considering as many of these features as you feel to be important in terms of the learning objectives or requirements of subject content, you do have a basis for selecting media. The best way to do this is to ask a series of questions like the following:

1. "Will the material be presented to a group or will it be used for self- paced learning?" Some resources, like overhead transparencies, are best used for presentations. Others, like materials on paper, are more suitable for self-paced learning. Most can be adapted to either group or individual uses.

2. "Does the content require graphic treatment (design, artwork, lettering, coloring), photography, or a combination of graphics and photography?" Graphics (diagrams, artwork, cartoons, charts) can clarify and simplify complex concepts, but for some needs the truer reality of a photographic form (photographs, slides, film or video recording) may be necessary.

3. “Should visuals be prepared in the form of still pictures or as a motion picture (film or videotape)?” A motion picture is a “transient” medium, requiring learners to grasp the message as each concept or bit of information in the film is being presented. A still picture is a “persistent” medium, allowing a learner to study the message at length. These differences may be important when selecting the visual medium unless an overriding need for motion is critical to the treatment of the subject.

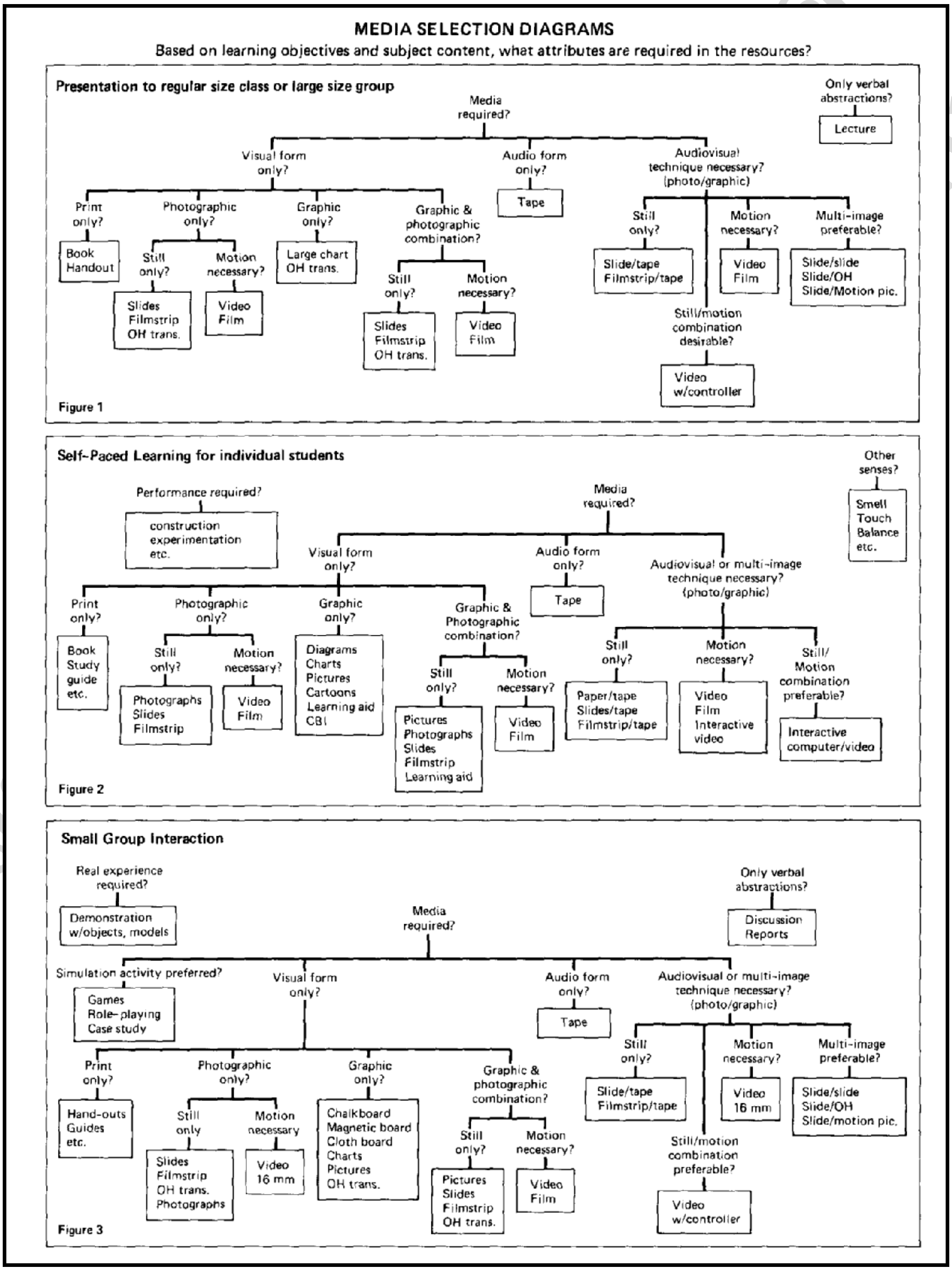
4**.** “Should the visual materials be accompanied by recorded sound?” When used with visuals, sound on tape or film can direct attention, explain details, raise questions, provide answers, and make transitions from one picture or idea to the next one. On the other hand, some subjects can be treated visually so that they have suitable impact without verbal explanations. If necessary, explanatory information can be put on paper to accompany silent visuals.

The above questions illustrate the type of reasoning that can lead to a media decision. If all the features previously listed are considered, a flow diagram for each of the three teaching/learning patterns (presentation, group interaction, and self-paced learning) can be developed. See the media selection diagrams following on page 139. In using a diagram, start with one or a group of related learning objectives and subject content for which you want to select a medium. Decide on an answer for the question or questions at the first level, near the top of the diagram. A “yes” answer to a question will lead you to the next lower level. Answer the questions on that level. Your decision at each level eventually leads to a group of related media from which a final choice can be made. Although each of us might answer a question differently and end at a different place in a diagram, the decision would be acceptable as long as you can justify the answer to each question as you proceed.

Final Media Decision

As the three diagrams (Figures 1, 2, 3) indicate, often your answers lead to a group of related resources near the bottom—for example, to still pictures such as the box containing photographs, slides, filmstrips in Figure 2. Each of these is a still picture form, any one of which may be acceptable as appropriate for accomplishing the topic objectives. The final choice, from among these three still picture resources, should be based on the most practical form to use, considering the relative merits of a number of empirical factors that result from asking the following questions:

- Does the needed material already exist in suitable form and quality?
- What would be the cost of purchase or preparation?
- What are the reproduction or duplicating costs, if any?
- How much time will be required to locate or prepare the material?



• What are the production requirements for equipment, facilities, and technical skills?

• Is one medium more suitable than the others because of ease of viewing or handling by learners?

• Will there be any problems regarding equipment, facilities, supervision, and scheduling for use?

• Will there be problems in the maintenance and storage of the materials for future use?

• Do you have evidence that learners may prefer to use one kind of material over the other ones?

• Does the instructor have a preference for use?

In order to answer some of these questions, the assistance or opinions of qualified media specialists may be desirable. You will find that some materials will rate high on one criterion, moderate on a second, and possibly low on a third. Prepare a table or *matrix* like the one illustrated in Table 9.1.' Mark the appropriate boxes. You will quickly see how each medium rates with respect to the criteria you wish to use. By following this procedure, you will have an objective basis on which to make the final media decision.

Summary

One or more resources are required to support the teaching/learning activities that have been chosen to carry out the instruction. Resources can be selected from specific items within six categories. A selection procedure has been described in this chapter which can assist you to make the most appropriate choice for your situation.

The ASSURE Model

All effective instruction requires careful planning. Teaching with instructional media is certainly no exception to this educational truism. This chapter examines how to plan systematically for the effective use of instructional media. We have constructed a procedural model to which we have given the acronym ASSURE, because it is intended to *ASSURE effective use of media in instruction.*

The ASSURE model, a procedural guide for planning and delivering instruction that incorporates media, assumes that training or instruction really is required (e.g., students don't know how to use the new laboratory microscopes, or assembly line workers must learn to handle safely the toxic materials they work with).

Unneeded or redundant instruction may be regarded as a fairly trivial nuisance in academic settings, but in business/industry training **it** is recognized as a major waste of time and money. Nevertheless, such instruction sometimes occurs, because training is the most obvious solution to performance problems. For example, the sales force of Amalgamated Houseware Industries is falling short of its target in sales of dustpans. So the marketing vice-president suggests that the training department develop a self-instructional motivational videocassette on 'Dynamic Dustpan Sales Techniques." In reality, **it** may be that the salespeople already *know* how to sell dustpans, but that Amalgamated dustpans are notoriously poorly engineered, or that the whole market for dustpans is depressed, or that higher commissions can be earned on other products in the Amalgamated line. If the cause of the problem is not a lack of knowledge, training will not solve the problem. Techniques for properly diagnosing learning needs or the sources of performance problems include needs assessment and front-end analysis (i.e., analysis prior to a commitment to design instruction).

The ASSURE model focuses on planning surrounding the actual classroom *use* of media. It is less ambitious than models of *instructional development,* which intend to guide the entire process of designing instructional systems. Such models include the processes of needs analysis, subject- matter analysis, product design, prototype tryout, system implementation, and the like. These larger-scale instructional development procedures typically involve teams of specialists and require major commitments of time and money. (Further information about instructional development can be found under that heading in the print references cited at the end of this chapter.) The ASSURE model, on the other hand, is meant for use by the individual instructor for planning everyday classroom use of media.

A: Analyze Learners

If instructional media are to be used effectively, there must be a match between the characteristics of the learner and the content of the lesson and its presentation. The first step in the ASSURE model, therefore, should be analysis of your audience.

It is not feasible to analyze every psychological or educational trait of your audience. There are, however, several factors about your learners that are critical for making good media and method decisions. First, in the category of *general characteristics* are broad identifying descriptors such as age, grade level, job/position, and cultural or socioeconomic factors. General characteristics are factors that are not related to the content of the lesson. These factors help you to determine the level of the lesson and to select examples that will be meaningful to the given audience. Under the heading of *specificentry competencies* you should think about content-related qualities that will more directly affect your decisions about media and methods: prerequisite skills (Do learners have the knowledge base required to enter the lesson, such as the technical vocabulary?), target skills (Have learners already mastered some of the skills you are planning to teach?), and attitudes (Are there biases or misconceptions about the subject?). A third factor, *learning style,* refers to the whole spectrum of psychological traits that affect how we perceive and respond to different stimuli, such as anxiety, aptitude, visual/auditory preference, and so on. The issue of what constitutes learning style, how it can be measured, and how it can be factored into educational decision making is still very much open. Because it is still such an innovative issue.

General Characteristics Even a superficial analysis of learner characteristics can provide helpful leads in selecting instructional methods and media. For example, students with substandard reading skills may be reached more effectively with nonprint media. If you are dealing with a particular ethnic or cultural subgroup, you might want to give high priority to considerations of ethnic/cultural identity in selecting particular materials. If learner apathy toward the subject matter is a particular problem, consider using a highly stimulating instructional approach, such as a dramatic videotape or a simulation game. If you have a group diverging widely in background, consider self-instructional materials to allow self-pacing and other aspects of individualization.

Learners entering a new conceptual area for the first time will need more direct, concrete kinds of experiences (e.g., field trips, role playing). The more advanced have a sufficient base for using audiovisual or even verbal materials.

Heterogeneous groups including learners varying widely in their conceptual sophistication or in their amount of firsthand experience with the topic can profit especially from an audiovisual experience like a film or videotape. The media presentations provide a common experiential base that can serve as an important point of reference for subsequent group discussion and individual study.

For instructors dealing with a familiar audience, analysis of general characteristics will be some thing of a given. At times, however, audience analysis may be more difficult. Perhaps your students are new to you, and you have had little time to observe and record their characteristics. Perhaps your learners are a more heterogeneous group than is or narily found in the classroom— business trainees, for example, a civic club, a youth group, or a fraternal organization—thus making it more difficult to ascertain all or even a majority of your learners are ready for the media and method of instruction you a considering. In such cases, academic and other records may be helpful, as may direct question of and conversation with learners and group leaders.

Specific Entry Competencies When you begin to plan any lesson, your opening assumption is that the learners *lack* the knowledge or skills you are about to teach and that they *possess* the knowledge or skills needed to understand and learn from the lesson. In reality, these assumptions are often mistaken. For example, a life insurance company used to routinely bring all i new sales associates back to the home office in Hartford, Conned cut at the end of their first year f a course on setting sales priorities. Puzzled by the cool reception given by the agents, the trainer decided to give a pretest, which revealed that a majority of the trainees already knew perfectly well how to set sales priorities. The company shifted to a less expensive and more productive strategy of giving incentives to field representatives who sent in acceptable sales plans showing their priorities.

The second assumption—that learners have the prerequisite knowledge or skill to begin the lesson—can seldom be accepted casually in school settings. Teachers of mixed-ability classes routinely anticipate that some students will need remedial help before they are ready to begin a particular new unit of instruction. Further, researchers studying the impact of different psychological traits on learning have reached the unexpected conclusion that a student's *prior knowledge* of a particular subject influences how and what he or she can learn more than does any psychological trait. For example, students approaching a subject new to them learn best from *structured* presentations (even if they have learning style that would otherwise indicate more open-ended, unstructured methods).

These realizations underline the importance of verifying assumptions about entry competencies through informal means, such as in-class questioning or out-of-class interviews, or more formal means, such as testing with standardized or teacher-made tests. *Entry tests* refer to assessments, both formal and informal, that determine whether or not the student possesses the necessary prerequisites (entry skills). *Prerequisites* are those competencies that the learner must possess in order to benefit from the instruction, but that you or the media are not going to teach. For example, you may be teaching an apprentice lathe operator to read blueprints and assume that he or she has the ability to make metric conversions—and hence not teach this. Such previously acquired skills are properly referred to as prerequisites and should be assessed before instruction by use of an entry test.

Pretests are also given before instruction but are used to measure the content to be taught. If the learners have already mastered what you plan to teach, you are wasting your time and theirs by "teaching" it.

S: State Objectives

The second step in the ASSURE model for using instructional media is to state the objectives of instruction. What learning goal is each learner expected to reach? More precisely, what new *capability* should the learner possess at the completion of instruction? Thus, an objective is a statement not of what the instructor plans to *put into* the lesson but of what the learner ought to *get out of* the lesson. Your statement of objectives should be as specific as possible. For example, 'My students will improve their mathematical skills" is far too general to qualify as a specific lesson objective. It does, however, qualify as a "goal' '—that is, a broad statement of purpose. Such a goal might serve as the 'umbrella for a number of specific objectives, such as "The second-grade students will be able to solve correctly any single-digit addition problem."

Why should you state instructional objectives? In the first place, you must know your objectives in order to make the correct selection of media and methods. Your objectives will, in a sense, dictate your choice of media and your sequence of learning activities. Knowing your objectives will also force you to create a learning environment in which the objectives *can* be reached, For example, if the objective of a unit of a driver's training course is "to be able to change a flat tire within fifteen minutes," the learning environment must include a car with flat tire. If, on the other hand, the unit objective is "to be able to name and describe the tools necessary to change a flat tire," a driver's manual or textbook would probably suffice.

Another basic reason for stating your instructional objectives is to help assure proper evaluation. You won't know if your learners have achieved an objective unless you are absolutely sure what that objective is. For information on deriving test items from objectives, see pages 57—58. Particularly note the box titled "Test Items: General"

Without explicit objectives your students won't know what is expected of them. If objectives are clearly and specifically stated, learning and teaching become objective-oriented. Indeed, a statement of objectives may be viewed as a type of contract between teacher and learner: "Here is the objective. My responsibility as the instructor is to provide learning activities suitable for your attaining the objective. Your responsibility as the learner is to participate conscientiously in those learning activities."

S: Select Media and Materials

A systematic plan for *using* media certainly demands that the media be *selected* systematically in the first place. The selection process will be presented here in two stages: **(1)** choosing an appropriate media format and (2) selecting, modifying, or designing the specific materials within that format.

Choosing a Media Format Choosing a media format can be a very complex task, considering the vast array of media available, the infinite variety among learners, and the objectives to be pursued. Over the years many different formulas have been proposed for simplifying the task. They are referred to as media selection models, and they usually take the form of flowcharts or checklists.

Within most media selection models the instructional situation or *setting* (e.g., large-group, small-group, or self-instruction), learner variables (e.g., reader, nonreader, or auditory preference), and the nature of the *objective* (e.g., cognitive, affective, motor skill, or interpersonal) must be considered against the *presentational capabilities* of each of the media formats (e.g., presenting still visuals, motion visuals, printed words, or spoken words). Some models also take into consideration the capability of each format to give *feedback* to the learner. One of the most recent and comprehensive models is that of Reiser and Gagne.* The user is first asked to specify the instructional *setting,* which includes both the grouping arrangement and one major learner variable—reader versus nonreader. The choices of setting are as follows: instructor with readers, instructor with nonreaders, self-instruction with nonreaders, and central broadcast. Within each of these settings the user then specifies what *objective* is being pursued. This decision leads to a short list of "candidate" media. illustrates one of Reiser and Gagne's flowcharts—for the setting of "instructor with readers."

The limitation of any such media selection model is the trade-off between simplicity and comprehensiveness: reducing the process to a short checklist forces one to ignore some possibly important considerations. For example, the Reiser and Gagne model ignores all learner characteristics except reading ability; it ignores such settings as tutorial and small group; it ignores or downplays such media formats as simulation, gaming, manipulative materials (tactile), and direct immersion experiences (kinesthetic).

Our approach in this book is to give you the tools to construct your own schema for selecting appropriate media formats. We accept the desirability of comparing the demands of the setting, learner characteristics, and objectives against the attributes of the various media formats. But only *you* can decide how to weight these considerations: what options you have in terms of setting, which learner characteristics are most critical, and what elements of your objectives are most important in your own situation. You will have to make your own trade-off between simplicity and comprehensiveness of the schema you will employ.

Obtaining Specific Materials: Select, Modify, or Design? Having decided what media format suits your immediate instructional objective, you face the problem of finding specific materials to convey the lesson. This is certainly one of the most important problems that instructors face, given the research finding that on the average 90 to *95* percent of instructional class time is spent on activities based on the use of instructional materials. Obtaining appropriate materials will generally involve one of three alternatives: (1) selecting available materials, (2) modifying existing materials, or (3) designing new materials. Obviously, if materials are already available that will allow your students to meet your objectives, these materials should be used to save both time and money. When the media and materials available do not match your objectives or are not suitable for your audience, an alternate approach is to modify the materials. If this is not feasible, the final alternative is to design your own materials. Even though this is a more expensive and time-consuming process, it does allow you to prepare materials to serve your audience precisely and meet your objectives.

Selecting Available Materials The majority of instructional materials used by teachers and trainers are *"off* the shelf"—that is, ready-made and available from school, district, or company collections or other easily accessible sources. How do you go about making an appropriate choice from available materials?

Survey of Sources. Your first step might be to survey some of the published media reference guides to get a general idea of what is available. Unfortunately, no single comprehensive guide exists to all audiovisual materials available in all media formats in all subjects; you may have to consult several sources for a given problem. One of the more comprehensive sources is the set of indexes published by NICEM (National Information Center for Educational Media). The NICEM indexes are arranged according to media format—e.g., slides, filmstrips, overhead transparencies, and 16-mm films. In addition, there are several indexes devoted to specific topics, cutting across multiple media formats—e.g., environmental studies, health and safety, psychology, and vocational/technical education. These indexes do not include evaluations.

There also is a separate data bank for information and materials on special education: NICSEM (National Information Center for Special Education Materials). NICSEM publications provide information on the content of materials and their applicability to specific handicapping conditions. This information is intended to help in preparing individualized education plans for handicapped learners. (See Appendix A for details about NICEM and NICSEM.)

If you are working in elementary or secondary education, there are several additional sources that cover a broad range of media formats; for example, *Core Media Collection for Elementary Schools* and *Core Media Collection for Secondary Schools.* These books recommend specific audiovisual titles as core materials for elementary and secondary school library collections.

For general and adult audiences, a major reference source is the *Reference List ofAudiovisual Materials Produced by the United States Government.* It describes all the training and educational materials produced by the armed forces and other government agencies that are available for general purchase. (See Appendix A for further details on all the reference sources discussed here.) Beyond the sources just described, you will have to turn to the more specialized guides and indexes that are limited to specific media formats or specific subjects. These are too many and too diverse to list here, but some are mentioned in the individual chapters dealing with different media formats, and others are gathered under the heading of "Specialized Information Sources" in Appendix A. Also, see Appendix B for sources of free and inexpensive materials.

Selection Criteria. The actual decision about whether to use a particular piece of instructional material depends on several factors. Among the major questions to ask are the following:

• Do the objectives of the material match my own?

• Do my learners have the required entry capabilities (reading ability and vocabulary level are often important)?

• Is the information accurate and up-to-date?

• Is the presentation likely to arouse and maintain interest?

• Does it promote active involvement of learners?

• Is the technical quality acceptable?

• Has the producer provided evidence of effectiveness, such as results of field tests?

• Is it free from objectionable bias?

Over the years scholars have debated over what should be *the* criteria applied in selecting materials. Studies have been conducted to try to quantify and validate various criteria. The net result is an understanding that different criteria are suitable for different situations. For example, a remedial reading teacher might decide to use a particular filmstrip primarily because its vocabulary level is just right, regardless of any other qualities. On the other hand, an elementary school teacher with a class that is very diverse ethnically might sort through materials with a special sensitivity to racial and ethnic portrayals.

Further, different media formats raise different issues. Film and video materials, for example, raise the issue of the pace of presentation, whereas this would not be relevant for overhead transparencies. In examining computer- assisted instruction courseware, one would look for relevant practice and remedial feedback, but these would not be expected in a filmstrip. To account for these differences this book provides a separate Appraisal Checklist for each media format. You will notice that certain criteria appear consistently in each checklist (they are all listed in the table of contents). These are the criteria that we feel have the securest basis in research and real-life experience. The Appraisal Checklists have been provided to give you a systematic procedure for judging the qualities of specific materials. But it's up to you to decide which criteria are most important to you in your own instructional setting.

The Instructor's Personal File. Every instructor should develop a file of media references and appraisals for personal use. This personal file card need not be as detailed as the appraisal form. What you are primarily interested in recording is instructional strengths and weaknesses. Figure 2.7 illustrates a suggested personal file form that is relatively simple and will fit on a 4-by-6- inch card. Under "synopsis," you can note the overall content of the item. Under "utilization pointers and problems," you might note information about vocabulary used in the material, lack or inclusion of opportunities for student response, timeliness of the content, inclusion of sensitive topics, and so on.

Modifying Available Materials If you cannot locate entirely suitable materials and media off the shelf, you might be able to modify what is available. This can be both challenging and creative. In terms of time and cost, it is a more efficient procedure than designing your own materials, although type and extent of necessary modification will, of course, vary. Perhaps the only visual available showing a piece of equipment being used in a junior high woodworking class is from a repair manual and contains too much detail and complex terminology. A possible solution to the problem would be to use the picture but modify the caption and simplify or omit some of the names of the labelled parts.

In a business or industry new employee orientation program, you may be using a slide set developed by corporate headquarters. Where possible and appropriate, you can replace existing slides with slides showing local facilities and local personnel. Or perhaps there is just one film available that shows a needed visual sequence, but the audio portion of the film is inappropriate because it is at too high or too low a conceptual level or discusses inappropriate points. In such a case, a simple solution would be to show the film with the sound turned off and provide the narration yourself. Another modification technique, which many instructors overlook, is to show just a portion of a film, stop the projector, discuss what has been presented, then continue with another short segment followed by additional discussion. A similar approach may be used for sound filmstrips with audiotape. *You* can rerecord the narration and use the appropriate vocabulary level for your audience—and even change the emphasis of the visual material. If a transcript of the original narration is available, you probably will want to refer to it as you compose your own narration.

Modification also can be made in the audio portion of foreign language materials (or English language materials used in a bilingual classroom). Narrations can be changed from one language to another or from a more advanced rendition of a foreign language to a simpler one. Videocassette recorders now provide teachers with the opportunity to modify television programs that previously were available only as shown on the air. With video playback units available in most schools, many producers now distribute programs having educational potential in videotape format. Programs may also be recorded off the air for replay on playback units.* Procedures and practices for modification of videotape are much the same as for film (as noted previously). Videocassette recorders also, of course, give the teacher much more flexibility in using television programs for instructional purposes. Programs can be shown at whatever time best suits the instructional situation and to whatever student group or groups that can best profit from viewing them.

One frequently modified media format is a set of slides with an audiotape. If the visuals are appropriate but the language is not, *it is* possible to change the language. It also is possible to change the *emphasis of* the narration. For example, an original audiotape might emphasize oceans as part of an ecosystem, whereas the teacher may want to use the slides to show various types of fish found in oceans. By rewriting the narration, the teacher could adapt the material to his or her purpose while using the same slides. Redoing the tape can also change the *level* of the presentation. A slide-tape presentation produced to introduce a new product could have three different audiotapes. One tape could be directed toward the customer, another could be prepared for the sales staff, and the third for the service personnel.

Instructional games can be readily modified to meet particular instructional needs. It is possible to use a given game format and change the rules of play in order to increase or decrease the level of sophistication. Many instructional games require the players to answer questions. It is relatively easy for the teacher to prepare a new set of questions at a different level of difficulty or even on a new topic.

If you try out modified materials while they are still in more or less rough form, you can then make further modifications in response to student reaction until your materials meet your exact needs. A word of caution about modifying commercially produced materials (and, indeed, about use of commercial products in general): be sure your handling and use of such materials does not violate copyright laws and restrictions. If in doubt, check with your school administrator or legal advisor.

Designing New Materials It is easier and less costly to use available materials, with or without modification, than to start from scratch. There is seldom justification for reinventing the wheel. However, there may be times when your only recourse is to design your own materials. As is the case with selecting from available materials, certain basic considerations must be taken into account when designing new materials. For example:

Objectives—What do you want your students to learn?

Audience—What are the characteristics of your learners? Do they have the prerequisite knowledge and skills to use and/or learn from the materials?

Cost—Is sufficient money available in your budget to meet the cost of supplies (film, audio- tapes, etc.) you will need to prepare the materials?

Technical expertise—Do you have the necessary expertise to design and produce the kind of materials you wish to use? If not, will the necessary technical assistance be available to you? (Try to keep your design within the range of your own capabilities. Don't waste time and money trying to produce slick professional materials when simple inexpensive products will get the job done.)

Equipment—Do you have available the necessary equipment to produce and/or use the materials you intend to design?

Facilities—If your design calls for use of special facilities for preparation and/or use of your materials, are such facilities available?

Time—Can you afford to spend whatever time may be necessary to design and produce the kind of materials you have in mind?

U: Utilize Materials

THE next step in the ASSURE model is the one that all the other steps lead up to and away from: the presentation itself. To get maximum learning impact from your presentation, you must follow certain utilization procedures identified in formal research stretching back to U.S. military training in World War II and the practical experience of several generations of teachers: in short, preview the materials, practice the presentation, prepare the environment, prepare the audience, and present.

Preview the Materials No instructional materials should be used blind. During the selection process you should have determined that the materials are appropriate for your audience and objectives. Published reviews, reports of field tests, distributors' blurbs, and colleagues' appraisals all add evidence. However, the prudent instructor will insist on previewing the materials. Only such detailed familiarity with the contents can enable you to wrap the lesson around the audiovisual material properly.

For example, an industrial trainer ordered a videotape on fraction-to-decimal conversions. The information describing the videotape indicated that the content was exactly what many of the company employees needed. The videotape arrived ten days before the presentation, but the trainer did not take time to preview **it.** When the videotape was shown, **it** met with giggles and laughs; although the content was appropriate, the videotape was addressed to an elementary school audience. The adults were understandably distracted by the level of the narration and the examples used.

In addition, sensitive content may need to be eliminated or at least discussed prior to showing to prevent student embarrassment and/or impediment of learning. In one case, an elementary teacher and her young students were horrified to find that an unpreviewed and ostensibly unobjectionable film on Canada's fur seals contained a sequence showing baby seals being coldbloodedly clubbed to death by hunters.

Practice the Presentation After previewing the materials, you should practice your portion of the presentation. It is advisable to go through the presentation at least once well in advance and then to review your notes immediately before the presentation. However, do not overpractice, or the presentation will sound 'canned." Some presenters prefer to practice before a mirror; others like to have a colleague or friend present to provide feedback. Media can be used to provide a "replay" of your practice. An audiotape recording will let you hear how you sounded—what you said and how you said **it.** If you are concerned about how you look, how you handle manipulable objects, or whether or not you have any distracting mannerisms, you should use a video recording. The camera and recorder can be set up in the rear of the room, turned on, and allowed to operate while you go through the presentation.

The newness of the material, the importance of the presentation, and the amount of time available will determine how many times you practice and the type of "mirror" you use—a real mirror, a friend, an audiotape recorder, or a videotape recorder. The importance of practice cannot be overstated. Don't just "walk through it" in your mind; actually stand up and perform as you will in front of your group.

Prepare the Environment Wherever the presentation is to take place—classroom, auditorium, meeting room, or whatever—the facilities will have to be put in order. Certain factors are taken for granted for any instructional situation—comfortable seating, adequate ventilation, climate control, suitable lighting, and the like. Utilization of many media requires a darkened room, a convenient power supply, and access to light switches. At the least the instructor should check that the equipment is in working order and should arrange the facilities so that all the audience can see and hear properly.

Prepare the Audience Research on learning tells us very clearly that what is learned from a presentation depends highly on how the learners are *prepared* for the presentation. In everyday life we notice that entertainers are obsessed with having the audience properly warmed up. Nobody wants to come after "a hard act to follow" or to come on "cold." The same applies to media.

Proper *warm-up,* from an instructional point of view, will generally consist of an introduction including a broad overview of the content of the presentation, a rationale of how it relates to the topic being studied, a motivation (creating a "need to know"—how the learner will profit from paying attention), and cues directing attention to specific aspects of the presentation. Several of these functions— directing attention, arousing motivation, providing a rationale— may be served simply by informing the viewers of the specific objectives.

In certain cases, other steps will be called for. For example, unfamiliar vocabulary may need to be introduced, or special visual effects, such as time-lapse photography, may need explanation. Other preparation steps relevant to particular media will be discussed in later chapters.

Present the Material This is what you've been preparing for, so you will want to make the most of it. Our term for this is *showmanship.* Just as an actor or actress must control the attention of an audience, so must an instructor be able to direct attention in the classroom. The later chapters on individual media point out "showmanship" techniques relevant to each specific media format. General showmanship tips for all types of presentations are given in this chapter.

R: Require Learner Performance

The fifth step in the ASSURE model is to provide opportunities for learners to practice the capability being taught. Educators have long realized that participation in the learning process by the learner enhances learning. In the early 1900s, John Dewey urged reorganization of the curriculum and instruction to make student participation a central part of the process. Later, behavioral psychologist such as B. F. Skinner demonstrated that instruction providing for constant reinforcement of desired behaviors is more effective than instruction in which responses are not reinforced. More recently, cognitive theories of learning, which focus on the internal mental processes, have also supported the principle that effective learning demands active manipulation of information by learners. Gagne* has concluded that there are several necessary "conditions" for effective learning of each type of objective; the one condition that pertains to *all* objectives is *practice* of the desired skill.

The implication for designers and instructors is clear. The most effective learning situations are those that require learner performance of activities that build toward the objective. The form of the participation may range from repetitive drill of new spelling or vocabulary words, to solving math problems on a worksheet, to rehearsal of a basketball play, to construction of a product such as a term paper. Responses may be overt (outwardly observable) or covert (internal, not observable). An overt performance would be, for example, manipulating task cards illustrating the stages of mitosis. A covert performance could be silent repetition of phrases heard on a French language tape. Some media formats lend themselves to participation more than others—at least on the surface. For example, student response to projected still pictures is easier to manage than response to a motion picture. Learners can read or elaborate on captions in filmstrips, discuss what is on the screen, or refer to other materials while the image is held on the screen. (Substitution of sound filmstrips for silent ones tends to weaken this advantage.) However, learners can also participate in and respond to the showing of a film. For example, May and Lumsdame demonstrated that overt responses (vocalized verbal responses) during a film improved learning. The same authors cited research demonstrating that psychomotor skills are learned better if practiced while the skills are being performed in a film.* Overt written responses during the showing of film (or any other fixed-pace medium) have been shown to facilitate learning, unless the responses are so involved that students are prevented from watching the film.

AV Showmanship - GENERAL TIPS

- **You are a medium.**

Most audiovisual presentations include some sort of live performance by the instructor, perhaps as narrator or actor, perhaps as both. As a performer, you become an important component of the medium. Indeed, in a sense, you yourself become a medium, one that must perform effectively if your presentation is to be successful.

Be natural. Your audience will quickly sense affectation. Do not try to be someone or something you are not. But, by all means be enthusiastic! Successful actors know that their "energy level" directly affects audience response.

Avoid distracting mannerisms. Do you have an annoying habitual mannerism—smoothing your hair, twisting your watch, clicking a ballpoint pen—or a "verbal tic" such as inserting "um" or "you know" at every pause? Such mannerisms can become very annoying to an audience. The listener stops hearing the message and begins concentrating on the mannerism. The first step toward controlling such distractors is to become aware of them. Videotaping yourself in action can be an effective aid to discovering and correcting them.

- **Your classroom is a stage.**

When you are making a presentation from the front of a classroom, you are functioning like an actor on the stage. Your impact on the audience can be strengthened by observing a few of the basic principles of stagecraft.

Strong Areas. The front of the classroom, the "stage," can be divided into six sections, as shown in Figure A. Note that the front (near the audience) is generally stronger than the back, and that the center is stronger than either side. Of the two sides, the left (as seen by the audience) is stronger than the right.

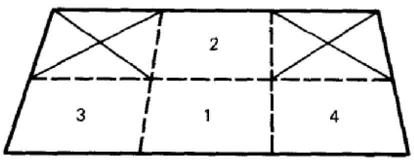


Figure A. The sectors of the "stage" vary in strength, with the front center strongest and the rear corners weakest.

The audiovisual presenter can use these strengths and weaknesses to good psychological advantage by using position to feature the dominant points of a presentation. See, for example, Figures B, C, and D.

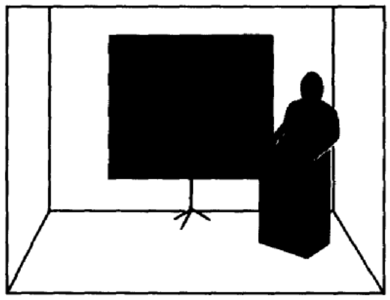


Figure B. In this example the screen, because of its placement in the center, has dominance over the presenter.

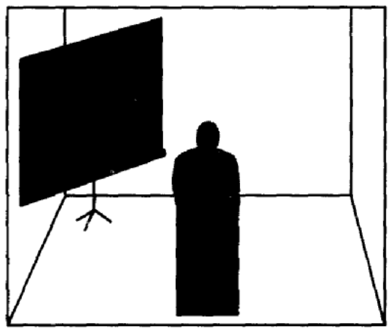


Figure C. Here the presenter, situated at the front center, has more dominant placement.

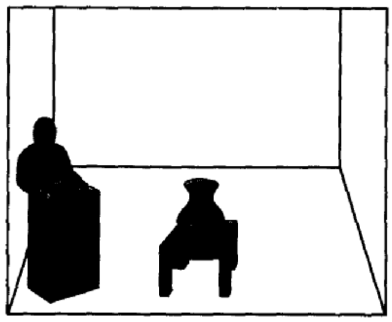


Figure D. Here the presenter is in a moderately strong location, but the display table, at the front center, takes precedence.

Body Position. Facing the audience full-front is the strongest position. Three-quarters full-front is weaker; profile is weaker yet. Weakest is the one-quarter view, with the back nearly turned toward the audience. The use of chalkboards or charts will push you toward the weak position unless you consciously avoid it. (See Figures E, F, G and H.)

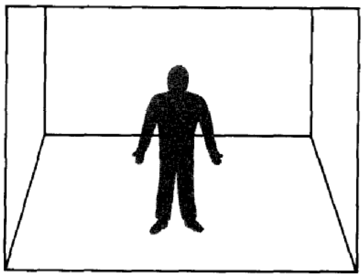


Figure E. The full-front body position is the strongest one.

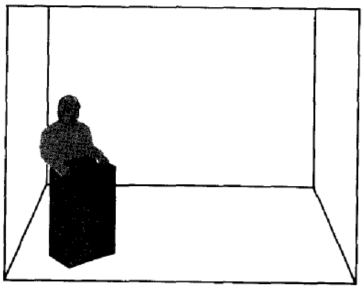


Figure F. Three-quarters full front is the second strongest body position.

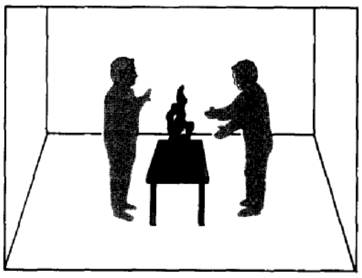


Figure G. Standing in profile, these figures are in a rather weak body position.

Movement. Given a static scene, any movement attracts the eye. This is one reason that nervous gestures are objectionable; they may distract attention from a point to be made. But movement can also be used positively to underscore important points. Experienced speakers often signal the beginning of a new topic by pausing and shifting their position, possibly walking to a different part of the room. But some movements are definitely stronger than others. As illustrated in Figure I, the strongest movement is toward the front center of the "stage" from one of the weaker areas. Conversely, the weakest movement is away from the front center, especially toward a corner.

In Figure G, if the speaker leaves the lectern to approach the display table, he or she will be executing a very strong movement that will add dramatic emphasis to the presentation.

- **Keep it light.**

A relaxed environment has been shown to increase suggestibility, a state conducive to rapid, effective learning. Humor can be very effective in establish-

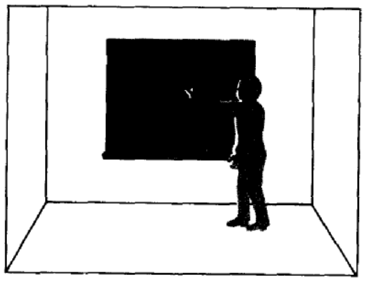


Figure H. A one-quarter view is the weakest body position.

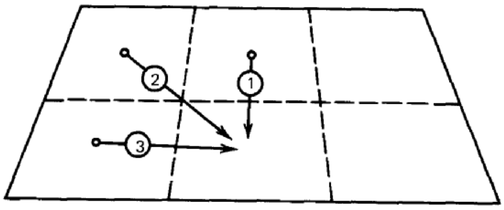


Figure I. The three stage movements shown here give the greatest emphasis to the presenter (in the order indicated by the numbers).

Immediate confirmation of a *correct* response is particularly important when working with students of lower-than-average abilities. For such students, evidence of immediate success can be a strong motivating force for further learning.

Discussions, short quizzes, and application exercises can provide opportunities for response and reinforcement during instruction.

Follow-up activities can provide further opportunities. Teacher guides and manuals written to accompany instructional materials often contain suggested techniques and activities for eliciting and reinforcing student response.

Research on the internationally renowned television series “Sesame Street” and “Electric Company” demonstrates impressively the importance of following up a media presentation with practice activities. Research on “Sesame Street” showed that frequent viewers not only learned the specific skills aimed at but also had higher scores on a test of verbal IQ and more positive attitudes about school. Johnston* pointed out, though, that “parental encouragement and supplementary materials were essential to achieving the effects observed.” In the case of “Electric Company,” children with low reading ability who watched the programs *in school* under teacher supervision showed significant reading improvement. Johnston concluded that “learning definitely did occur when viewing was insured, and when teachers supplied additional learning materials and helped the children to rehearse the material presented on television.”

E: **Evaluate / Revise**

The final component of our ASSURE model for effective learning is evaluation. The most frequently thought of type of evaluation is the paper-and-pencil test; the most frequently thought of purpose, to measure student achievement. There are, however, many purposes of evaluation. Three that we will discuss here are evaluation of learner achievement, evaluation of media and methods, and evaluation of the instructional process.

Evaluation of Learner Achievement The ultimate question in the instructional process is whether or not the students have learned what they were supposed to learn. Can they display the capabilities specified in the original statement of objectives? The first step in answering this question was taken back near the beginning of the ASSURE process, when you formulated your objectives, including in that statement of objectives a *degree* or *criterion* of acceptable performance. You now want to assess whether the learner’s new skill meets that criterion.

The method of evaluating achievement depends on the nature of the objective. Some objectives call for relatively simple cognitive skills; for example, recalling Ohm’s law, distinguishing adjectives from adverbs, describing a company’s absence policy, or summarizing the purposes of the European Common Market. Objectives such as these lend themselves to conventional written tests or oral examinations.

Other objectives may call for process-type behaviors (for example, conducting an orchestra, performing a forward roll on a balance beam, operating a metal lathe, or solving quadratic equations), the creation of products (a sculpture, a written composition, a window display, or an account ledger), or the holding of attitudes (tolerating divergent political opinions, appreciating expressionist painting, observing safety procedures while on the assembly line, or contributing money to community charities).

The evaluation procedures should be directly correlated with the objectives stated earlier in the ASSURE model. See the box titled "Test Items: General" for examples. Capabilities of the process, product, or attitude type could be assessed to some extent by means of written or oral tests. But test results would be indirect and weak evidence of how well the learner has mastered the objective. More direct and stronger evidence would be provided by observing the behavior *in action.* This implies setting up a situation in which the learner can demonstrate the new skill and the instructor can observe and judge it.

In the case of process skills, a performance checklist can be an effective, objective way of recording your observations, as shown with the checklist for driving skills. Other types of activities that can be properly evaluated through performance checklists are sales techniques, telephone- answering skills, and face-to-face customer relations. During the instructional process these types of activities may need to be evaluated in a simulated situation, with other learners, or with the instructor role playing the customer/ client. For product skills, a product rating checklist can guide your evaluation of critical subskills and make qualitative judgments more objective, as in the accompanying example regarding welding. Other types of products that lend themselves to evaluation by a rating scale include pastry from a bakery, compositions in an English course, and computer programs.

Attitudes are admittedly difficult to evaluate. For some attitudinal objectives, long-term observation may be required to determine if the goal has really been attained. In day-to-day instruction we usually have to rely on what we can observe here and now, however limited that may be. A commonly used technique for making attitudes more visible is the attitude scale, an example of which is shown regarding biology. A number of other suggestions for attitude measurement can be found in Robert Mager's *Developing Attitude Toward Learning* *

Evaluation of Media and Methods Evaluation, as previously noted, also includes assessment of instructional media and methods. Were your instructional materials effective? Could they be improved? Were they cost effective in terms of student achievement? Did your presentation take more time than it was really worth? Particularly after first use, instructional materials need to be evaluated to determine if future use, with or without modification, is warranted. The results of your evaluation should be entered on your personal file form. Did the media assist the students in meeting the objectives? Were they effective in arousing student interest? Did they provide meaningful student participation? Class discussions, individual interviews, and observation of student behavior should be used to sound out evaluation of instructional media and methods. Failure to attain objectives is, of course, a clear indication that something is wrong with the instruction. But student reaction to your instructional unit can be helpful in more subtle ways. Student—teacher discussion may indicate that your audience would have preferred independent study to your choice of group presentation. Or perhaps viewers didn't like your selection of overhead transparencies and feel they would have learned more if a film had been shown. Your students may let you know, subtly or not so subtly, that your own performance left something to be desired.

You may solicit learner input on the effectiveness of specific media such as a film or videotape. You may design your own form or use one similar to the "Module Appraisal Form."

Evaluation of the Instructional Process Although ultimate evaluation must await completion of the instructional unit, evaluation is an ongoing process. Evaluations are made before, during, and after instruction; for example, before instruction, learner characteristics are measured to ensure that there is a fit between student skills and the methods and materials you intend to use. In addition, materials should be appraised prior to use, as noted earlier in this chapter. During instruction, evaluation may take the form of student practice of a desired skill, or it may consist of a short quiz or self-evaluation. Evaluation during instruction usually has a diagnostic purpose—that is, it is designed to detect and correct learning/teaching problems and difficulties in the instructional process which may threaten attainment of objectives.

Evaluation is not the end of instruction. It is the starting point of the next and continuing cycle of our systematic ASSURE model for effective use of instructional media.

Revision The final step of the instructional cycle is to sit back and look at the results of your evaluation data gathering. Where are there discrepancies between what you intended to happen and what did happen? Did the student achievement fall short on one or more of the objectives? How did students react to your instructional methods and media? Are you satisfied with the value of the materials you selected? If your evaluation data indicate shortcomings in any of these areas, now is the time to go back to the faulty part of the plan and revise it. The model works, but only if you *use* it to upgrade the quality of your instruction constantly.

Summary The ASSURE Model

Analyze Learners The first step in planning is to identify the learners. Your learners may be students, trainees, or members of an organization such as a Sunday school, civic club, youth group, or fraternal organization. You must know your students to select the "best" medium to meet the objectives. The audience can be analyzed in terms of (1) general characteristics and (2) specific entry competencies—knowledge, skills, and attitudes about the topic.

State Objectives The next step is to state the objectives as specifically as possible. The objectives may be derived from a needs assessment or a course syllabus, stated in a textbook, taken from a curriculum guide, or developed by the instructor. Wherever they come from, they should be stated in terms of what the learner *(audience)* will be able to do as a result of instruction *(behavior).* The *conditions* under which the student or trainee is going to perform and the *degree* of acceptable performance should be included.

Select Media and Materials Once you have identified your audience and stated your objectives, you have established the beginning (audience's present knowledge, skills, and attitudes) and the ending points (objectives) of instruction. Your task now is to build a "bridge" between these two points. There are three options: (1) select available materials, (2) modify existing materials, or (3) design new materials.

Utilize Materials Having either selected, modified, or designed your materials, you then must plan how the materials will be used and how much time will be spent using them. Next, prepare the class and ready the necessary equipment and facilities. Then present the material using the "showmanship" techniques and suggestions described in the chapters of this text.

Require Learner Performance Learners must practice what they are expected to learn and should be reinforced for the correct response. The first time they are expected to perform the behavior called for in the objectives should *not* be on the examination. Instead, there should be activities within the lesson that allow learners to respond and to receive feedback on the appropriateness of their performance or response.

Evaluate/Revise After instruction, it is necessary to evaluate its impact and effectiveness. To get the total picture, you must evaluate the entire instructional process. Did the learners meet the objectives? Did the media assist the trainees in reaching the objectives? Could all students use the materials properly? Wherever there are discrepancies between what you intended and what you attained, you will want to revise the plan for tie next attempt.

The "Cone of Experience"

Much of what we found to be true of direct and indirect experience, and of concrete and abstract experience, can be summarized in a pictorial device which we call the "Cone of Experience." The cone is not offered as a perfect or mechanically flawless picture to be taken with absolute literalness in its simplified form. *It is merely a visual aid* explaining the interrelationships of the various types of audio-visual materials, as well as their individual "positions" in the learning process.

Looking at the cone, you see at once that each division represents a stage between the two extremes—between direct experience and pure abstraction. If you travel upward from the base, you move in the order of decreasing directness. Thus, "contrived experience" is one stage more direct than "dramatized experience"; and "dramatized experience" is one stage more direct than "field trips"; and so on. Similarly, if you travel downward from the pinnacle of the cone, you move the order of increasing directness: "verbal symbols" are more abstract than "visual symbols"; and "visual symbols" are more abstract than such "one-sense aids" as recordings, radio, and still pictures. You will make a dangerous mistake, however, if you regard these bands on the cone as rigid, inflexible divisions. A few examples will make this clear. A motion picture can be silent or can combine sight and sound. You can view a dramatization as a spectator or you may participate in it an actor. Students may merely watch a demonstration, or they may watch it and then take part in it. The cone device, then, is a visual metaphor of learning experiences, in which the various types of audio-visual materials are arranged in the order of increasing abstractness as one proceeds from direct experiences.

One further reminder: "increasing abstractness" does not mean "increasing difficulty." Exhibits are nearer to the pinnacle of the cone not because they are more difficult than field trips but only because they provide a more abstract experience. (An abstraction is not necessarily difficult. All words, whether used by little children or by mature adults, are abstractions.)
Part II of this book discusses each of the divisions of the cone in extended detail. In this chapter we shall merely define them and then take into account some related ideas to which our discussion inevitably leads. For the sake of logical simplicity, we shall consider each of the divisions, starting with the base.

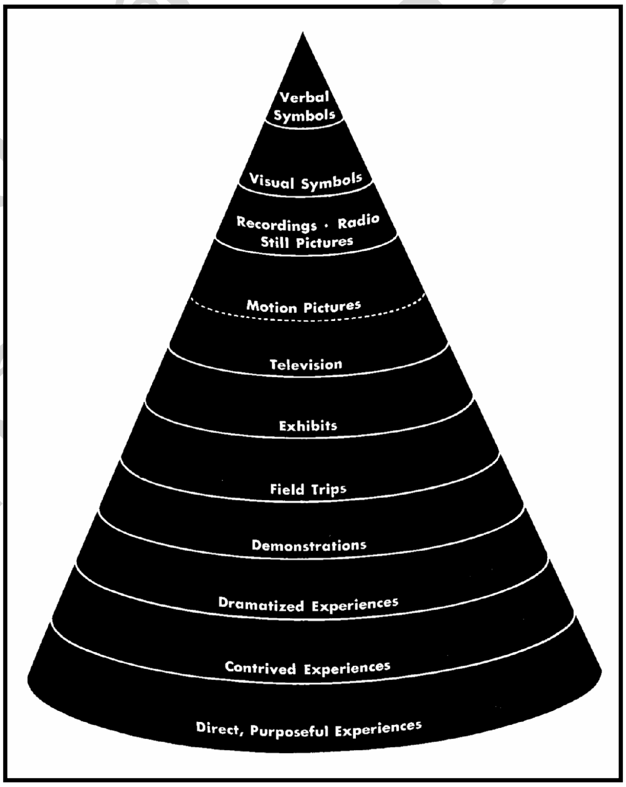


Figure 1: Cone of Experience

Direct, Purposeful Experience

The base of the cone represents direct reality itself as we experience it at first hand. It is the rich, full-bodied experience that is the bed rock of all education. It is the purposeful experience that is seen, handled, tasted, touched, felt, and smelled. It is the unabridged version of life itself —the experience that we commonly refer to as “something you can get your hands on,” “something you can sink your teeth into.” These experiences are not only direct; they are purposeful. In going to the store, preparing meals, making a piece of furniture, taking a trip, performing a laboratory experiment, and a great many other similar experiences, you have *direct participation, with responsibility for the outcome.*

You may do well to think seriously about this purposeful, direct experience and its role, not merely in the teaching process but in your own life. When you think of your childhood, your richest, most vivid memories—the worn desk in the fourth-grade room in Westwood School, the earliest wild strawberries in the meadow behind the barn—are evoked by direct experiences. It is worth noting that this division constitutes the base of the cone, for it is in reality the *basis* of all effective learning. Bonaro W. Overstreet calls for “a new respect for the senses,” through which we experience reality. “The plain fact is that whatever we think about, whatever we believe in, whatever we appreciate, is something that was originally introduced to our consciousness by one or more of our five senses: sight, hearing, touch, smell, and taste. Even the most abstract ideas that we cherish —ideas that seem to us to be above physical limitations—came to us in the first place through sight or hearing or one of the other senses. Even the creative insights that seem entirely the product of our own minds are, in the final analysis, a reordering into new and vivid imaginative patterns of materials already collected through our senses.

“The whole curious confusion about the importance or unimportance of physical sensation to mental and spiritual richness has done tremendous harm. It has made us accept as natural a state of affairs in which most adults have let their sense experience become a purely routine, practical affair. It has made us accept as proper an educational system that does next to nothing to encourage children and young people toward those vivid sense experiences out of which a rich- textured appreciation of the world and of other human beings can be made. It has made us regard as somehow abnormal those few among us—poets, artists, and their fellows in sensitive perception— who have carried into adulthood an undiminished capacity for taking in new impressions and remaking these into new insights. It is almost as though we had pronounced upon ourselves, and labeled as respectable, a peculiarly melancholy doom: the doom of putting behind us, while yet we have most of our years ahead of us, the experience of fully using our natural equipment for getting information about life.” Life cannot, of course, be lived exclusively on this direct, concrete, sensory level. Whenever we remember something we have experienced, we have begun to abstract. Even our earliest experiences involve some degree of abstraction. As very young children we learn to talk about the doll or the cat or the man that is not physically present, and thus our direct, concrete experience becomes *associated with abstractions.* We have italicized the last few words because you must bear them in mind, not only with the first band of our cone but with every other band. The moment we talk about an experience, it becomes associated with abstractions.

Contrived Experiences

The second stage in the development of increasingly abstract experience may be illustrated by a model of a petroleum refinery. The actual installation, with its towering, complex structures sprawling over many acres, baffles most people. It is too much for the eye to take in. But a model of the same refinery is easy to “grasp.” With the model, the layout of the installations and the processes of manufacture are far simpler to see and to understand.
A contrived experience differs from the original in size, in complexity, or in both. We simplify by means of a working model if the model makes the real-life original easier to understand. A contrived experience is, therefore, an “editing” of reality, an editing that becomes necessary when the real thing cannot be clearly perceived directly: when it is too big or too minute, when the things we are interested in are obscured or confused or concealed. In such circumstances the imitation is better for teaching purposes than the reality.

A city area presented through models often helps immensely in the study of city planning. As a beginning it is a better teaching method than traveling over miles of streets and viewing scores of buildings, parks, and the like. It summarizes a great deal of information, making the area of many square miles “see-able.” Such a contrived experience is an effective teaching device.

Many similar examples come to mind. Few youngsters have the opportunity of operating the controls of an airplane, but a model which they can "fly" explains the basic mechanisms while omitting the distracting details. A miniature working model of Eli Whitney's cotton gin instantly shows students the enormous savings in time obtained by this device for removing seeds from cotton.

A different application of the working model appears in the so-called mock-up. This device has proved especially useful in teaching industrial employees certain lessons that are less efficiently learned "on the job." The wiring system of an automobile, for example, can be explained by spreading it out on a board in drastically "edited" form. There is less actual wire in the mock-up, but the dashboard is a real dashboard and the lights go on and off when the switches are operated. With the distracting details of the reality eliminated, the key points can be emphasized. Did the school you attended provide terrain models, globes, specimens of fish, animals, and birds, or a miniature whaling ship? Did you learn to tell time with the help of a mock-up: a clock whose hands you could turn to speed up the minutes and hours? If you learned through such contrived experiences, you already know their value in teaching. Such substitutes for confusing or unmanageable or inaccessible first-hand experience are easier to study than the originals that they represent. To be sure, they differ in important respects from the real thing, and yet they also involve hearing, seeing, handling, and other sensations. Contrived experiences, therefore, presem us with choices: between an original that is difficult to grasp and an abridged or edited version whose meanings come through clearly.

Dramatized Experiences

There are, alas, a great many things that we cannot possibly experience. Not only are our lives too short, but restrictions of time and place prevent us from experiencing directly much of what we need to know to be educated. We cannot experience directly something that is already in the past. Besides, some matters cannot be conveyed by a contrived experience, and some ideas are by their very nature abstract and symbolic. Dramatic participation, however, can help us get closer to certain realities that are no longer available at first hand. We can participate in a reconstructed experience, if not the original. We relive the opening of the West by acting out the role of characters in a play, tableau, or pageant. Schools commonly dramatize the first Thanksgiving, the signing of the Mayflower Compact, the Gettysburg Address, a United Nations session, and many other events. But dramatizations can also be used to advantage in informal classroom situations.

Though it is not the real thing, though it stands for something else, a dramatization may have certain teaching advantages over the real-life situation. It can eliminate many insignificant elements that merely distract attention. It can sharpen and stress the truly important ideas. When we reconstruct an experience, we are able to focus on the things that "matter," thus manipulating the experience for teaching purposes. Dramatizations and contrived experiences, therefore, share the common quality of sometimes being more efficient for learning than the realities they represent.

We must distinguish between participating in a dramatization and watching it. Both experiences can be fruitful, but a student who plays a part in a dramatic reconstruction gets closer to the direct experience than his classmate who merely looks on. Thus, if we were to subdivide this band on the cone, "Participating in a dramatization" would be at the bottom, because it is the more direct experience. "Observing a dramatization" would be above it, because the spectator is farther removed from the original reality than the participants who relive the scenes. The especial values of participation are frequently used in connection with student adjustment and human relations in the classroom. Through the "role-playing" procedures of the so-called psychodrama and psychodrama, people are helped toward gaining insight into themselves and others. By acting the part of some other person, a participant can obtain fresh understandings. General education makes excellent use of role-playing for stimulating group discussion. The psychodrama, which is one type of role-playing, has much to offer the teacher in furthering the unity of the students as a group of learners. The three cone bands discussed thus far all involve *doing.* Thus, in the direct experience, in the experience obtained through such a contrivance as a working model or a mock-up, and in the experience of reconstructing reality by acting it out in a dramatization—in these three the student is not a spectator but a participant. In the next seven stages on the cone, he is primarily an observer: though he may participate by imagining himself as the actor, he is not responsible for the outcome. In this sense, he merely watches. Thus, the third stage of our "doing" group—dramatic participation—blends into our "observing" group when the student sits in the audience. He can do little to change the experiences which confront him in the next bands on the cone: demonstrations, field trips, exhibits, television, motion pictures, radio and recordings, and still pictures. Does this mean, however, that he does not become involved? Involvement is a problem in all communication. Sometimes we achieve it through direct action—the advertisement in the newspaper tries to involve you in a purchase at a store; an article on savings tries to involve you in a commitment to put aside a certain amount each month. But involvement of an indirect kind occurs when you are influenced in such a way as to participate imaginatively. The novelist, playwright, filmmaker, and photographer are trying to make you feel like saying, "Why, it's almost like being there!"

Whenever we use audio-visual materials of the "observing" type, pupils are apt to be somewhat less involved than they are when they participate actively. Even though we cannot change the stimulus, however, we can influence the response in the direction of greater involvement. If, for example, you show your pupils a film about Zion Park, you can achieve a high degree of involvement by suggesting a visit to a near-by national park or by raising questions about how our government administers these parks.

Demonstrations

A demonstration is a visualized explanation of an important fact or idea or process. The demonstrator shows how certain things are done. A science teacher demonstrates the separation of hydrogen from oxygen by electrolysis; an arithmetic teacher demonstrates the use of an abacus. A football coach shows his team how to block or throw a pass. In an adult-education class, an instructor uses a felt board to demonstrate trends in consumer buying. Of course, the chalkboard is used as a demonstration medium in almost every classroom almost every day. Do our students observe good demonstrations accurately? Early in the century, a chemistry professor at Amherst was particularly troubled by the observing habits of his students. To make them aware of their lacks, he devised a special demonstration. The following report appears in the memoirs of one of his students, John Erskine:

On the long desk from behind which he imparted the science of chemistry, rested a vile-looking, vile-smelling, black pot. "There's not a chemist in the class !" he roared. "You're all too delicate. When I studied under the great scientists of Germany, I learned to stop at nothing, no matter how unpleasant. A chemist must have courage and backbone. Also he must have eyesight. There isn't one good eye among you!" He picked up the black pot and sniffed at it. "Suppose you had to find out what is in this?" He stuck his finger into the revolving mess, tasted it, smacked his lips, then with a wicked grin passed the pot along the row of students, challenging them to imitate his heroic curiosity. They accepted the invitation, not daring to decline. One by one they turned green and made a dash for the washroom. The Professor waited patiently till they were able to return. "Now, boys, if you had half the eyesight of a chemist, you would have noticed that I stuck my first finger into the pot, but sucked my little finger."

Demonstrations may require nothing more than observation—accurate observation—on the part of the student, or he may be asked to do what he has just been shown how to do. Whether the demonstration is followed by such performance depends on what we expect the student to learn. It may be enough for the teacher to show by electrolysis how hydrogen can be separated from oxygen. But the use of an abacus or slide rule is most effectively demonstrated if the students are immediately asked to use it themselves.

You can see once again why the cone of experience is not to be looked on as a rigid device. Dramatizations, as we have seen, may be of two kinds; and demonstrations may involve *doing,* even though they are placed in the *observing* group. The cone device does not imply any restrictions upon the use of audio-visual materials. On the contrary, in any teaching program a variety of levels of abstraction may be effectively mixed. Indeed, in any continuous program of teaching—even in a single lesson—there will be a wide range: from direct, responsible sense-participation to abstractions on a high level.

Field Trips

When we make an excursion, school journey, or field trip, we often see other people doing things. We watch and note the meaning of their actions. As spectators, we are not responsible for what happens—we may be on the sidelines, without authority or ability to alter the event. We merely watch it unfold.

So well known is this type of sensory experience that extended comment here is unnecessary. We should remember, however, that a field trip, like a demonstration, need not always be limited to mere observation. When students interview government officials, or workers in a mill, or reporters at a newspaper, or technicians at a radio station, the field trip gains in directness. Observation combined with participation brings added meaning. Such a variation of the field trip again indicates how the bands of the cone overlap and blend into one another. Are you beginning to look at our cone not as a mechanically perfect representation of the different levels of abstraction but as a device that accents certain key points—that explains learning materials by "spreading them out" for you to look at? Students can, of course, have many direct, purposeful experiences in the course of a field trip. In Chapter 26, for example, we talk about some young children from a downtown Cleveland school who took a field trip to a farm. In the course of the trip they had a variety of direct experiences that had marked effects upon their language development. Bear in mind, however, that though significant direct experiences may occur during a field trip, the field trip itself is undertaken primarily for the purpose of experiencing something that cannot be encountered within the classroom.

Exhibits

Where shall we place exhibits on the cone? Sometimes they consist only of working models arranged in a meaningful display. Sometimes they are a series of photographs or of photographs alongside models and charts and posters. Sometimes they include a demonstration or a film. We shall keep our bearings if we remember that an exhibit is essentially something one sees as a spectator. A mock-up is seen by a spectator, but he also operates some of the spread-out materials or is otherwise engaged in some activity. Usually we are not involved in handling anything or working the materials, though some complex exhibits include some added sensory experiences—when there is a crank for us to turn, a swatch of material to touch and feel, the learning can become that much more meaningful.

Two general types of exhibits can be distinguished: the "ready-made" and the "homemade." Despite the expertness with which the former have been prepared—by a manufacturer, a museum, or some similar agency—the exhibit that has been planned and produced by the students with the aid of the teacher is often to be preferred. Here again is an overlapping—a blend of seeing and doing, of observation and participation, with its resulting enrichment.

Television and Motion Pictures

Where does television fit on the cone? Since television can be a film—indeed, it often is a film—we may discuss its special qualities after we examine the motion picture in terms of the cone. Films are a varied medium. They are silent, or they combine sight and sound; three-dimensional or three- dimensional combined with sound; and any of these four types may be combined with color.

The motion-picture experience, unlike the field trip, may compress both time and space. Not all of the original experience is there, but compression of the experience provides advantages. The film can omit unnecessary and unimportant material and can thus concentrate on a few selected points. In a field trip to a steel mill, for example, we may follow each of the processes from beginning to end. But a film on steel-making can quickly pass over less important processes and emphasize the more significant ones. Furthermore, mechanical devices for slow motion enable us to emphasize the key ideas.

Remember, however, that we are *spectators* before a motion picture. We are some distance from touching, tasting, handling, feeling—from directly experiencing. Nor do we get a contrived experience. We are merely watching an event, and we are involved only in an imaginative way. We are seeing other people do things—and through an edited version of their experiences, in which time and space may have been altered.

This is another way of saying that films present an abstracted version of the real event, with consequent losses as well as gains. This film version may he easier to understand than a more direct experience, for a deliberate and contrived order has been imposed on the material, so that it differs from the reality it portrays. A film gives us special opportunities because of its contrived nature; we can see a finished product at the start of the picture and then turn the clock back and see the steps involved in arriving at this result. When the "three-dimensional" Cinerama wa first shown in 1952 the audience literally held on to their chairs so as not to "fall off" the roller coaster. But even without using a technique of this type, the film can dramatize events so effectively that we feel that we are in the presence of the reality itself, For this reason it is a great educational medium, enabling us to obtain a degree of understanding of certain important materials that would otherwise remain much too vague. For example, how clear are you as to the issues and action in the Revolutionary period, from 1765 to 1800—a thirty-five-year era of exceptional historical richness and importance? Can you recall many of the events in full detail? Is Tom Paine a real flesh-and-blood character? Can you see him trudging down the streets of Philadelphia, taunted by small boys and scorned by the Tories of his time? Or is he just a vague, misty, verbal symbol?

Motion pictures can reconstruct this period with such dramatic intensity, with such realism and poignancy, that even the slowest child will react to its meaning. They could make Tom Paine so alive that high-school students who have read passages from *Common Sense* would get new meaning out of his ringing phrases about "the summer soldier and the sunshine patriot." They would know why he said of this critical period, "These are the times that try men's souls." Now television can supply a dimension beyond the range of motion pictures. It can bring us the real event as it actually happens. But unedited occurrences often have long stretches that are uninteresting—such "real-life" television could be more boring than the edited version or more exciting. Hence, even a televised nominating convention, coronation, or similar event is somewhat edited—there has been highlighting by long shots, close-ups, and the like. You may see the event more clearly and more comprehensively than you could if you were actually present. When we watch a motion picture, we know that the outcome is not in doubt—for the event has been filmed; it is now history. But a television broadcast of a real event is history in the making, history unfolding, with the outcome uncertain. Because it brings this impact of immediacy, television is as close as any mechanical device can get to the direct experience. But let us remember an equally important fact about television. It can bring to our screen a very wide range of materials—a highly concrete picture of a real event unfolding and the next instant a series of printed words: verbal symbols, the abstraction at the pinnacle of the cone of experience. The same point can be made about televised films and the motion picture. The unique value of the film and of television, however, lies in their sensory concreteness, their realism, their emphasis upon persons and personality, their ability to dramatize, to highlight, to clarify.

Still Pictures, Radio, Recordings

Our next division on the cone includes a wide variety of materials—still pictures (photographs and other visual reconstructions of reality), radio, and recordings. These visual or auditory devices may be used by an individual or a group, When using them with classes, we resort to such additional aids as filmstrip projectors, opaque projectors, playback, and public-address systems.

All these materials are less direct than the audio-viua1 experiences we have discussed previously. A still photograph lacks both the motion and the sound of a sound film. Take the motion out of a three-dimensional film and you have a stereograph. When you remove the depth from a stereograph, you have a glass slide or a single frame in a filmstrip. Similarly, the radio broadcast of an actual event is a televised broadcast minus its visual dimension. We may think of radio and recordings as mass-produced messages prepared for listeners who are not physically present— somewhat like multiple one-way long-distance telephone calls. A photograph in a book or a Kodak chrome slide is a visual record made "on location" for the eyes of people dozens or thousands of miles away.

These materials have been roughly classified as "one sense" despite the fact that no experience can be so named in terms of the central nervous system. A stimulus may start through the eyes or ears, but when the impulse reaches the association centers of the brain, other neural areas are always involved. It is therefore more helpful to think of these materials as devices that emphasize specific aspects of a visual or an auditory experience. To say that radio and recordings are more symbolic than television or motion pictures is merely to state that certain elements have been abstracted. But this does not mean that they offer a lean, impoverished experience to the learner. There is an intrinsic advantage in the projected glass slide or filmstrip, for example. You can dramatize an idea by visual magnification. Though the student handles no material and merely watches, he nevertheless can experience the view with great intensity. The impressive image on a white screen in a darkened room eliminates distractions and heightens attention.

Visual Symbols: Chalkboard, Flat Maps, Diagrams, Charts, Etc.

As we enter the next stage on the cone, we no longer have the realistic reproduction of the thing itself but an abstract representation. Charts, graphs, maps, diagrams are substitutes. We communicate by means of a new language—visual symbols. The chalkboard, of course, is the most widely used medium for presenting these symbols, though many other media (projected and non- projected) will serve. A chart may use a dollar sign or a drawing of a coin to represent money, or a stylized drawing of a stork to symbolize births. It may use a pie to represent one dollar of federal tax money, and a slice of the pie (fraction of one dollar) for federal expenditure on veterans' pensions. A graph may use a line to show growth or progress—a line tracing a rise or fall in income, fluctuating production of steel, changing birthrate.

Elementary-school children cannot always understand even the simplest kind of visual symbols. Even high-school students may have trouble with simple charts and graphs and read them incorrectly. Map reading also can be difficult when the geographer's symbols for north and south, mountains and rivers, or steepness of contours are not instantly grasped. The teacher must see that the symbolic aid is geared to the level of the learners—that they have been prepared to use the new language of visual symbols. One of the best procedures is to have students make their own charts, graphs, and maps. These materials are so commonly used in newspapers, magazines, and books that further comment is hardly necessary. We have all seen how vividly a time chart can show the progress of events over any desired period of time—how clearly a chart or a diagram portrays the stages in the operation of a gasoline or jet engine. A chart is often the most effective means of indicating how material progresses through a factory from the raw stuff to the finished product. A diagram can clarify a sequence—of ideas in a paragraph or a speech, of the organizational structure of the U.S. Congress or of the United Nations, of the stages through which a bill passes to become a law. The visual symbols help students to *see* an idea, an event, a process. Dewey, you may remember, remarked that it is "the deposit" that counts in a learning experience. Students who understand charts, graphs, maps, and diagrams are *using* such deposits. Even elementary-school children, when they have been properly prepared, can manage a great deal of conceptualized experience through the abstract language of visual symbols.

Verbal Symbols—Pinnacle of the Cone

The final stage brings us to verbal symbols— designations that bear no physical resemblance to the objects or ideas for which they stand. All appearances have been removed from the original. The word *horse* does not look like a horse or sound like a horse or feel like a horse. The term *weather* reproduces none of the hundreds of specific experiences directly related to its meaning. At the pinnacle of the cone we have abstracted everything from the original except the meaning of the term, and on this meaning we have reached more or less common agreement. The verbal symbol may be a word for a concretion *(horse),* an idea *(beauty),* a scientific principle *(the law of gravity),* a formula *(H20),* a philosophic aphorism *(Honesty is the best policy),* or any other representation of experience that has been classified in some verbal symbolism. The range is limitless, from the elementary word for a concretion *(pencil)* to such abstract terms as *democracy* or *truth or justice.* The important fact is the absolute abstractness of the symbol, regardless of what it symbolizes.3 Thus, the pinnacle of the cone is not a rarefied height frequented only by the great intellects. It is the common ground for every human being who can talk and listen.

Is there a distinction to be made between written and spoken words? The linguists hold that spoken language is primary and printed language is secondary; or, as Ernest Horn puts it, “printed words are only the symbols of symbols.”[4] Jespersen observed that “A written word is mummified until someone imparts life to it by transposing it mentally into the corresponding spoken word.”[5] It seems reasonable to place spoken words lower on the cone than written words. It seems reasonable, also, to assume that speaking about experiences is an excellent means of making students able to read intelligently about them. Speaking is also an excellent means of reinforcing the meanings communicated through every other stage of the cone, whether one discusses direct experience, a model, a field trip, a sound film, a recording, or a diagram. Speaking is, of course, an essential procedure in dealing with the written verbal symbols regardless of the complexity of the ideas for which they stand. *Verbal symbols, therefore, are used together with every other material on the cone,* though they themselves are abstractions.

Some Possible Misconceptions

If you remember the two preceding sentences, you are likely to avoid many misunderstandings that may affix themselves to our cone device. Any such diagram carries the dangers of oversimplification—against which we must be always on guard. Do you fully understand why the bands of the cone often overlap and blend into one another? Once you bear in mind that any child who can talk uses the most abstract of communicative materials—verbal symbols—you will not mistake the cone device for a hierarchy or rank-order of learning processes. You must see that the cone classifies sensory aids in terms of greater or less concreteness and abstractness as learning experiences, and *not with respect to the difficulty of the ideas they communicate.* You can use a tape recording to play back a story from a nursery-school reader or to explain some abstruse problems in nuclear physics. This should be clear, and yet we must consider some mistaken impressions that may still remain.

1. *Does the cone device mean that all teaching and learning moves systematically from base to pinnacle?* Emphatically no. We have noted that young children use simple abstractions—before entering school they have mastered one or more meanings of at least 2500 words, each of

which is an abstraction. Our point is rather that abstractions range from the simplest to the most complex—there are vast differences in difficulty. We can help students learn what they find difficult by offering them *all the ways of experiencing* that relate to the specific subject. Ralph Tyler's observation in this connection is worth studying:

> The experiments in the teaching of zoology show that some students effectively learn the principles of zoology through certain types of laboratory projects, others through demonstrations and problems, others through other kinds of experiences. *No one series of learning activities has proved equally effective with all students* [our italics]. This fact seems to demand a much wider range of materials in college work; that is, the learning activities in which students may engage need to be extended greatly. Furthermore, this expansion of possible learning activities should be supplemented by a means of discovering for the students where their difficulties are and of suggesting what kinds of activities will be most helpful to them in overcoming these difficulties in learning.[6]

2. *In discussions of audio-visual materials, claims are sometimes made about the value of one sense over another.* Actually, of course, our sensory experiences are mixed. When we listen to a speaker, we may think we are getting only aural experience, but we are also reading his facial and bodily expressions. When we look at an object with a view to picking it up, we may think we are involved in an exclusively visual experience, but we are also making judgments about its weight, feel, position, etc. Were you ever handed a beaker filled with mercury? You did more than see. Your muscles were adjusted to ordinary weight and you found the beaker much heavier than your eyes had led you to expect. Similarly you may pick up a piece of balsa wood that looks heavy but is actually very light; your hand flies up because you made an incorrect muscular response. You look at a glistening object and call it "shiny," believing that it would be smooth to the touch—thus connecting touch with sight.

Are hearing experiences less effective than visual experiences? Some brilliant people have been blind almost from birth. This fact alone should prove that one can learn effectively without sight. But there is more to be considered when attempting an evaluation of this kind. Other things being equal, we learn quite as readily through one sense as another, with the exception, of course, of individuals whose receiving, connecting, or central mechanisms are defective. Other conditions, consequently, determine which avenue of presentation is to be preferred. Very young children learn new words better, for example, when they are presented to the ear than when presented to the eye, for the reason that their early word experience is auditory and not visual. If they have attended school, by the average age of eight or thereabouts children memorize better material presented visually. This is mainly due to the fact that during reading the child can regulate the speed of reacting to the words to suit his capacity; he can attempt recall when and where he pleases; he can stop and repeat the especially difficult items, and disregard those already mastered.

The relative values of moving pictures, graphs, diagrams, mechanical instruments, verbal explanations, and clay models are similarly determined by past experience and mechanical advantages. The main questions are: Which method makes most clear the thing to be learned and which does it most interestingly and most economically of time, space, and money.7

3. *But can we overemphasize direct, first-hand experience?* The danger is a real one. Dewey points out:

While direct impression has the advantage of being first-hand, it also has the disadvantage of being limited in range. Direct acquaintance with the natural surroundings of the home environment, so as to give reality to ideas about portions of the earth beyond the reach of the senses and as a means of arousing intellectual curiosity, is one thing. As an end-all and be-all of geographical knowledge it is fatally restricted. Just as the race developed especial symbols as tools of calculation and mathematical reasoning, because the use of the fingers as numerical symbols got in the way, so the individual must progress from concrete to abstract symbols that is, symbols whose meaning is realized only through conceptual thinking. The teacher must have an artist's sensitivity in determining when his pupils are ready for generalizing. The pupil, too, must see that the art of generalizing at an appropriate time is a significant phase of his education.

4. Are the upper levels of the cone for the older student and the lower ones for the child? It is true that the older a person is, the more abstract his concepts are likely to be. We can explain this developmental change by greater physical maturation, greater opportunity for wider experiences, and (in certain circumstances) greater motivation for learning. But concepts or abstractions are not bricks that we collect; we do not improve our minds by gathering more and more of them.

Though a brick in a wall is “related” to the bricks that surround it, a concept cannot be compared to a brick, for a *concept is both stable and fluent.* It is a “deposit,” but it is also an active element with multiple relationships and always ready to become part of a new deposit. Our concept of *four* flows into eight and sixteen; it is directly related to the idea of *fourth* and to any number of new experiences and ideas to which it can be significantly connected.

As the building of concepts relates to the different levels of the cone, it is not a matter of finishing up one level and then moving to and remaining on the higher one. Each of us every day acquires new concrete experiences—through discussion with others, through gardening, traveling, dramatics, tinkering, and endless other means. Such learning by doing, such pleasurable return to the concrete, is natural throughout our lives— and at every age level. But both the older student and the child make abstractions every day and may need to be assisted in doing this.
Perhaps the word *functioning* should be applied to abstraction, for it is a functioning abstraction that gives new meaning and insight into the concrete experiences of one’s daily life. As Curti points out, “we greatly need a more realistic and humanistic kind of education which will determinedly avoid mere verbal teaching and seek to equip our children with *serviceable growing ideas,* thoughtfully acquired out of their experience our italics.

The Kinds of Materials

Consider the specific contributions and special requirements of these six audiovisual materials: photographs, slides, filmstrips, large transparencies, motion pictures, and visual materials for television. Then select those most appropriate for your purposes.

Notice the sequence that is being developed. First establish *purposes* and consider your audience; now select the specific audiovisual *materials* to carry through your purposes. Why this sequence? Because only after establishing *what it is that you wish to communicate* are you able properly to select the channel or medium that will do the best job. If motion is inherent in the subject, consider a motion picture; but if motion is not important, then consider materials that demand simpler skills, less time, or less money, and may do the job equally well. To think further: a series of large photographs, which can easily be studied in detail, may be preferable to a filmstrip and less difficult to make. Also, consider using combinations of media to serve your purposes: a series of transparencies that outline a process may be supplemented with a set of slides and the two used concurrently for effective instruction. On the other hand, perhaps for practice or perhaps because you have certain equipment available, you may wish to prepare a specific material, possibly a series of slides or a motion picture. If this is your starting point, select a subject and establish purposes which will use the medium to its best advantage. Each of the several types of audiovisual materials makes its own unique contribution to improving communications and subsequent learning. All require careful planning before preparation—some more than others. In selecting the ones to serve your purposes, examine all of them and become aware of their specific contributions and special characteristics. The chief characteristics are here given, briefly.

Picture Series

Picture series may consist of drawings or photographs, in black-and-white or in color. Usually they are enlargements from camera negatives. They may include explanatory captions and they may be accompanied with directions for their use. They lend themselves to display and also to detailed self-instructional follow-up study. They are among the simplest audiovisual materials to prepare, but they are limited for projection by reason of the bulkiness and relative inefficiency of opaque projectors. Because picture series are normally used by individuals rather than by groups under direction, they need to be self-sufficient and self-explanatory; brief, concise captions impart this quality.

Slide Series

Slides are a form of projected audiovisual materials easy to prepare, hence they frequently serve as the starting effort in a local production program. The pictures are generally taken on reversal color film, which is sent to a film-processing laboratory where the mounted slides are made up. Since they are ready for projection as the laboratory completes them, relatively little time goes into the mechanics of processing and mounting.

For many uses, simple and inexpensive 35-millimeter cameras make satisfactory slides. But for filming some subjects, for close-up work, and for copy work, either special cameras or special attachments on the inexpensive cameras are required.

The standard slide dimensions are 2 inches by 2 inches. Since the slides are thus small, they are easily handled and stored. Their sequence can be changed, and slides may be selected from a series for special uses. But this flexibility entails some disadvantages. Slides can become out of order, can be misplaced (it is a common occurrence to leave the last slide in the projector!), and sometimes they are accidentally projected upside down or backwards. Most of these disadvantages can be overcome by the use of inexpensive trays and magazines which store the slides and hold them during use. Also, automatic and remotely controlled projectors permit an instructor, while making his presentation, to make slide changes for himself. Tape recordings can be prepared to accompany slides and, with special recording equipment, slides can be shown automatically as the taped narration is played. The development of small, compact viewers also opens many possibilities for using slides with taped narration for self-instructional purposes. Although 35-millimeter film is most common for photographic slides, cameras requiring film of other sizes (120, 127, 620, 828) also can be used. In addition, Polaroid transparency film, available in two sizes for Land Polaroid cameras, produces completed slides in a few minutes.

Filmstrips or Slide films

Slide films or 35-millimeter filmstrips are closely related to 2” X2” slides, but instead of being mounted as separate pictures, the film after processing remains uncut as a continuous strip.

Filmstrips have the advantages of compactness, ease of handling for projection, and low cost for duplication when additional copies are heeded. Since pictures are always in order, no wrong positioning can occur, as with slides. On the other hand, filmstrips are not flexible since rearrangement of pictures is not possible.

Filmstrips are more difficult to prepare than are slides and they present problems for a beginner. It is not advisable to film subject matter with a 35-millimeter camera and then plan to use this film directly as a filmstrip. To do this would require extreme care to insure the consistency of pictures in composition and exposure. Usually enlarged photographs, drawings, and titles are prepared and then photographed in sequence with a suitable 35 millimeter copy camera. Or, if you desire to prepare a color filmstrip, start with color slides, or with color transparencies. Many commercial film laboratories will convert the slides or transparencies into filmstrip form.

Accompanying narration may be in the form of captions, filmed with the pictures, or as separate tape or disk recording to supplement the projected picture.

Transparencies for Overhead Projection

Transparencies are relatively new in the field of locally prepared audiovisual materials. The growing use of large transparencies is furthered by the development of efficient *overhead projects* combined with simple techniques for preparing transparencies and by the dramatic effectiveness of the medium.

The projector is used from near the front of the room, with the instructor standing beside it, facing the group. The projection screen is behind him and room light is at a moderate level. Transparencies are placed on the large stage of the projector and the instructor may point to features and make marks on the film. His work appears immediately on the screen. Progressively disclosing areas of a transparency and adding *overlay* films to a base transparency are special features that make the use of this visual medium effective in many subject areas.

Overhead projectors are especially useful for instructing large groups on all educational levels. As the projectors become more numerous in schools and in industrial-training facilities, the range of techniques for preparing transparencies should be investigated and the most appropriate ones selected for use. Some methods require no special equipment or training, while for others experience in photography and the graphic arts is necessary.

Motion Picture

Motion pictures, whether 8-millimeter or 16-millimeter, are the most complex and costly of the audiovisual materials to be considered here. They require costly equipment, skilled personnel, much time for preparation. and much money for materials and services. But for some purposes nothing surpasses the motion picture is effectiveness as a medium of communication. The motion picture should he considered whenever motion is inherent in a subject or when you wish to show relationships of one idea to another, t' bulb! a continuity of thought, or to create a dramatic impact.

Films need not always he formal and lengthy productions. For some purposes a brief film shown completely in a few minutes is sufficient. It may treat a single concept, a problem situation, or a skill which is to be explained and applied. Such a film may not require titles or special motion-picture effects. If proper projection equipment is available, the film can be loaded into a cartridge as a "continuous loop" for individual repeated viewing without complex projector threading and operation each time it is used.

Until recently most educational films have been of the 16- millimeter size, but with the development of 8-millimeter sound projectors a new era of inexpensive film production appears possible. These projectors permit the easy addition of sound to magnetic-striped film. The 8-millimeter films can be used very satisfactorily for individual study, with small groups, or with regular classes. Because maximum screened image size is small, do not consider 8-millimeter films for projection before large groups (more than *75).*

People with limited knowledge of film production can accomplish various effective techniques, such as time-lapse and slow- motion photography, close-ups, photomicrography, and animation. But generally, someone who has experience in making films should be a member of the production staff if advanced techniques are to be used. Such a man can deal effectively and economically with problems of planning, filming, lighting, editing, title-making, and adding sound.

Combined Visual Materials

Combinations of visual materials are effective when used together for specific purposes—either concurrently or in succession. Just as the narration on a sound motion picture supplements the pictures, a filmstrip containing local applications may be studied right after a motion picture has shown principles and generalized applications. Or, adjacent screens can be used for projecting outlines or diagrams as transparencies at the same time with 2”X2” slides, which describe other details, applications, or examples relating to the subject.
These combination uses and others have many worthwhile applications when general principles need to be given concrete meaning through immediate illustration.

Television Materials

Visual materials for instructional television include graphic materials (charts, summary lists, display-board materials, and titles), photographs, slides, and motion pictures. (The use of models and of actual objects—--realia-----is not discussed in this book.) Thus an instructional television program may and usually does employ a combination of visual materials. The success that television has gained in the educational field comes in part from the wise selection of the best aspects of all audiovisual materials and their proper utilization. Audiovisual materials for television are unlike other audiovisual materials in that they are not ends of production but contributions to the total televised presentation; their effectiveness must be assessed in terms of the support they give to the purpose of the entire presentation.

The choice of visuals depends not only upon the purposes to be served by the materials, but also on the ways they will be displayed and used on the program. The method of use will determine whether information should be presented, for example, as a slide for projection or as a large chart for use before the television camera. Ease of preparation, required skills, facilities, time, and material costs are other factors that influence choice. Finally, the technical requirements of television—format and proportions, size, color, and contrast limitations—must all be considered as materials are selected and prepared.

Now apply what you have read

1. Of the six types of audiovisual materials described in this section, which are of especial value for: (a) individual study? (b) use with a large group?

2. In question 2 following section I (page 4) , you were directed to select a topic and to start planning for the preparation of an audiovisual material. Which material would you now choose for use in developing this topic? Why do you think it the most appropriate?

3. Describe a combination use you might plan to make of two audiovisual materials in presenting the same topic, as was suggested.

Each of six types of audiovisual materials—picture series, slide series, filmstrips, overhead transparencies, motion pictures, and materials designed for television—as well as combinations has different planning requirements and different degrees of complexity in preparation and use. Some require close adherence to all steps in the planning process, while others, such as photographs and transparencies, may be developed without strict procedure. Refer to the appropriate sections in Part Three of this book for guidance as you study the planning steps in section 4, next following this.

Table 1: Summary of Characteristics of Audiovisual Materials

Material	**Advantages**	**Limitations**	**Relative Cost to Prepare* Originals Duplicates**
Picture series	1. Require only limited planning 2. Permit close-up detailed study at individual's own pacing 3. Are useful as simple self-study materials and for display 4. Require no equipment for use	1. Not adaptable for large groups 2. Require photographic skills, equipment, and darkroom for preparation	15g lOg per 8"X 10" black and white print $375 $3.50 per 8"XlO" color print (by processing laboratory)
Slide series	1. Require only filming, with processing and mounting by film laboratory 2. Result in colorful, realistic reproductions of orig- inal subjects 3. Prepared with simple 35-mm cameras for most uses 4. Easily revised and up-dated 5. Easily handled, stored, and rearranged for various uses 6. Increased usefulness with magazine storage and automatic projection 7. Can be combined with taped narration for greater effectiveness 8. May be adapted to group or to individual use	I. Require some skill in photography 2. Require special equipment for close-up photography and copying 3. Can get Out of sequence and be projected incorrectly if slides are handled individually	1 8g 30g per color slide

Material	Advantages	Limitations	Relative Cost to Prepare* Originals Duplicates
Filmstrips	I. Are compact, easily handled, and always in proper sequence 2. May be supplemented with captions or recordings 3 Are inexpensive when quantity reproduction is required 4. Are useful for group or individual study at projection rate controlled by instructor or user 5. Are projected with simple lightweight equipment	1. Are relatively difficult to prepare locally 2. Require film laboratory service to convert slides to filmstrip form 3. Are in permanent sequence and cannot be rearranged or revised	65g lg per frame, black and white $1.50 30 per frame, color (by processing laboratory)
Large transparencies	1. Can present information in systematic, develop- mental sequences 2. Use simple-to-operate projector with presentation rate controlled by instructor 3. Require only limited planning 4. Can be prepared by variety of simple, inexpensive methods 5. Particularly useful with large groups	1. Require special equipment, facilities, and skills for more advanced preparation methods	30p 25g per single sheet of film
Motion pictures	1. May consist of complete films or short film clips 2. Are particularly useful in describing motion, showing relationships, or giving impact to topic 3. 8-mm sound film reduces Cost for materials and services 4. Are useful with groups of all si7es and with individuals .	1 Are expensive to prepare in terms of time, equipment, materials, and services 2. Require careful planning and some skills 3. 8-mm size limited to small- group use	$4.10 *$6.50 50'* 8-mm color $8.00 $4.00 100' 16-mm black and white $12.00 $10.00 100' 16-mm color *2-5g 2* per 1' of magnetic striping

Material	Advantages	Limitations	Relative Cost to Prepare* Originals Duplicates
Motion pictures	5. Sound is easily added to magnetic film 6. May include special techniques for handling con- tent 7. Insure a consistency in presentation of material		
Television materials	1. Permit selecting the best audiovisual media to serve program needs 2, Permit shifting from one medium to another during program 3. Permit normally unavailable resources to be presented 4. Require the same careful planning as for other audiovisual materials	1. Do not exist alone, but are part of total television production 2. Must fit technical requirements of television 3. At times require rapid preparation of materials	Refer to the specific types of material above
Combinations of media	1. Combine slides or motion pictures with transparencies; or photographs, slides, or filmstrip for follow up study after a motion picture 2. Provide for more effective communications in certain situations than when only a single medium is used	1. Require additional equipment and careful coordination during planning, preparation, and use	Refer to each type of material above

* Estimated cost of materials for a single unit. Time and special services would be in addition.

Teaching the Conventions of Pictures

Mary M. Bartlett writes of the early stages of picture reading as follows:’9 Most children at the age of entering school have had experiences with pictures. Almost from infancy they have had their own picture books in which, early in their second year, they have learned to point to such familiar objects as “the kitty” and “the boy.” By their fifth year they have learned to recognize in pictures vast array of everyday experiences; they have become conscious, through the illustrated books and periodicals which adults bring into the home, of many things outside their immediate environment; and they have developed a high degree of interest in and curiosity about pictures.

The child who has arrived at this typical stage of familiarity with pictures has learned to interpret the chief conventions of pictorial representation. He recognizes a two-dimensional black-and-white line drawing as a comprehensible reproduction of three- dimensional colored objects which he has met in daily life. He recognizes as a truck the object which is shown as two inches in height. He knows that an airplane held in a boy's hand is a model plane rather than a real aircraft because of its size in relation to that of the boy. He interprets the portrayal of familiar motion and correctly infers that some of the children are walking while one boy stands still. He understands the effect of perspective—although he does not know the term and could not describe the process—so that he is not confused or misled by the fact that the little girl in the foreground is several times larger than the policeman in the middle distance. Without these and many similar or related techniques, he could not grasp the import of even the simplest picture.
While most children possess these techniques at the time of entering school, it is not unusual among underprivileged children and those from isolated homes to find one or more pupils who have had no contacts with picture materials and who therefore lack the abilities which make picture interpretation possible. When these abilities are not present, the teacher's first task is to develop them before proceeding to more complex activities with pictures.

Teaching Students How to "Read" a Picture

If you have never seen *a jai alai* racket, you may be puzzled as you look at a photograph of it for the first time. You cannot be sure whether the elaborate construction is part of a costume, of a ritual or celebration, or whether it is a weapon or a utilitarian instrument. Unless something in the picture clearly shows the use of the racket, you will not conceivably understand its function. If the picture does not supply *cues that you understand,* it will not communicate.
We read a photograph in the same general way that we read a page of words: we derive meaning from the medium by putting meaning into it. With this *jai alai* picture you were able to read certain items because of your past experiences. You could enumerate some parts of the picture in

isolation. But you were unable to draw the proper inferences. In interpreting, you were guessing; and even if you guessed correctly you could not be sure.

Any picture can be read on these three levels— enumeration, description, interpretation. Actually some interpreting is involved in picking out isolated items and in describing them; but even this is not always easy. Furthermore, the camera may show a familiar object in an unfamiliar way. Of course, a good teaching picture avoids ambiguous representation, since our reproductions of reality must be lifelike in order to be real.

How do unsophisticated persons "read" pictures? We have already noted the reaction of the Ankara shoe-shine boy who failed to recognize his own likeness and the laughter of the Iranians who "read" the close-ups incorrectly. Young children come to our schools with some facility with picture cues, but not all of them are equally adept and some are quite unskilled. Surely we must establish a level of "picture-reading ability" if we are to make proper use of photographs and illustrations in teaching. Note in the following report the various levels in picture reading:

1. Merely enumerating objects in isolation, as a *ball,* a *boat.*

2. Reporting in sentences what is seen but not attempting a sequential narration. For example, "There is a red ball," or "I see a red ball."

3. Using only present tense, even though attempting a narrative. "Dick throws the ball to Jane. Spot jumps up to get it," or "Dick is throwing the ball to Jane, and Spot is jumping for it."

4. Beginning to use several tenses as required in story telling, "Dick threw the ball to Jane, but Spot is trying to get it. It looks as if Spot will get the ball."

5. Beginning to use more colorful and interesting sentences, such as, "One day Dick and Jane were playing in the yard. They were playing ball. Spot wanted to play, too. So he jumped for the ball when Dick threw it to Jane."

6. Beginning to infer conversational text from situations. For example, "One day Dick said, 'Come, Jane, would you like to play ball?' Jane said, 'Yes, I will play with you.' So Dick threw the ball to Jane. Spot saw it and jumped for it. Jane said, 'Oh, oh! Spot wants to play, too. He will get the ball and run away with it.'

The developmental process shows an increase in the amount of inferring done by the children. In the last stages, a good deal of interpretation is under way. Much more is “being read *into”* the picture by the child.

This interpreting and inferring is extremely important. If we show an excellent photograph of a landscape to someone skilled in geography, he is likely to be able to draw many useful inferences. They may deal with rainfall, level of technology, time of the year, quality of the soil, and density of the population. A group of farmers who made field trips by plane over their own countryside in Illinois noticed certain areas in particular—that is, they saw something in the landscape below that gave rise to important inferences clear to them because they were equipped to make them. Furthermore they were on the alert for cues of this kind, because they had a “mental set” of a special kind.

Reading pictures can be most rewarding when the viewer knows *what* to look for and *how* to look. Once our students are prepared in this twofold approach, they need not be reminded to enumerate, describe, and infer every time they see a picture: they will have learned how to learn from photographs and illustrations.

We must not, then, merely display a picture and expect it to be fully utilized by the viewer. Pictures must be read as printed material is read: with the aid of discussion. Teaching students to read pictures skillfully involves both individual and group activities. Pointed questions covering a wide range of content and interpretation are as necessary with picture reading as with book reading.

“Looking at pictures,” in the light of such questions, emerges now as an *active experience for pupils, in which their critical responses are called into play.* Unfortunately many pictures cannot stand up under an intensive examination, for most pictures are not carefully made for teaching purposes. However, the principle of “reading pictures” applies no matter how lacking the illustration may be in revealing detail. We want to develop “thoughtful seeing,” with respect not only to pictures but to real-life situations. A pupil who has been taught to read pictures may well carry over this attitude to other experiences.

Slides

The term slide refers to a small-format photographic transparency individually mounted for one-at-a-time projection.

The size of slides most frequently encountered in educational use is 2 by 2 inches (metric equivalency either 50 by 50 millimeters or *5* by *5* centimeters) measured by the outer dimensions of the slide mount. When 35-mm and other popular types of slide film are sent out to be processed, they are usually returned mounted in 2 by 2-inch mounts. The actual dimensions of the *image* itself will vary with the type of film.

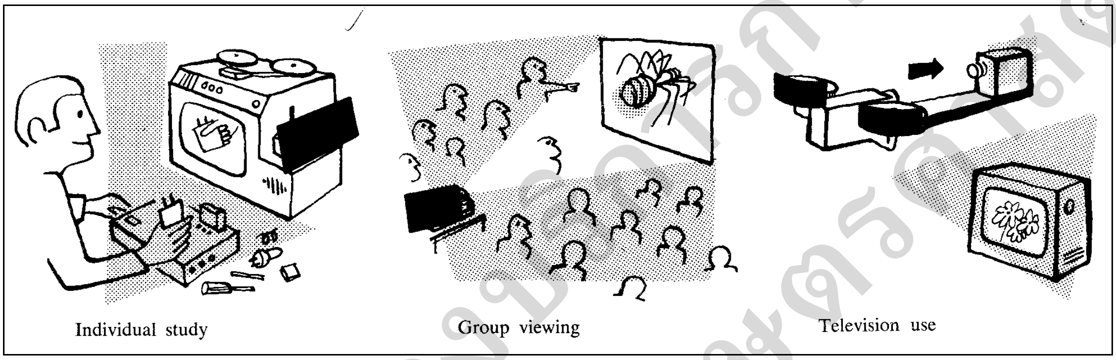


Figure 1: Slide

A Slide series consists of transparencies, usually in color, all mounted in square frames, usually 2”X2”.

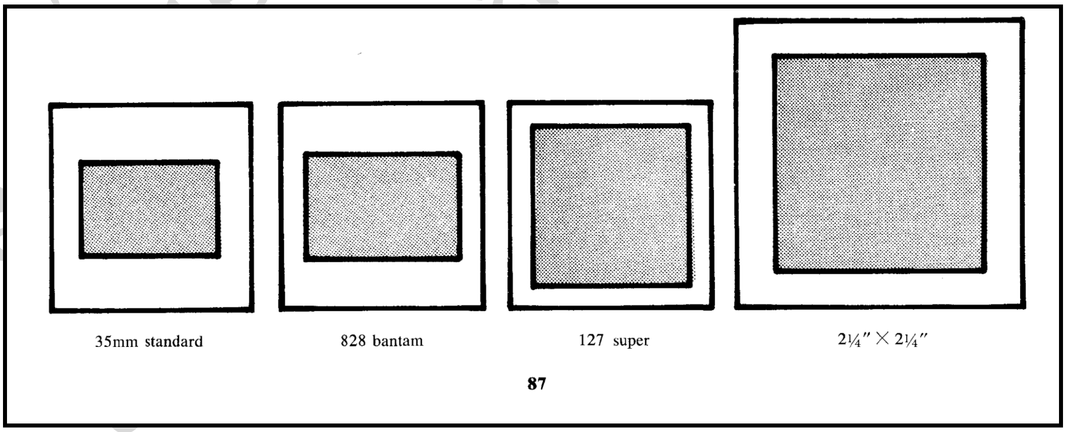


Figure2: Frame Slide

A slide series may convey information, teach a skill, or affect an attitude through individual study, group viewing, or television use. Before making slides always consider this planning check list:

• Have you clearly expressed *your idea* and limited the topic?

• Have you stated the *purposes* your slide series should serve?

• Have you considered the *audience* which will use the slide series and its characteristics?

• Have you prepared a *content outline?*

• Have you considered the *specifications* necessary for your slides?

• Have you written a *treatment* to help organize the material and then sketched a *storyboard* to assist in your visualization of the content?

• Have you prepared a *scene-by-scene script* as a guide for your slide-making?

• Have you, if necessary, selected other people to assist you with the preparation of materials?

Advantages

Because slides can be arranged and rearranged into many different sequences, they are more flexible than filmstrips or other fixed- sequence materials. As photographic equipment is continually refined and simplified, more and more amateurs are able to produce their own slides. Automatic exposure controls, easy focusing, and high-speed color films have contributed to this trend. High-quality color slides can be taken by any amateur photographer.

The assembly of slide programs is facilitated by today's automatic projectors, which hold sets of slides in trays and feed them into place in sequence. Most automatic projectors also offer the convenience of remote control advancing of slides, allowing the presenter to remain at the front of the room or off to a side while advancing the slides via a pushbutton unit connected by wire to the projector. Wireless remote control is also available. Certain models can be preset to advance automatically. This feature allows continuous showing in exhibits, display cases, and other automated situations.

General availability and ease of- handling make it relatively easy to build up permanent collections of slides for specific instructional purposes. Instructors may collect and store their own collections, or the slides may be compiled and kept in a learning resource center. Such collections enable users to assemble presentations partially or wholly from existing pictures, thus reducing the expense required for new production. Slides can be integrated into individualized instruction programs. Although slides have been developed primarily as a large- group medium, recent hardware innovations have made slides feasible for small-group and independent study as well. However, the complex nature of these new mechanisms makes them relatively expensive. Thus, slide -tape viewers for individual use are more likely to be found in learning resource centers than in classrooms.

Taking picture

Your camera

Most of the cameras described on pages 37-38 can be used to prepare slides. Color films are available for box cameras (using film sizes 116, 120, 127, 616, or 620), for twin-lens reflex cameras (using film sizes 120 or 620), and most popularly, for 35mm and size 828 cameras. Negatives from films used with larger cameras can be reduced by a laboratory to 2" x 2" slides. Those cameras with adjustable lens openings *(f/* numbers), shutter speeds, and attachments for focusing are especially useful since their flexibility enables you to record various subjects under almost any light and action conditions. The majority of slide series are made with 35mm cameras. There are two major types.

• One with a *separate viewfinder* through which you see a picture slightly different from the one that the camera will record. This difference becomes greater as the camera gets closer to the subject.

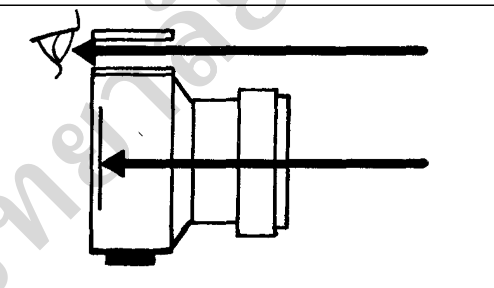
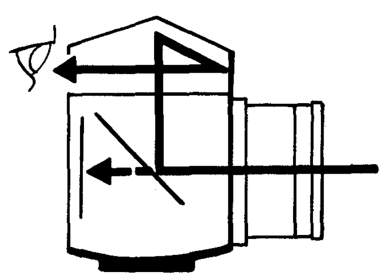

Separate viewfinder—parallax

Figure 3: Separate viewfinder



Single-lens reflex—no parallax

Figure 4: Single-lens reflex camera

• The other (single-lens reflex camera) with a *reflecting mirror* and a prism which permits you to see the same picture that the lens transmits to the film—regardless of the distance from camera to subject.

The single-lens reflex camera is preferable for picture-taking in which framing is critical, as in close-up and copy work. But most other 35mm cameras can be adapted for close-up photography. Carefully study the three settings that are made on adjustable cameras—lens opening, shutter speed, and focus. Understand the purposes of each, the relationship of one to another and to depth of field, and determine how each setting is made on your camera.

Accessories

You may find need for:

- A photographic light meter to determine exposure accurately
- A tripod to steady the camera (When filming at shutter speeds slower than 1/25 second *always* use a tripod.)
- A flash gun or photoflood lights for indoor scenes
- A close-up attachment to photograph subjects at close range and to do copy work
- A cable release to eliminate any possibility of jarring the camera during long exposures

Film

Select a reversal film to prepare slides when only one or a few copies Wi! be needed. If many copies will be required, use a color negative film if it is available for your camera, select film on the basis of:

• The main light source that will strike the subject

• The anticipated light level (low, moderate, high)

• The desired sharpness of reproduction

• The desired reproduction of colors

• The expected number of pictures to be taken (based on 35mm 20- or 36-exposure cassettes or rolls)

• The manner of film processing (by film laboratory or by yourself)

Exposure

Correct exposure is based on proper camera settings for the film used and for the general conditions under which pictures are to be taken. Film information sheets provide general exposure data for average conditions. For proper exposure, reversal color films permit only a narrow range of camera settings, limited to from one-half to one *f/* stop on either side of the correct setting; therefore use a photographic light meter to determine exposure accurately.

Characteristics of Commonly Used Color Films

CHARACTERISTICS OF COMMONLY USED COLOR FILMS

		REVERSAL FILM (See each film information sheet for the recommended light-balancing filters if the film is to be used with other than recommended light sources.)								NEGATIVE
		Regular Anscochrome	*Super Anscochrome*		*Regular Ektachrome*	*High Speed Ektachrome*		*Kodachrome II*		*Kodacolor*
		Daylight	Daylight	Tungsten	Daylight	Daylight	Type B	Daylight	Type A	
Exposure index (ASA)		32	100	100*	32	160	125*	25	40†	32
Light conditions necessary		good	low level		good	low level		good		daylight clear flash
Exposure range		moderate	good		moderate	good		moderate		wide
Exposure latitude		fair	good		fair	good		fair		wide
Color reproduction		soft	soft		soft	soft		true		true
Sharpness in details		good	fair		good	fair		excellent		good
Available sizes	35mm magazines, 20 exposures	x	x	x	x	x	x	x		x
	35mm magazines, 36 exposures	x	x					x	x	
	120	x	x	x	x					x
	127	x	x	x	x					x
	616									x
	620	x			x					x
	828	x			x			x		x
Processing by laboratory (L) or by self (S)		L or S	L or S		L or S	L or S		L only		L or S

*3200°K. flood †Regular flood

Table 1: Characteristics of Commonly Used Color Films

Lighting

As is indicated in the table of film characteristics, color films are designed for use with specific light sources. Select your film accordingly, although with a proper light- balancing filter a film can be used under other than the recommended light conditions. When such filters are used, the exposure index of the film is reduced (example: Kodachrome II Daylight, with exposure index *25,* when used indoors with photoflood lights requires a No. 80B filter and the exposure index is reduced to 12). Refer to the film-information sheet packaged with each roll for detailed information about light-balancing filters. For many slide subjects the use of artificial lighting is important. To boost the light level striking the subject and then reflecting to the camera, photoflash bulbs in reflectors or electronic flash units may be used. They are handy and easy to operate, especially when small areas must be illuminated. Make sure that your camera is synchronized (at the recommended shutter speed) with the flash.

For more carefully controlled lighting and for larger areas, use photoflood lamps. They are available in three sizes (No. 1, *250* watts; No. 2, 500 watts; and No. 4, 1000 watts), and are used with separate metal reflectors or have reflectors built into them (type RFL-2). In place of regular photoflood lamps, consider using inexpensive and highly efficient *sealed quartz lamps* of approximately 1000 watts. Avoid flat lighting created by placing lights beside the camera only. Instead, establish a lighting pattern involving a key light, fill lights, and supplementary background and accent lights. Study the purposes and placement of these lights and methods for determining exposure with them as described.

Remember that the sensitivity of color reversal films to a brightness range (the ability of the film to record a wide range of tones from white to black) is more limited than for black-and-white or color negative films. Therefore avoid heavy or deep shadows contrasted with brilliant highlight areas. Control the lighting in order to maintain a ratio between key and fill lights of not more than 2 to 1.

Close-up and copy work

Close-up and copy techniques often are very useful when preparing color slides. Your script may call for close-ups of objects, for details in a process, or for copies of maps, pictures, and diagrams. For these purposes, as has been mentioned, the single- lens reflex camera is the more suitable by reason of its accuracy in viewing. These deal with view finding, parallax, focusing, lens openings, exposure timing, and equipment and attachments that you may need for this special kind of photography. They also suggest procedures for copying flat materials and for constructing and using a simple copy stand.

To make a negative slide:

1. Prepare lettering and art work in black on white paper or on cardboard (if necessary use the paste-up technique.

2. Film the title, Use either 35mm Eastman Kodalith or 35mm Eastman High Contrast Copy film (formerly called 35mm Microfilm). The use of the Kodalith film is similar to the high-contrast process described.

3. Process according to instructions; when dry, swab the emulsion (dull) side of the negative with transparent water-color dye or with a colored felt pen.

4. Mount the film in a cardboard frame for use.

To make a positive slide:

1. Follow step 1 as for making a negative slide.

2. Follow step 2 as for making a negative slide.

3. Contact print the negative onto a piece of high-contrast cut film (page 60).

4. After developing, fixing, and washing, dip the positive into concentrated transparent water-color dye, then hang it to dry. The clear film background will absorb the dye evenly.

5. When the positive is dry. mount it in a cardboard frame for use.

Special titles, captions, or labels can be added to prepared color slides. In composing such slides be sure to provide light- colored areas where black lettering will appear and darker areas to support clear lettering:

To add black lettering to a slide:

1. Prepare a high-contrast negative and then a positive on cut film as in making a positive slide. Do not color the background.

2. Seal the slide and this positive in the same mount between glass covers.

To place white or clear lettering on a pictorial slide, double- expose the original subject and the lettering on the same frame of film. (Check your camera's instruction booklet to determine if double exposure is possible before applying this method.) Then:

1. Prepare lettering in white on nonreflecting black paper or cardboard.

2. Film the subject slightly darker than normal (one-half *f/* stop underexposed) so that the lettering will stand out.

3. Then cock the camera *without advancing the film.*

4. Film the lettering with normal exposure and then advance to the next frame.

You can use various methods, according to the materials you have to work with, for superimposing colored letters on a slide. Here are four:

• Place colored letters directly on an original flat picture, then copy the picture and lettering together as a slide. The letters most useful for this method are the pressure- sensitive adhesive transfer letters described.

• Place a diazo-colored transparency of the lettering over the original flat picture, then copy the combination as a slide. For information about diazo transparencies,

• Make a high-contrast positive of the lettering on film and use this as a master to prepare a diazo-colored 35mm slide. Then align and seal the diazo slide in the same mount with the prepared color slide. (Note: For very small lettering on a 35mm slide, diazo material may not produce sharp, clear lettering.)

• Make a high-contrast negative of the lettering, then reverse the image and rub a coloring dye over it to color the words. Align and seal this film in the same mount with the prepared color slide.

For preparing illustrations and diagrams:

1. Plan the art work in terms of the slide proportions.
2. Select suitable backgrounds.
3. Use appropriate illustrating, drawing, and coloring techniques.
4. Use suitable copy techniques to photograph each illustration as a slide.

Composition

Composition must take place in the viewer of your camera when you film each scene; therefore study the general suggestions for good composition on pages 43-44. As you select subjects, keep in mind the proportions of the slides you are preparing. If you can, prepare all slides with a uniform format—preferably horizontal.

Scheduling and record-keeping

As you plan to shoot your slides, make a list of scenes that conveniently can be filmed together. Then schedule each group. Organizing the work thus will save time and facilitate your picture-making. See the example Then as you prepare to make slides, consider the suggestions. Keep a record of the scenes filmed, the number of times each is taken, the camera settings used, and any special observations. Develop a form similar to the sample log sheet. Remember to obtain a release from the persons appearing in your pictures.

Processing film

One advantage and convenience for using reversal color film is that after exposure. a roll may be sent to a film-processing laboratory (through your local photo dealer). When returned, the slides are mounted in cardboard frames ready for projection. But, if desired, most color films (Anscochrome, Ektachrome, and Kodacolor negative) may be processed with inexpensive kits of prepared chemicals. Time can thus be saved between filming and seeing the completed slides: moreover, if a number of rolls are ready at about the same time, money also can be saved. The requirements and some of the cautions that must be observed when processing both reversal color films and color negative films are outlined.

Preparing slides

Slides may be mounted in commercial cardboard frames, in snap-together plastic mounts or between glass plates. The glass seems advisable for protection when slides are to be handled a great deal. But there are drawbacks to glass-mounted slides:

- They are heavier than cardboard mounts, and more expensive.
- They require more time when mounting.
- The glass may break if slides are dropped.
- Moisture often collects under the glass, or even mildew.
- Glass-mounted slides may not fit into some holders or slide magazines.

Moreover, slides may not need the protection of glass. In modern projectors they are removed from magazines and returned to magazines mechanically during projection. and thus are touched by the hands only when being filed or rearranged in the magazines.

Regardless of whether you mount in cardboard or bind between glass, always protect the surface of film being handled by wearing thin cotton gloves (generally used when editing motion-picture film).

Mounting in cardboard frames

Use these tools and materials: cotton gloves, hand iron, cardboard mounts, gummed-back thumbspots, scissors—and the film to be mounted.

Figure 5: Materials for mounting in cardboard frame

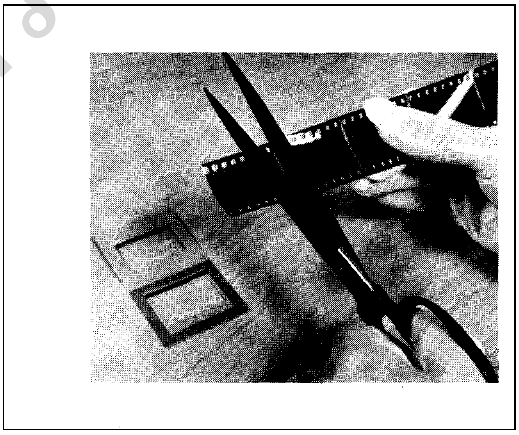
1. Cut the film along the frame line between the pictures.

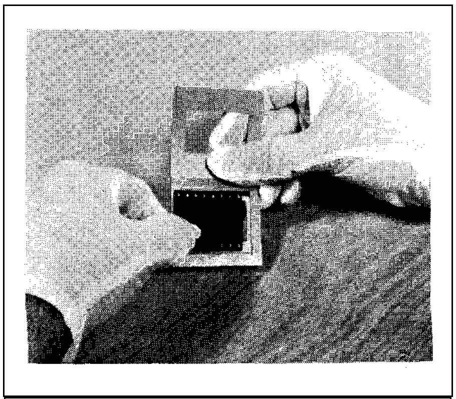
2. Align the film in the mount.

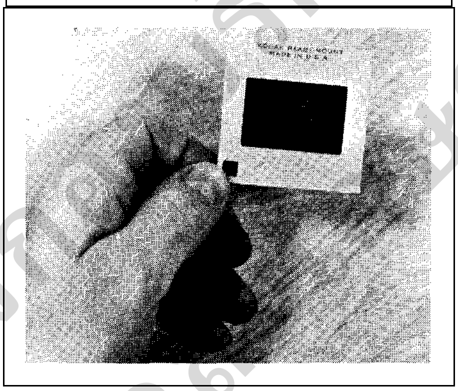
3. Using an electric iron (set at "low"), seal all four sides.

4. Put a thumbspot in the lower left-hand corner (as you view the slide correctly).

Figure 6: Making mounts in cardboard frame





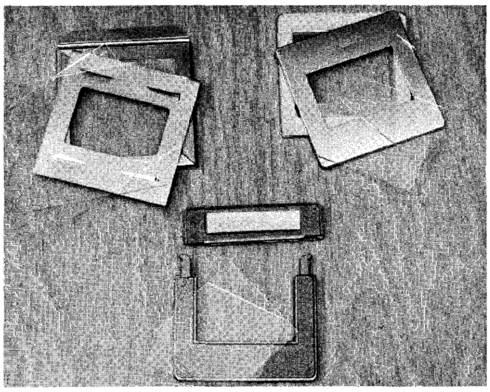


Binding in glass

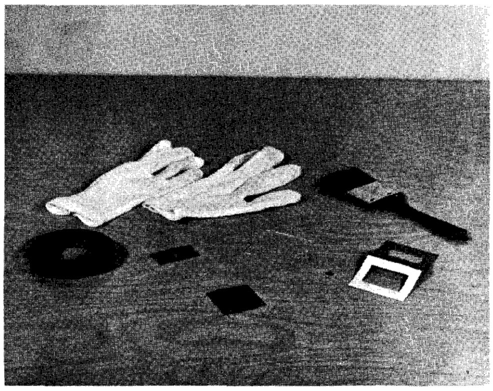
To bind slides in glass, use either commercial mounts or glass plates with slide-binding tape.

The commercial mounts consist essentially of plastic or metal assemblies to hold the glass covers and the film.

Get together these materials and equipment in the needed quantities: cotton gloves, soft brush, razor blade (or knife), paper mask, gummed-back thumbspots, glass plates, slidebinding tape—and the film to be mounted.

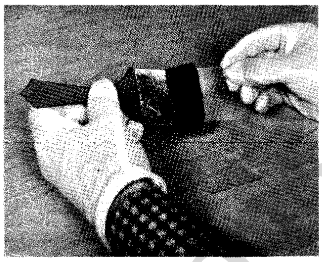


A selection of commercial mounts

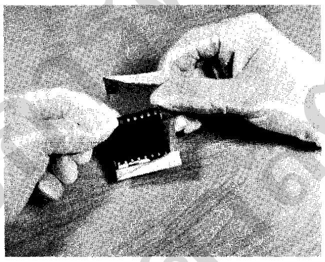


Materials for binding in glass

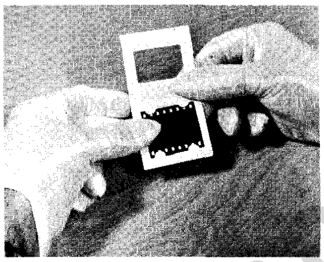
1



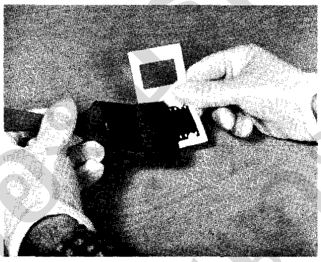
2



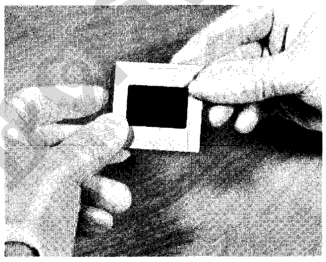
3



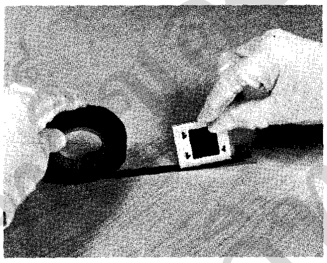
4



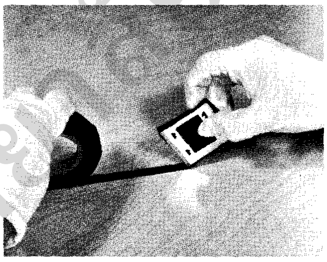
5



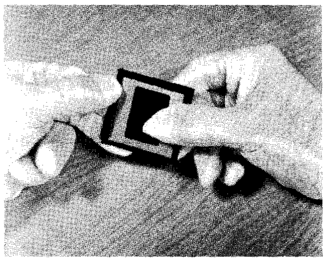
6



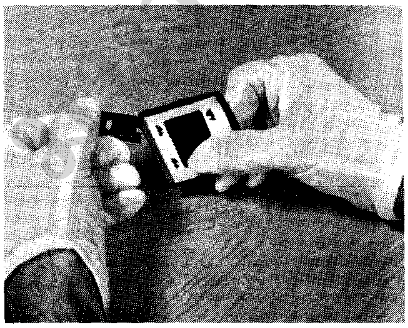
7



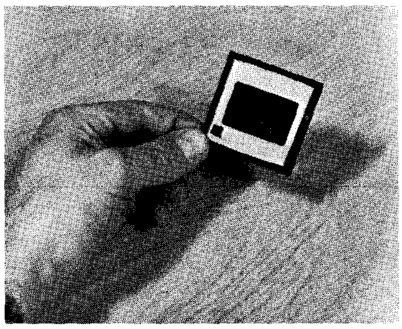
8



9



10



11

1. If the film is in a cardboard frame, cut the cardboard and remove the film.

2. Dust each piece of glass.

3. Align the film in the paper mask (silver side up).

4. Set the film under the paper tabs.

5. Dust the film on both sides.

6. Place the mask with the film between the glass plates.

7. Set the sandwich along the center of the tape.

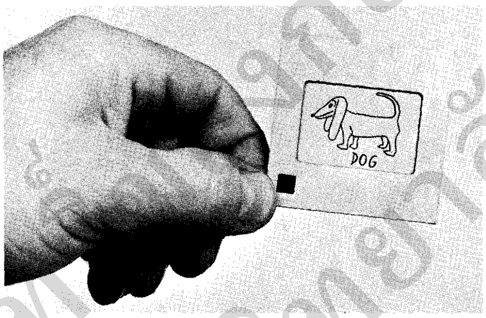
8. Rotate the sandwich slowly to adhere the tape to all four edges.

9. Cut the tape from edge to glass at each of the eight corners (four on each side).

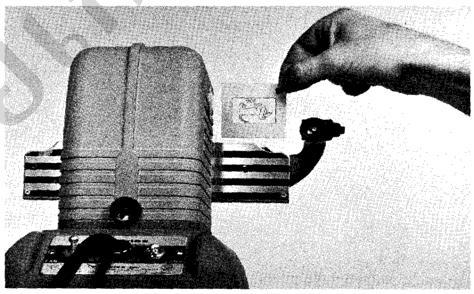
10. Press the tape to the face and the back of the glass on all slides.

11. Add a thumbspot to the lower left-hand corner (as you view the slide correctly).

Thumbspots, punched from gummed-back labels, help you to arrange slides correctly for viewing and for projection.



Thumbspot in *lower left corner* when slide is viewed correctly.



Thumbspot in the *upper right corner* when the slide is correctly positioned for projection.

Figure 7: Thumbspot

Editing

Selections must be made from among all the slides prepared some are in addition to those called for in the script or are substitutes; others are multiple *takes* of the same scene but differ in exposure and composition.

Place all slides on a light box or other illuminated area for ease of inspection. Discard those so indicated on the log sheet prepared while filming. Examine the slides; eliminate the poorer ones until the remaining selection is limited to those only of highest quality that fit or supplement the prepared script. Now revise the script as necessary and, if spoken or recorded commentary is to accompany the slides, refine it. With the editing finished, your slide series is nearing completion. It may be advisable at this time to show the series and to read the narration to other interested and qualified persons. For suggestions for developing a questionnaire to gather reactions and suggestions which may help you to improve your slide series.

Recording narration

Narration may be used with a slide series in the following ways:

• As informal comments while slides are projected

• As formal reading of narration as slides are projected

• As recorded narration with an *audible* signal to indicate slide changes.

• As recorded narration with an inaudible signal which electronically controls slide changes (requiring a special programming unit connected between the tape or record sound unit and the slide projector.

If a tape-recorded narration is to be prepared, refer to earlier suggestions concerning the selection and duties of personnel, recording facilities and equipment, and recording and tape-editing procedures. Disk recordings can be made in quantity from the master tape to accompany duplicate slide sets.

Duplicating slides

If the number of slides to be needed can be known before photographing begins, then the needed duplicates can be made as high-quality originals when the original subjects or materials are photographed on reversal film. Should additional sets be required after photography has been completed, a film-processing laboratory can make duplicates of the original reversal slides, generally by making an intermediate negative and printing the duplicates from it. It is an advantage of using color negative film that any number of duplicate positives can be made from a negative. Such positives will be softer in color and truer to the original scenes than copies made directly from reversal films.

Some people successfully project slides onto a matte-surface screen and then photograph the image to make duplicates. Careful exposure and film-color balance to match the color temperature of the projection lamp are important. (Use film balanced for photoflood light.) A slide made by this latter method will have more undesirable contrast (deeper and darker shadows and whiter highlight areas) than does the original slide.

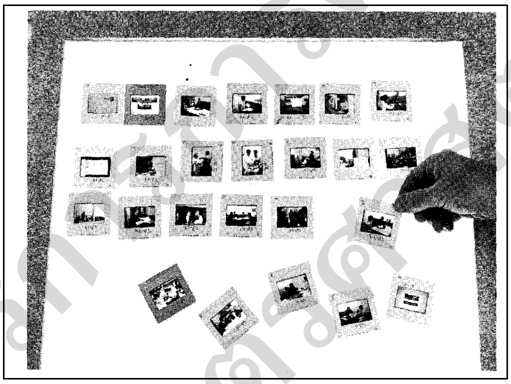


Figure 8: Duplicating slides

Selecting a projector

Simple slide projectors require the operator to insert each successive slide in a holder, feed it by hand into the projector, remove it by hand, and so continue with each slide in the series. The process is slow and requires much care to keep slides arranged properly. The operator must be alert for focus change as heat from the projection lens causes cardboard-mounted slides to buckle. The operator using such a projector must give undue attention to mechanics and can scarcely conduct a narration or give a lecture in addition.

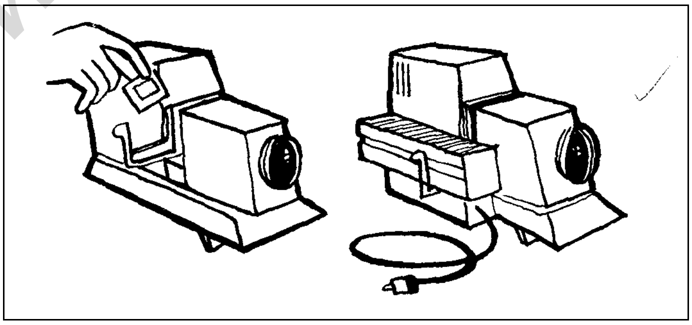


Figure 9: Slide projectors

For most slide projectors, adapters are available for attaching magazines or tray-fed low-cost slide-changing units, either hand-operated or remotely controlled from a distance through an electric cord with a push button (operated by the speaker once the machine is switched on). Newer projector models preheat slides in the magazine and are completely automatic, even permitting wireless remote control (including focus as well as slide changing). Such units eliminate all the problems inherent in the hand placement of slides—inversion, wrong sequence, or off-cue changes. Magazines for some projectors have capacities as high as 80 slides, thus permitting a quite long program to be set up in a single loading.

Magazine projectors offer further advantages with respect to the preservation, care, and storage of slides.

. Slides are protected from frequent handling and thus need not be protected by glass.

. Slides may be easily removed from magazines for examination and resequencing. Unless so removed, they are always in proper order and in proper position for projection.

. Magazines and trays are easily handled and stored.

Automatic slide-projector and tape-recorder combination units offer the added feature of being able to put an inaudible signal on the tape which, at the proper instant, will set off a relay that causes a slide change. Such a unit accomplishes automatic projection of slides, correlated with narration. Separate "programming units" for use with most tape recorders and slide projectors (having remote-control outlets) also permit this operation.

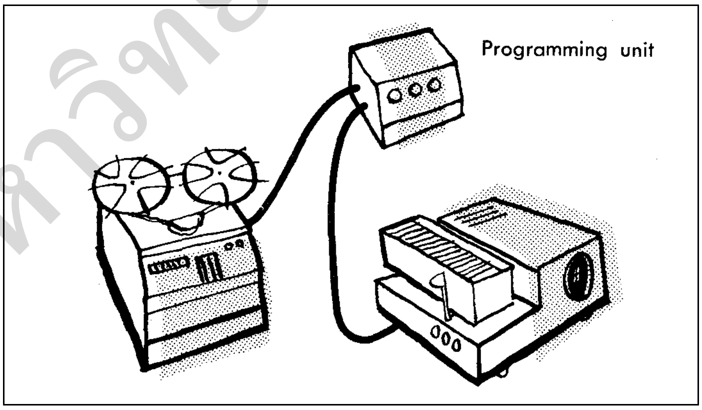


Figure 10: Programming unit

For individual use of slide series, a number of compact viewers that magnify or project the slide image from the rear onto a translucent screen may be used. More sophisticated models include sound playback units using tape cartridges which electronically control slide changes and may permit the viewer to stop the tape while studying the slide image.

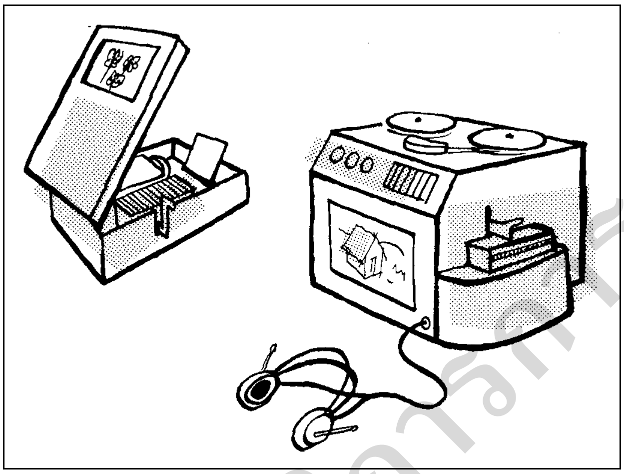


Figure 11: Slide projector

In summary, there are available:

. Projectors requiring hand placement of slides—may be used with separately operated tape recorders

. Projectors with hand-operated or remotely controlled changing units having slides in magazines or trays—may be used with separately operated tape recorders

. Combination or separate projectors and tape recorders— with inaudible-signal automatic slide-changing attachments

. Hand or table viewers for individual use—may be used with separately operated tape recorders

. Automatic projection viewers for individual uses—some with sound playback attachments.

Preparing to use your slide series

Remember that the success of your slide series will depend not only on its content and quality but also on the manner in which you introduce and show it to an audience. As you prepare for the first showing, if your materials are designed for group use.

Transparencies

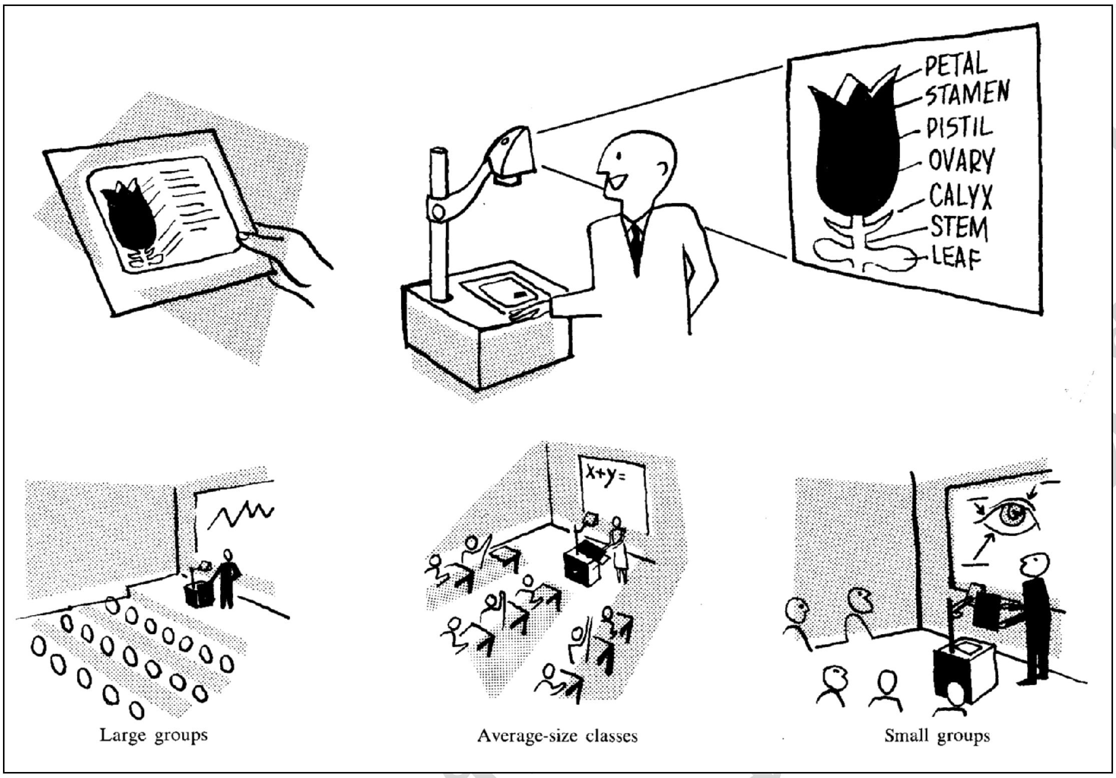


Figure 1: Transparencies

Transparencies are large slides for use with an overhead projector from the front of a lighted room. They project a large, brilliant picture. Transparencies can visually present concepts, processes, facts, outlines, and summaries to small groups, to average-size classes, and to large groups. A series of transparencies is like any other audiovisual materials in requiring systematic planning and preparation. Before you set about making your actual transparencies, therefore, always consider this planning check list:

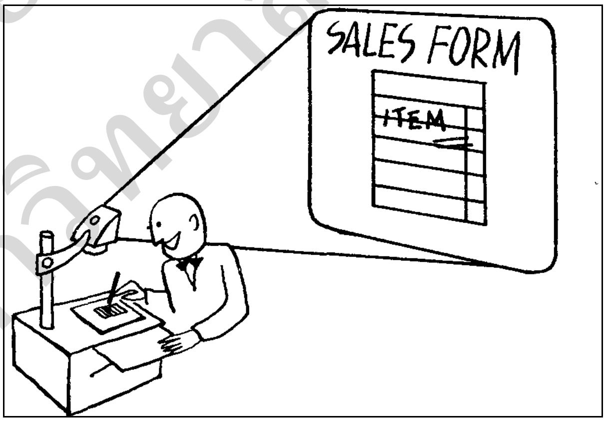
- What *purposes* will your transparencies serve?
- What factors are important to consider about the *audience* which will see the transparencies?
- Have you prepared an *outline* of the content to be included?
- Are transparencies the best medium to accomplish your purposes and to convey the content? Might they even be combined with other media for greater effectiveness?

- Have you *organized the content* and made *sketches* to show what is to be included in each transparency?

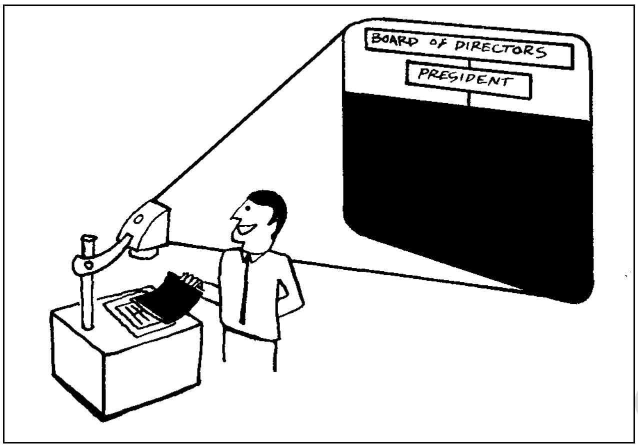
When showing visual materials with an overhead projector, you can make your presentation effective by using some techniques that are impossible with slides or with filmstrips:

• You can use a pointer at the transparency to direct attention to a detail and your pointer will show on the screen.

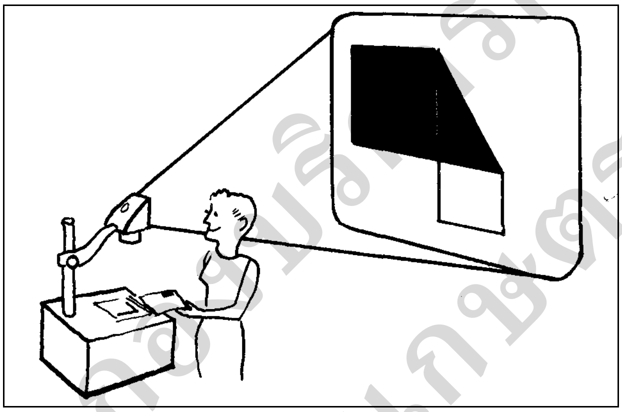
• You can use a pencil to add details or to mark points on the transparency during projection. If you make these marks with a grease pencil or a china-marking pencil, you can rub them off later with a soft dry cloth or a piece of cotton.



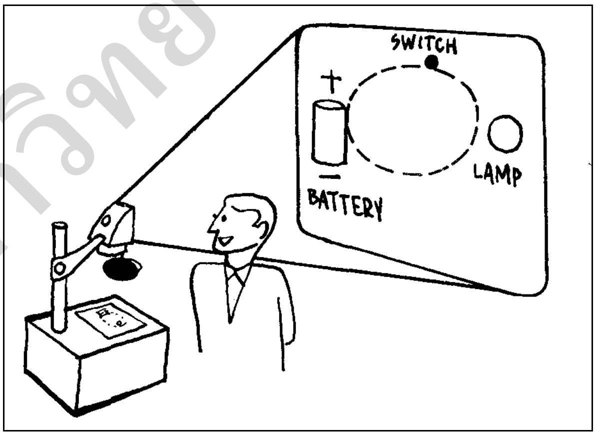
• You can control the rate of presenting information by covering a transparency with paper or cardboard and then exposing the data as you are ready to discuss each point.



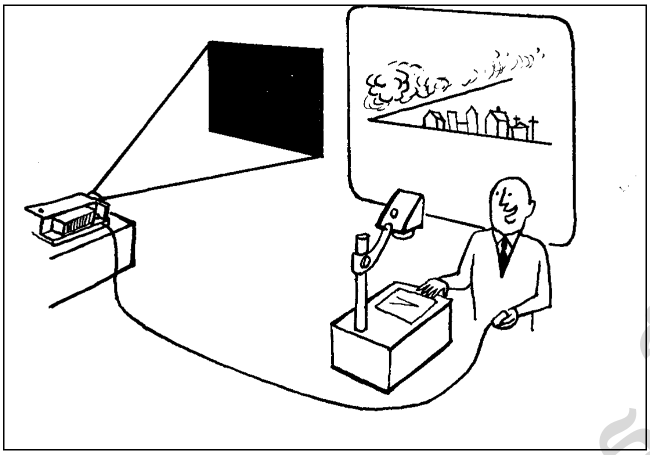
• You can superimpose additional transparent sheets as overlays on a base transparency so that you separate processes and complex ideas into elements and progressively present them.



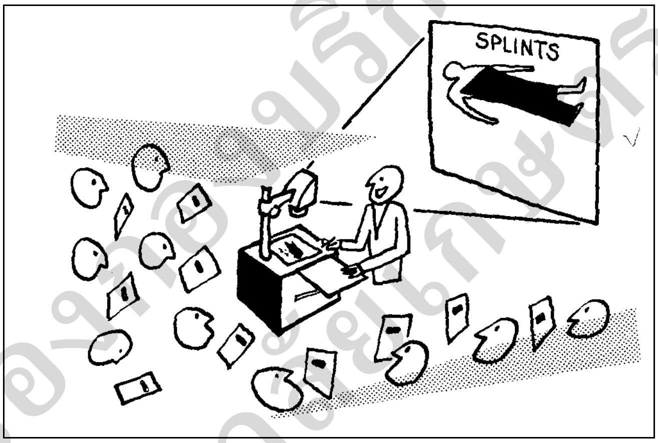
• You can simulate motion on parts of a transparency by using the effects of polarized light with a Polaroid spinner.



• You can simultaneously project other visual materials (slides or motion pictures) which illustrate or apply the generalizations shown on a transparency.



• You can duplicate inexpensively on paper the material to be presented as transparencies. Distributing copies to the class or audience may relieve them of the mechanics of copying complex diagrams and outlines.



Advantages

The overhead projection system has a number of unique features that give it the tremendous versatility for which it is acclaimed by so many instructors. Its bright lamp and efficient optical system generate so much light on the screen that the overhead can be used in *normal room lighting*

The projector is operated from the front of the room with the presenter facing *the audience,* allowing direct eye contact to be maintained. Most overhead projectors are lightweight and easily portable. All are *simple to operat.* A *variety of materials* can be projected, including cutout silhouettes, small opaque objects, and many types of transparencies.

Projected materials can be *manipulated* by the presenter. You can point to important items, highlight them with colored pens, add details during the lesson (notes, diagrams, etc.) by marking on the transparency with a marking pen, or cover part *of* the message and progressively reveal information in a step-by-step procedure. As noted previously, complex visuals can be presented in a series of overlays.

Instructors can easily prepare their own transparencies. Information that might otherwise have to be placed on a chalkboard during a class session (lesson outlines, for example) may be prepared in advance for presentation at the proper time. Research indicates that retention of main points improves significantly when visual outlines are presented.

A recent study indicates that the use of overhead transparencies also has positive attitudinal effects in business meetings. In a study by the Wharton Applied Research Center, candidates for master's degrees in business administration participated in a business simulation that included group meetings to decide whether or not to introduce a new product. The findings showed that

• More individuals decided to act on the recommendations of presenters who used overheads than on the recommendations of presenters who did not.

• Presenters who used overheads were perceived as better prepared, more professional, more persuasive, more credible, and more interesting.

• Groups in which presenters used overheads were more likely to reach consensus on their decisions than groups where no overheads were employed.

Another study suggests that teachers who use the overhead projector tend to be more organized than teachers who rely on notes or printed outlines. Students in this study participated more frequently in discussions in the classes where the overhead was used.

Preparing Transparencies

Many processes have been developed for preparing transparencies. They range from very simple hand lettering or drawing to methods requiring special equipment and particular skills. Of these, the most practical and proven techniques are considered here. The methods are grouped as follows:

Making transparencies directly on plastic on clear plastic

on treated or coated acetate

on frosted (matte) acetate

Making transparencies as reproductions of prepared diagrams with the spirit duplicator

on diazo film

Making transparencies as reproductions of printed illustrations with no size change

on heat-sensitive film

on diffusion-transfer (photocopy) film

on picture-transfer film—Thermo-fax method on picture-transfer film—Seal method

Making transparencies as reproductions of printed illustrations with size change

high-contrast subjects

halftone and continuous-tone subjects

Which method or methods to use? First, consider those most appropriate to your purposes, the subject matter, and the planned use for the transparencies. Your final decision should be based upon accessibility of equipment and materials, on your skills and available time, and certainly not of least importance, on your standards for quality.

Making Transparencies

Dimensions of the working area

In overhead projectors, the working area is usually square and either 10” X 10” or 7” X 7”. In either size, the entire square can be used for the transparency, but it is usually better to avoid the extreme edges. Also, since a square is less attractive for most purposes than a rectangle, it is usually well to work within a rectangle having a height-to-width ratio of about 4:5. Thus for the 10” X 10” projector a convenient transparency size is 7’ ½ ” X 9 ½ This is normally to be projected with the 9’ ½ ” dimension horizontal, but can be projected with the 7 ½ ” dimension horizontal if necessary and if the screen format will permit. You can buy prepared cardboard frames with the openings cut in them, or you can make your own from 6- or 10-ply cardboard. Outlines of masks for the 10”X 10” and 7”x7” projectors are printed inside the back cover of this book.

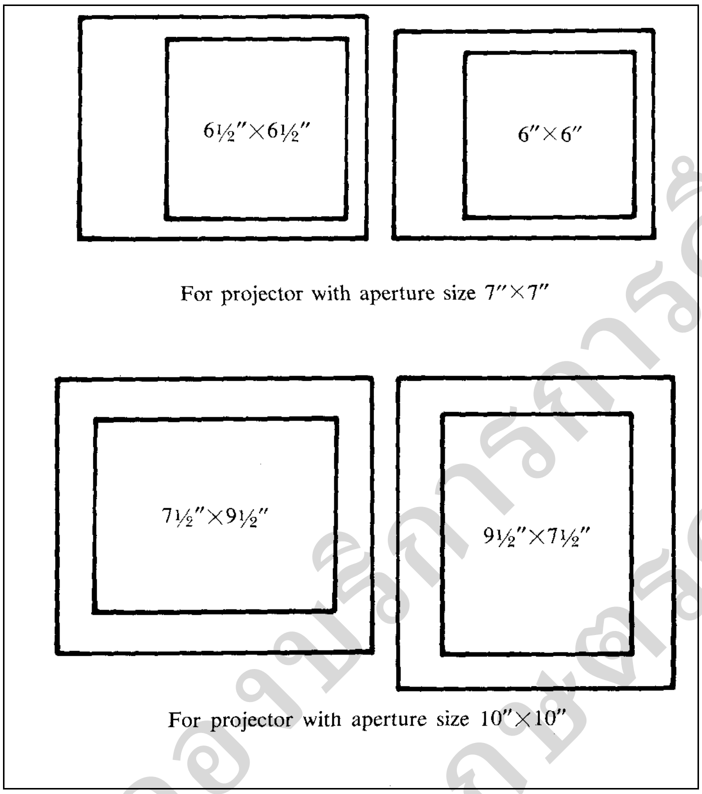


Figure 2: Dimensions of the working area

Whatever the size of your opening, prepare all art work, photographs and lettering to fit within this opening area or to have its proportions if size changes are to be made by photographic enlargement or reduction.

Making transparencies directly on plastic

With these simple techniques transparencies are prepared quickly. They are not durable. For repeated use, neater and more permanent methods are advisable. But use these techniques for trying out your visuals; then, if necessary, make revisions before redoing them in permanent form. On paper, outline the boundaries of the opening in the mount that you will use. Still on paper, make a sketch or position an illustration for tracing. Then, using the appropriate tools below, put your drawing or tracing on acetate. Complete the transparency as directed later in this section.

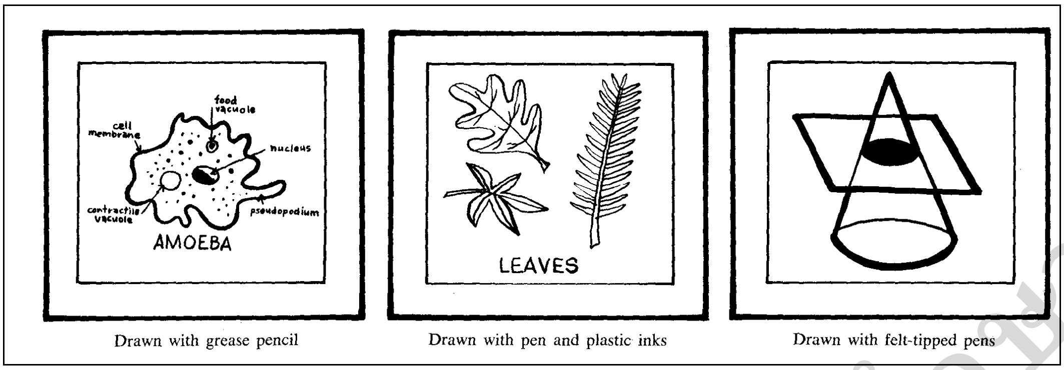


Figure 3: Making transparencies directly on plastic

On clear plastic (acetate) *Materials and tools:* clear acetate sheets (.005-.0 10" thick is preferable); a cardboard mount; a china-marking pencil (grease pencil), felt-tipped pens (in colors), or pen and plastic inks.

On treated or coated acetate *Materials and tools:* treated acetate sheets (having an irivisible ink-holding coating on both sides; cardboard mount; transparent colored drawing inks; pens; lettering aids.

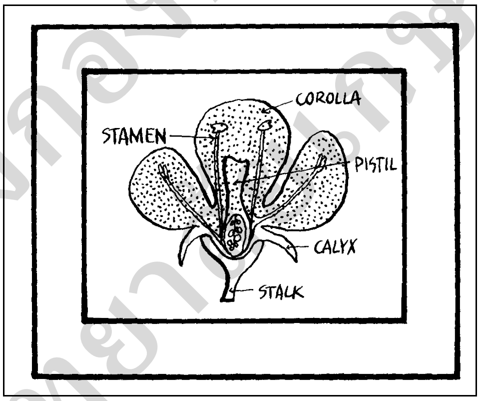


Figure 4: On treated or coated acetate

The advantage of this material is that ordinary drawing inks will adhere to its surface. Handle the acetate carefully before use, as scratches and fingerprints will make drawing difficult. Inks may tend to run slightly, therefore use pens lightly. Also, colors may not take to the acetate evenly, therefore use a stippling method (small dots of ink) to color large areas.

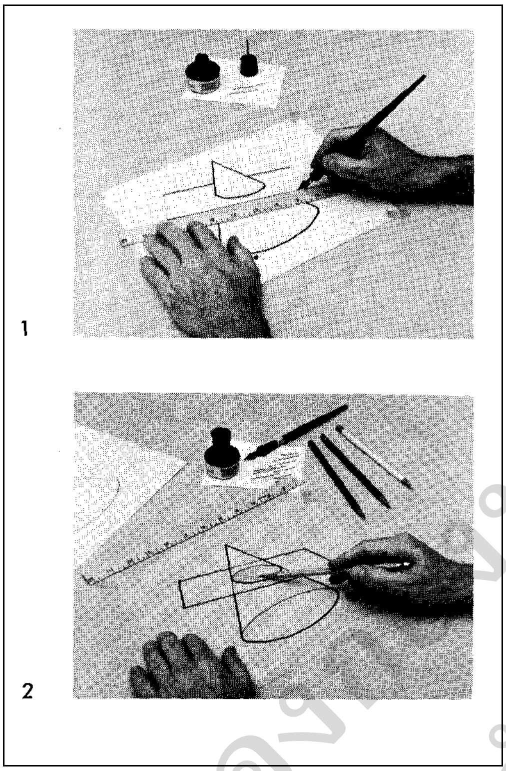
On frosted (matte) acetate *Materials and tools:* frosted or matte acetate (.010" thick and having a fine tooth); cardboard mount; black and transparent drawing inks; felt-tipped pens, or transparent colored pencils; lettering aids; clear plastic spray.

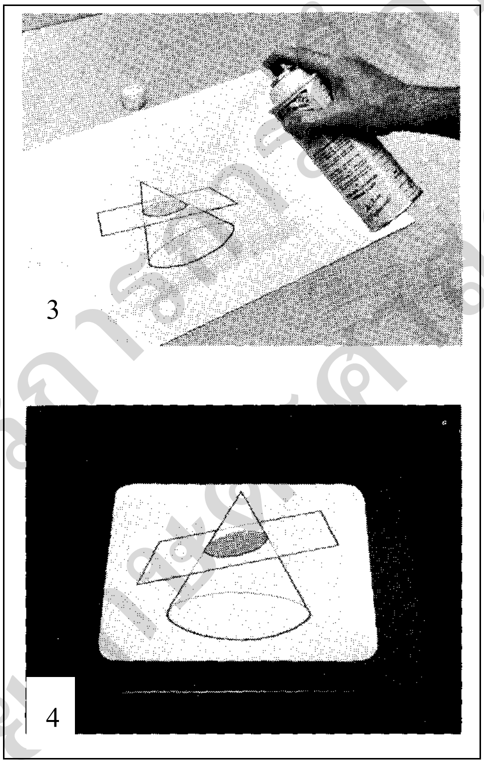
1. With the frosted side of the acetate up, trace the original sketch, using black or colored inks.

2. Apply color to the desired areas with pencils, felt pens, or inks.

3. Evenly and carefully coat the frosted side with plastic spray.

4. After the spray coat is dry, mount the transparency for use.





The difficult part of this process is in applying the plastic spray. It transparencies the surface to permit brighter projection and also protects the drawing. Use the spray carefully to flood the surface lightly and evenly. Too much spray will cause certain coloring agents to run.

Making transparencies as reproductions of prepared diagrams

To make transparencies as reproductions requires the preparation of one or more master drawings on appropriate paper and then the duplication of these drawings on transparent material. The spirit-duplicator and diazo methods are described immediately hereafter. In addition to these, the methods of copying on heat-sensitive film and on photocopy or diffusion- transfer film, described in the next section, are suitable for making transparencies from original diagrams.

With the spirit duplicator *Materials, equipment, and tools:* sheets of frosted (matte) acetate, 8 ½ X 11”, having a fine tooth; cardboard mount; spirit duplicating masters (with colored carbons); a spirit duplicating machine; hall-point pen and lettering aids; clear plastic spray.

1. Prepare the duplicating master in the same way used for making paper copies; use colored carbons as may be appropriate.

2. Attach the master to the drum of the duplicating machine, cause fluid to flow to the wick, and adjust pressure.

3. Feed some paper through the machine and when a good image is being transferred send through a sheet of acetate (matte side up).

4. The acetate will pick up the image from the master just as did the paper.

5. Coat the frosted side with clear plastic spray to transparencies the surface and protect it. Avoid using too much. *6*After the spray coat is dry, mount the transparency for use.

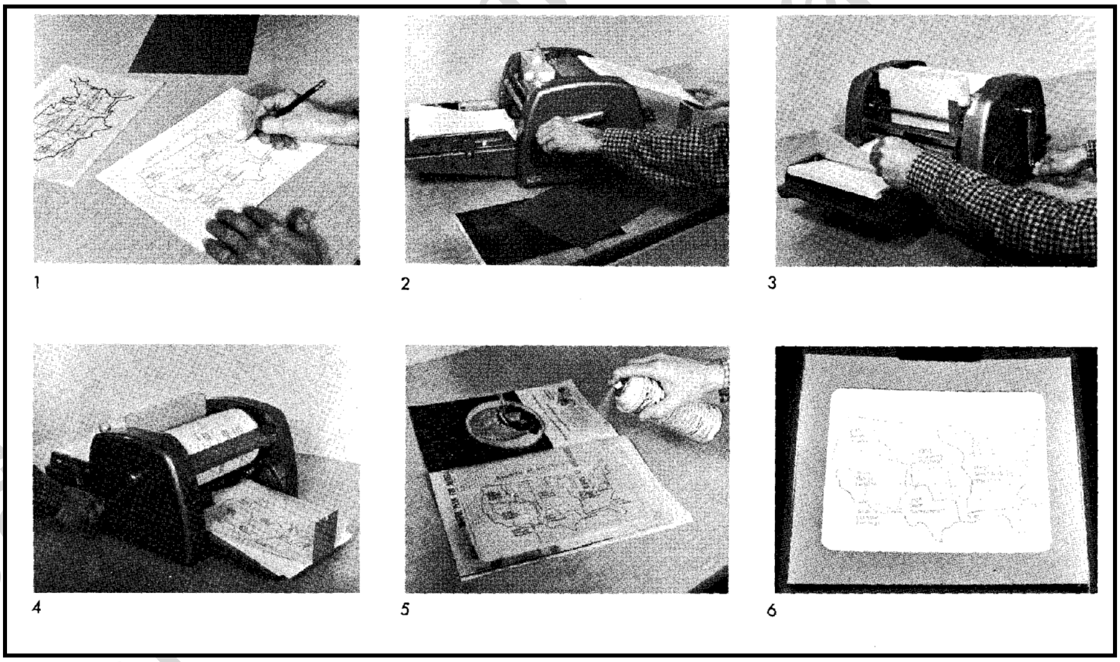


Figure 5: Making transparencies as reproductions of prepared diagrams

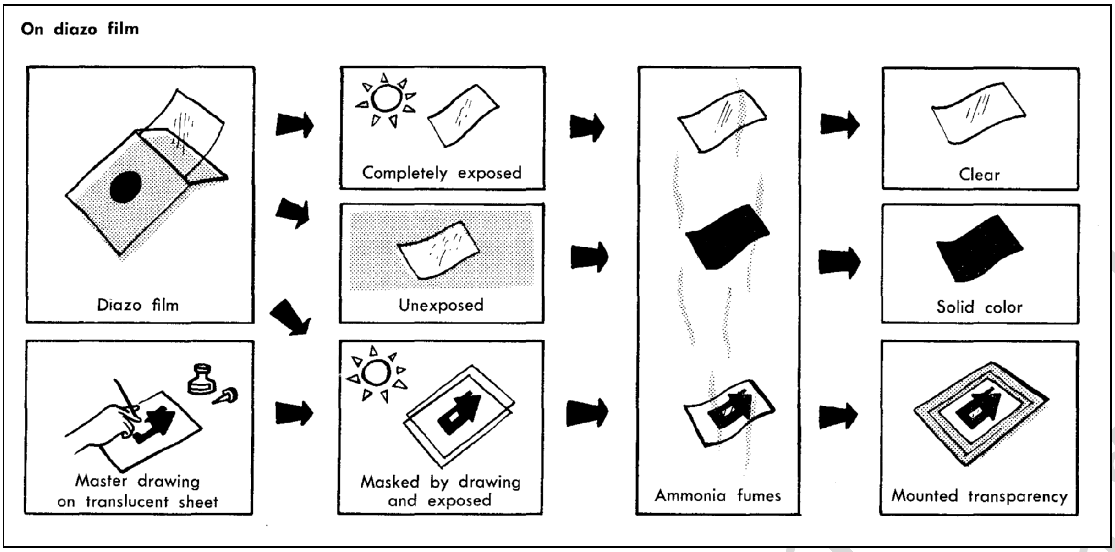


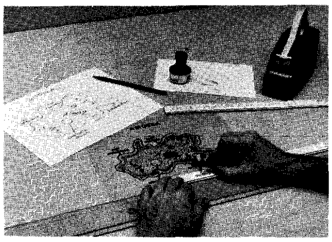
Figure 6: Making transparencies on diazo film

Diazo films have been designed especially for the preparation of brilliantly colored transparencies. The films have a *dye coating,* which if exposed to ultraviolet light is chemically changed so that no image will appear. But if the dye is *not exposed* to ultraviolet light and is *developed* in an alkaline medium (like *fumes of ammonia),* the dye combines with the *color coupler* in the film to form a *colored image.* Ten colors are available.

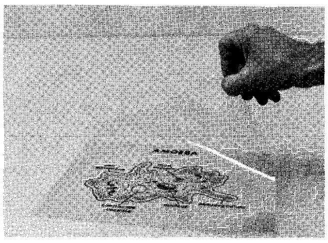
To prepare a diazo transparency, therefore, put lettering or drawing on a translucent sheet and expose it in contact with the diazo film to ultraviolet light; then develop the film in ammonia vapor. The opaque marks on the master diagram prevent the ultraviolet light from affecting the film next to them, hence color appears in these areas when the film is developed in the ammonia. *Materials, equipment, and tools:* translucent drawing material

—tracing paper or frosted acetate; cardboard mounts; diazo film of selected color; black drawing ink; pen and lettering aids; diazo reproduction unit—ultraviolet-light printer and ammonia- vapor developer.

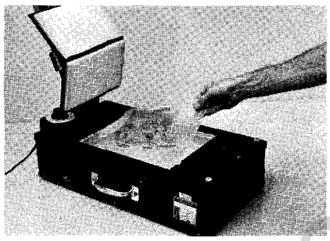
Although the equipment available for your use may differ from that shown or described below, the principle of diazo reproduction is the same.



1



2



3

1. Prepare a master drawing on frosted acetate or translucent paper using black inks or other materials that make opaque marks.

2. Cover the drawing with a sheet of diazo film.

3. Place the drawing and film in the ultraviolet light printer. (Note the correct order: light below, drawing, film on top).

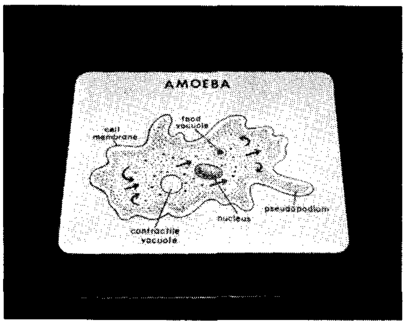
4

5

4. Close the cover and set the timer for proper exposure time.

5. After the exposure time has elapsed, transfer the exposed sheet of film to the container of ammonia vapor.

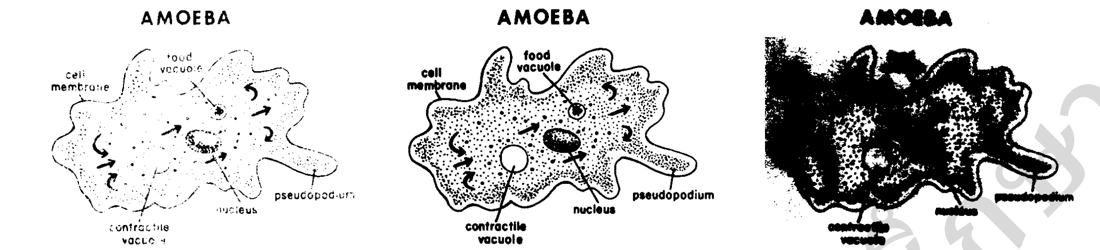
6



7

6. In a short time the image will appear. Keep the film in the ammonia until the color appears fully. (Overdevelopment is not possible.)

7. Remove the transparency and mount it for use.



Overexposed Correctly exposed Underexposed

The transparency image may be too *light* or *faint* for projection, if so, print it again with a new sheet of film, *reducing* the exposure time. A *faint* diazo transparency has been *overexposed.*

If, on the contrary, the transparency shows some *unwanted tones* in the background, print it again with a new sheet of film, *increasing* the exposure time. A *muddy* diazo transparency with unwanted background has been underexposed.

As many transparencies as are needed may be made from the one master drawing. For distribution to an audience, copies of the master drawing can also be made by the diazo process on inexpensive diazo paper.

The diazo process permits the use of a number of effective techniques both in preparing the master and in modifying the transparency. Among these are:

• Overlay transparencies, for successive presentation of elements of a diagram, may be made by preparing separate masters and transferring the images to diazo film. Over-lays may be of the same color as the base transparency, or of other colors. To insure proper alignment of all layers of the final transparency carefully *register* the master drawings to the original diagram and also each piece of film to its master when printing. Do this by placing a guide mark in each of two corners on the masters to correspond to marks on the original diagram; or more preferably, use punched paper and film aligned on a register board

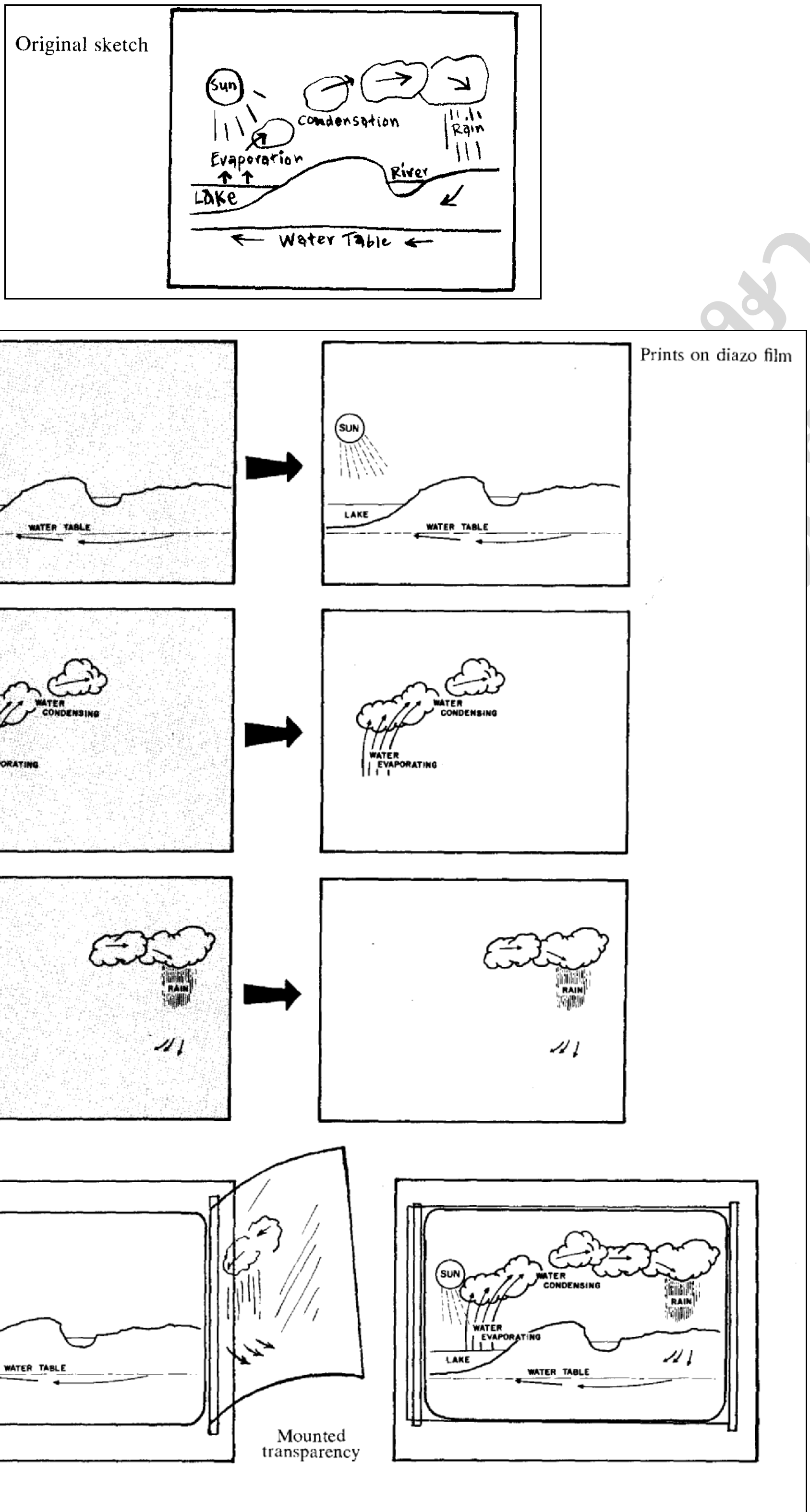
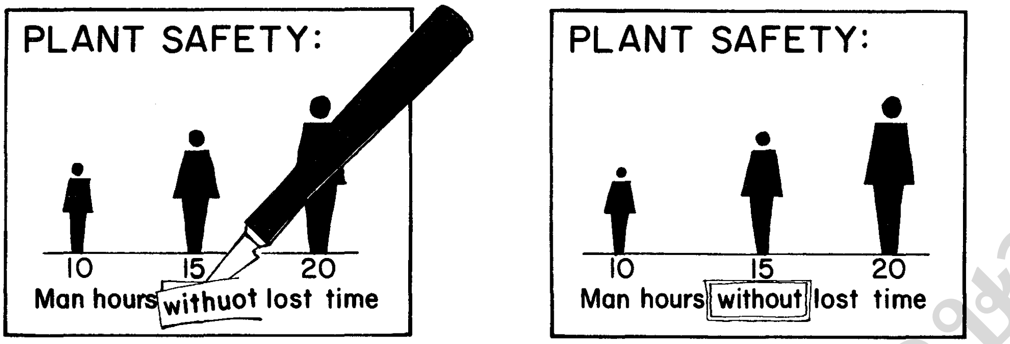


Figure 7: Overlay transparencies



Cut the error out of the paper or acetate master.

Insert the correction, on similar material, and fix it in place with translucent tape (Scotch No. 810).

Figure 8: Cut and insert

- Minor mistakes on the master may be corrected before the diazo film is exposed.
- Letters, symbols, patterns, and other art work may be placed on the master by using adhesive-backed *heat- resistant* printed material.
- The master can be prepared by making a photocopy on translucent film if the subject is of the proper size; the image may then be transferred to diazo film.
- The master can be prepared by making a black-and-white photograph of the desired size on film; the image may then be transferred to diazo film of the desired color. Subjects may be high-contrast or continuous-tone.
- Areas of the transparency can be colored by applying adhesive-backed sheets of transparent color tints.
- If two or more colors are desired in a transparency, separate masters may be made for areas requiring each color and the two diazo films superimposed in one mount for projection as a single transparency.

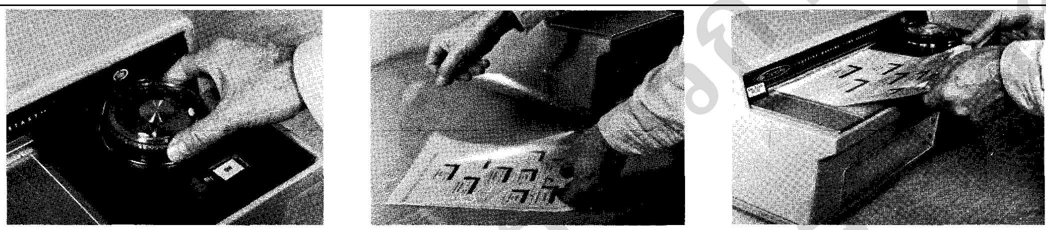
Making transparencies as reproduction of printed illustrations – with on size change

Of the four methods described under this heading, the first two may be used either with printed line drawings or with original drawings prepared in black ink on white paper. The two described thereafter can be used with illustrations printed on clay-coated paper. Whatever method is being considered, keep in mind the following:

• Permission may be necessary to reproduce copyrighted materials.

• Legibility standards for projected materials should be observed when printed items are considered.

On heat-sensitive film This process is completely dry and transparencies are ready for immediate use. Heat from an infrared-light source passes through the copy film to the original. The lines and other markings on the original, which are in contact with the film, absorb heat; the increase in temperature affects the film and forms an image on it within a few seconds. *Materials, equipment, and tooR:* printed or original material on paper; a cardboard mount; heat-sensitive projection film; Thermo-fax office copy machine.

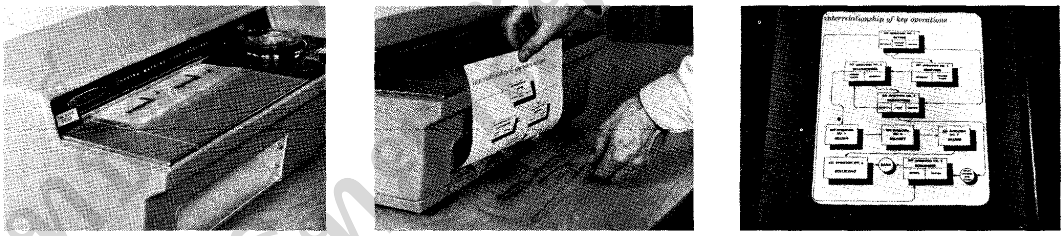


1 2 3

1. Turn on the copy machine and set the control at low or slow speed.

2. Place the projection film (with notch in upper right corner) on the original material.

3. With the film on top, feed the two into the machine.



4 5 6

4. The machine will carry the two around the heat source.
5. When the two emerge, separate the film from the original.
6. Mount the transparency for use.

The transparency image may be *too light* or *faint* for satisfactory projection; if so, print it again with a fresh sheet of film, *increasing* the exposure time (that is, with the machine running at *slower* speed). A *faint* heat-transfer transparency has been *underexposed.*
If, on the contrary, the transparency is *too dense,* or if there is *unwanted background tone,* print

the transparency again with a fresh sheet of film, shortening the exposure time (that is, with the machine running at *faster* speed). An *overdense* heat-transfer transparency has been *overexposed.* Some original materials cannot be reproduced by the heat- transfer process. Many inks, especially ball-point and spirit- duplicator inks, and many colored pencils do not absorb enough heat to affect the film.

On diffusion-transfer (photocopy) film The diffusion-transfer process is useful for reproducing pages from books, magazines, and other bound references, as well as from single sheets. It is a contact photographic process which takes place in subdued room light. A sheet of negative paper, held against the original page or sheet, is exposed to light which is transmitted through this negative to reach the original. The lighter areas of the original reflect light back to the negative sheet, while the printing or other marks on the original page absorb the light. This is *reflex exposure.*

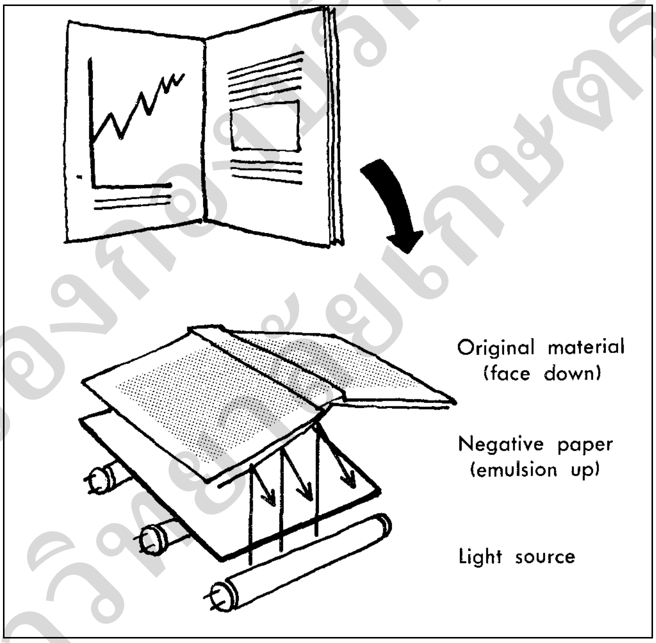


Figure 9: Making transparencies on diffusion-transfer (photocopy) film 1

Then the negative, placed in contact with a sheet of film positive, is developed in a single chemical solution. The image from the exposed negative transfers to the positive. After a few moments the two sheets are peeled apart carefully.

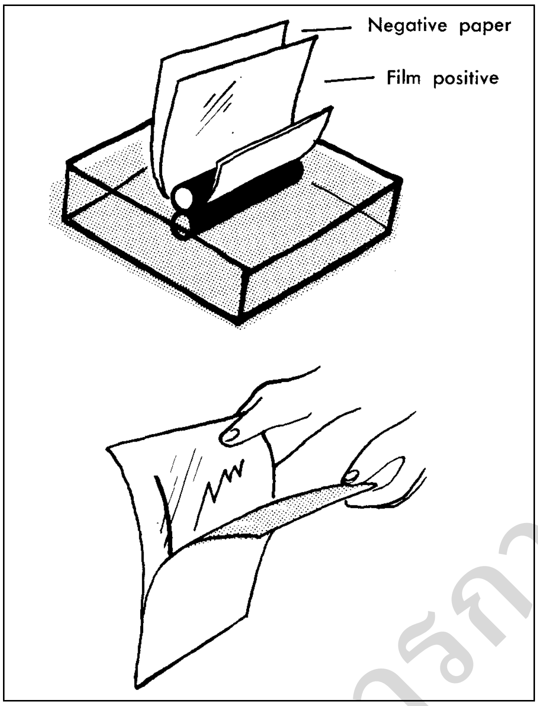
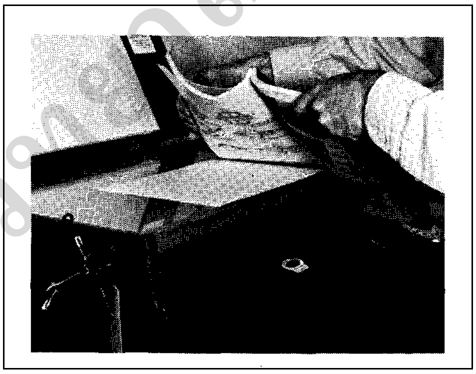
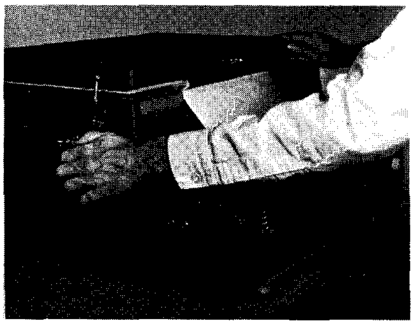


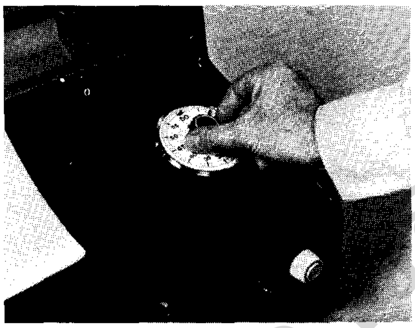
Figure 10: Making transparencies on diffusion-transfer (photocopy) film 2

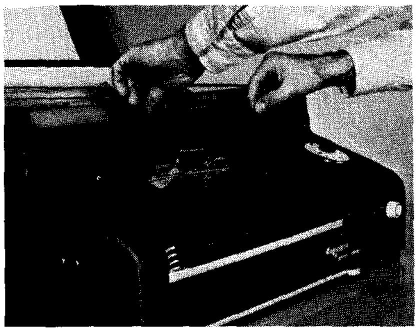
Materials, equipment, and tools: original or printed material to be copied; diffusion-transfer negative paper; diffusion-transfer film positive; developing solution; cardboard mount; diffusion- transfer (photocopy) printing and developing units.

The equipment available for your use may differ from that described and illustrated, but the principle of diffusion-transfer or photocopy is the same for all equipment.









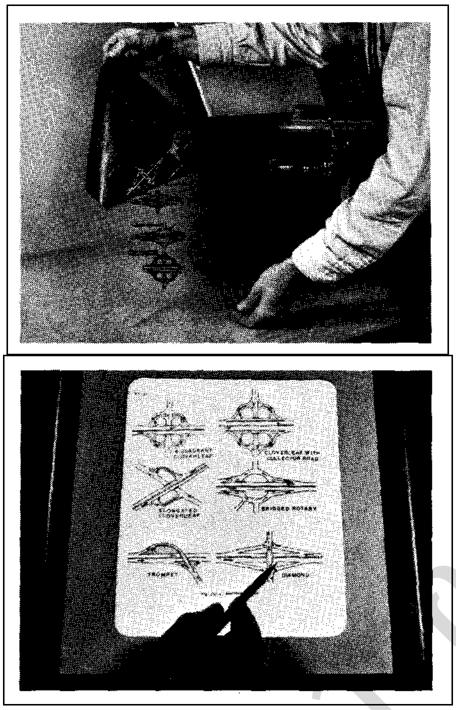


Figure 11: Making transparencies on diffusion-transfer (photocopy) film 3

1. In the copy machine place a sheet of photocopy negative paper (sensitive side up) against the sheet or page to be

2. Adjust and clamp the cover so that even pressure is exerted.

3. Set the timer for the recommended exposure and click on the switch.

4. After the exposure is completed, remove the negative sheet, placing against it a sheet of film positive (notch on upper left corner).

5. Feed the two sheets through adjacent slits in the developing unit.

6. As the negative and film emerge from the developer the image will be visible.

7. After 30 seconds (or other time as directed for the equipment and material), separate the film from the negative.

8. Hang the transparency to dry (some products require a water rinse) and then mount it for use.

The transparency image may be too *light* or *faint* for projection if so, repeat the entire photocopy process using another negative sheet and film positive and *reducing* the exposure time slightly (one second makes a big difference). A *faint* diffusion- transfer transparency has been made from an *overexposed* negative. If, on the contrary, the transparency shows some *unwanted tones* in the background, repeat the entire photocopying process using another negative sheet and positive film and *increasing* the exposure time. A *muddy* diffusion-transfer transparency with unwanted background tone has been made from an *underexposed negative.*

The diffusion-transfer or photocopy process permits several uses in addition to the making of transparencies. Another negative can be used to make a translucent copy for diazo reproduction on paper, in quantity. A negative can be used to make inexpensive aluminum offset plates when large numbers of copies of the original are needed for distribution to an audience. You can make up your original from pasted-up materials, then make the photocopy negative, and produce transparencies or a paper copy from the photocopy negative. In the copying process, paste-up marks tend to disappear.

You can work from continuous-tone photographs as originals by using a special printed screen to reproduce them. Check the manufacturer's recommendations for details of this procedure. If the original is of a different size from the transparency or paper copies you want, you can use a special fast photocopy negative paper as a camera negative (in a camera of size 8" X 10" or larger), enlarge or reduce the illustration upon this negative, then develop it in contact with photocopy positive paper or film as above. This fast negative paper must be handled under a red safelight, loaded into film holders, and tested for proper exposure.

On picture-transfer filni—Thermo-fax method In this process the inks of printed pictures (color or black- and-white, *on clay-coated paper)* adhere to specially prepared acetate to make a transparency of the picture. The picture and the acetate are sealed together with heat and pressure, then submerged in water to dissolve the clay coating and soak the paper free from the inks. The inks remain on the acetate. A plastic coating applied after the acetate is dry transparentizes and protects the picture side. A similar method that employs other equipment is explained next after this.

Materials, equipment, and tools: picture printed on clay- coated paper; Thermo-fax color-lift film and color-lift kit (including detergent, liquid brightener, brushing pads, and black paper with interleaf sheet): tray of water: hooks and string: cardboard mount; Thermo-fax office copy machine.

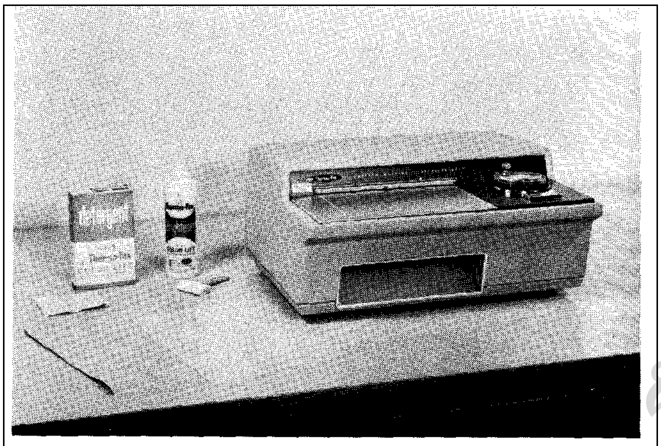


Figure 12: Materials of making transparencies on picture-transfer film

1. Turn on the copy machine and set the control to its lowest (slowest) setting.

2. Test the selected picture for clay coating by rubbing a dampened finger over a white area of the page, outside the picture. A white deposit on the finger indicates the presence of clay.

3. Place the picture (face down) on top of the lift film (notch in upper right corner); place both between the black paper and the interleaf sheet.

4. Feed the set into the copy machine.

5. Remove the picture and acetate (now adhering together).

6. Submerge the adhered materials in a tray of water containing a small amount of detergent.

7. After 2 or 3 minutes of soaking, separate the paper from the acetate. The inks and some clay adhere to the acetate.

8. Brush the image side of the film gently to remove any deposits of clay, and rinse well.

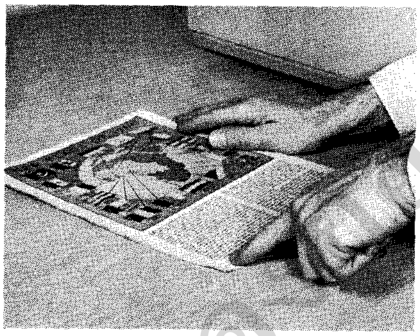
9. Hang the transferred picture to dry, or blot it between sheets of absorbent paper.

10. When the acetate is dry, apply color-lift brightener to the image side of the transparency, using slow and even strokes the length of the film.

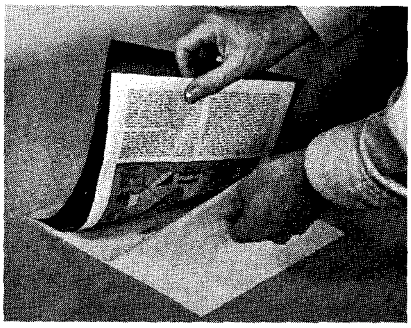
11. Let the brightener dry; afterward, mount the transparency for use.

1

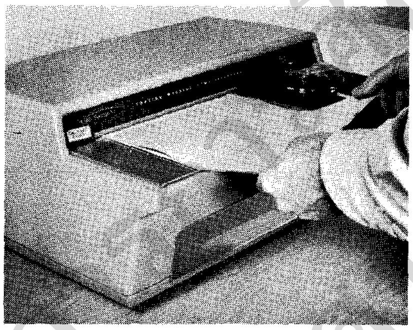
2



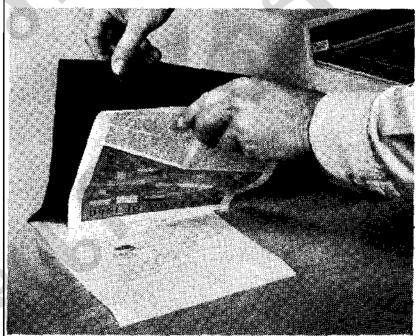
3



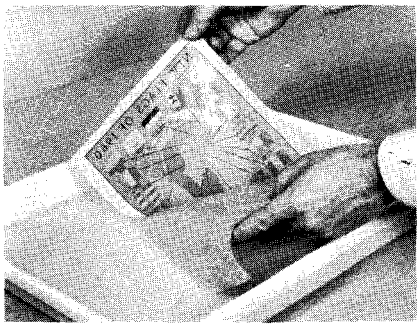
4



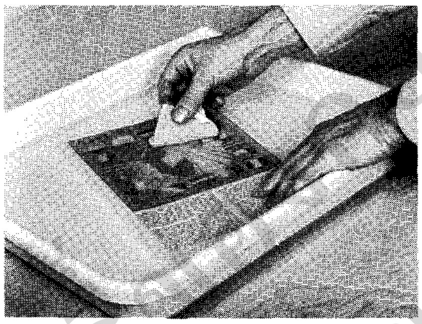
5



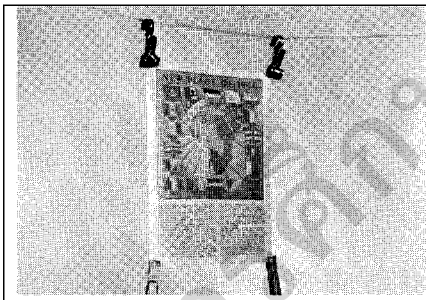
6



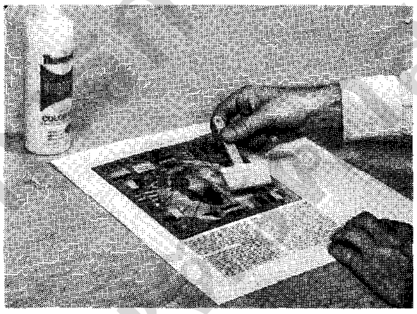
7



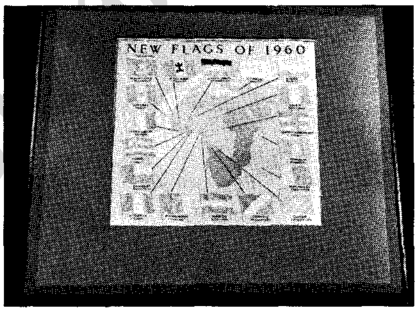
8



9



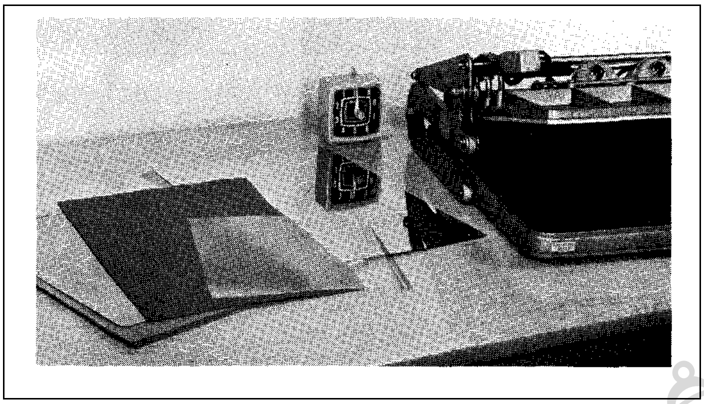
10

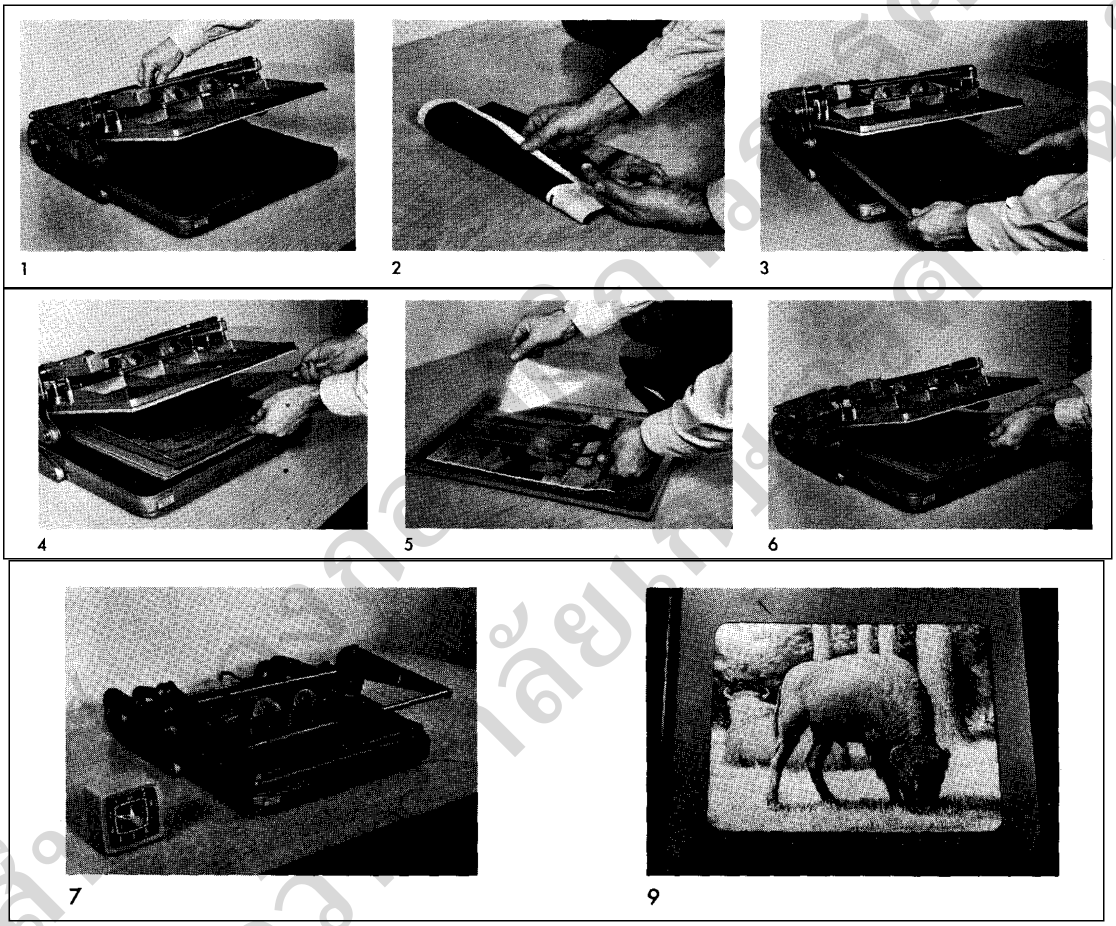


11

On picture-transfer film—Seal method This method is in principle the same as the preceding Thermo fax method. The differences are in materials and procedure.

Materials, equipment, and tools: picture printed on clay- coated paper; Seal Transparafilm and picture-transfer kit (including a pair of glossy metal plates, a piece of flannel, and detergent); tray of water; wad of cotton; plastic spray; cardboard mount; dry-mount press with adjustable temperature control; timer.





1. Set the dry-mount press at 27O F.

2. Test the picture for clay (as in the preceding process).

3. Insert the metal plates in the dry-mount press and preheat the flannel between the plates to drive out moisture.

4. Dry the picture in the press on the flannel between the metal plates.

5. Remove the metal plates, flannel, and picture from the press and set the top metal plate to one side. The flannel should remain on the shiny side of the bottom metal plate, the picture face-up on the flannel. Cover the picture with a sheet of Transparaflim, coated side down.

6. On top of the film set the other metal plate, shiny side down, and place the complete sandwich in the press. Have two pieces of thick cardboard on the base to increase the pressure.

7. Shut the press and apply heat for 2 minutes.

8. Follow steps *5* to 9 of the Thermo-fax process as directed and illustrated.

9. When the film has dried, coat the picture side with plastic spray to transparencies and protect the image. When the sprayed coating has dried, mount the transparency for use.

Making transparencies as reproduction of printed illustrations – with size change

To change the size of an illustration requires a camera and application of photographic methods. The following two techniques are basic ways of using photography to prepare overhead transparencies. Both use the same easy-to-handle film, but require different developers. Before proceeding, review the following:

• Legibility standards for projected materials when printed items are considered for reproduction

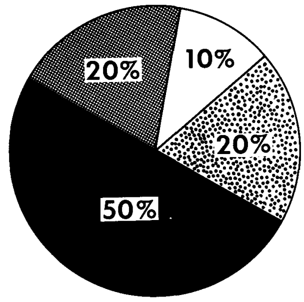
• Permission to reproduce copyrighted materials

• Use of your camera, especially with reference to: press and view cameras, if available camera settings correct exposure close-up and copy work

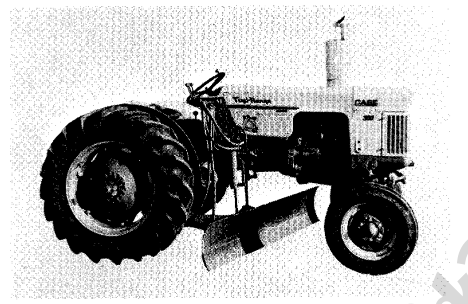
• Processing film

• Making prints

Two processes are used: one for *high-contrast* subjects, the other for *halftone* subjects. Here are examples of the two kinds:



High-contrast: lines, dots, or solid areas, with the paper between these unprinted



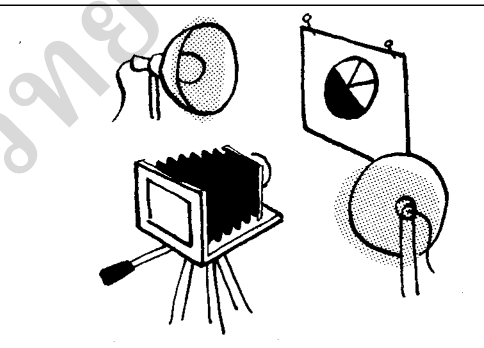
Halftone: printed picture consisting of uniformly spaced dots of varying size, which blend together and convey shades of gray

Figure 13: Two processes are used: one for *high-contrast* subjects, the other for *halftone* subjects

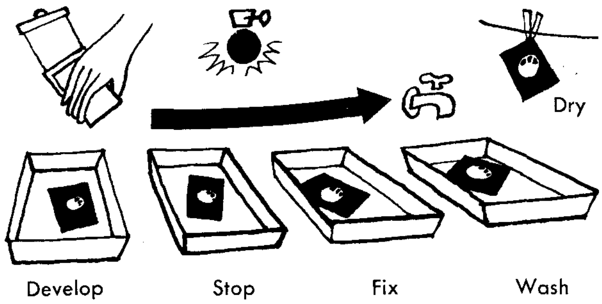
High-contrast film is used to make the transparencies, both for high-contrast and halftone subjects. High-contrast film is preferable to common orthochromatic sheet films for transparencies because it is easier to work with, has a clear base for projection, can produce more saturated gray shades, and dries quicker by reason of being thinner.

High-contrast subjects Use this process to prepare transparencies from line prints and other high-contrast subjects.

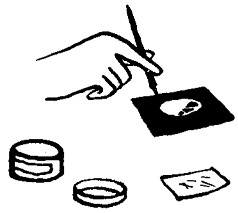
Materials, equipment, and tools: subject for reproduction; high-contrast cut film or 35mm Eastman Kodalith or High Contrast Copy film; appropriate film developer, stop bath, fix; cardboard mount; press or view camera or 35mm camera; camera accessories; film holders; copy stand; lights; darkroom facilities for film developing, printing, and enlarging under red safelights. The high-contrast process has four steps:



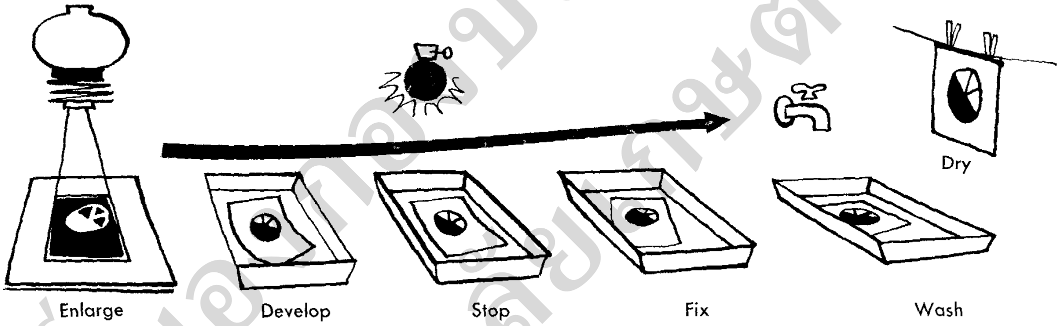
1. Film the subject, using high-contrast film.



2. Process the film to a negative under a darkroom red safe-light, using a recommended high-contrast developer.



3. Opaque the negative to eliminate clear spots, paste-up marks, or unwanted printed areas.



4 Enlarge the negative onto an 8"X 10" or larger sheet of the same high-contrast film and process the film as in step 2.

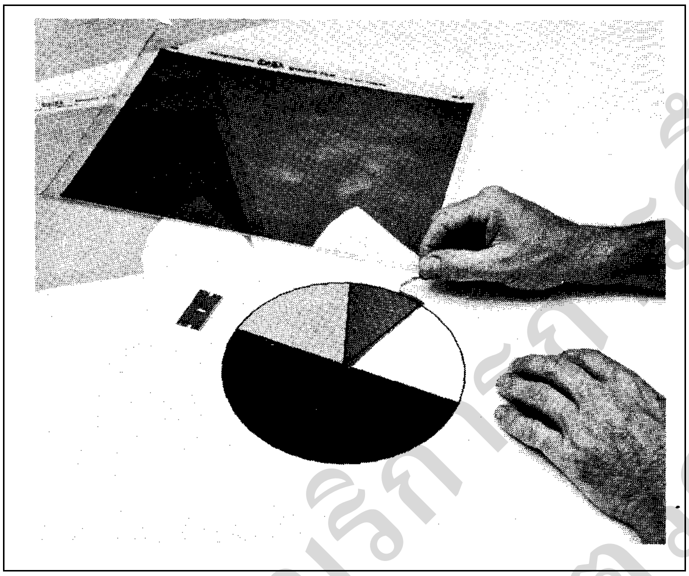
5 .Dry and mount the transparency for use.

Other suggestions:

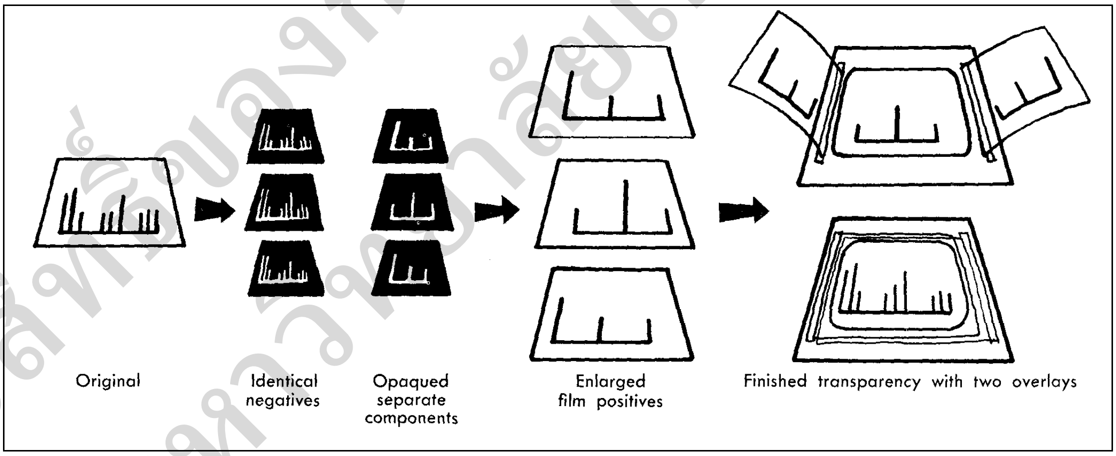
• Prepare a large (8"xlO" or greater) high-contrast negative and *reverse it,* after development, to a positive transparency. Doing this requires using an etch bath and then permits coloring the positive image with transparent dyes.

• Use high-contrast transparencies as masters for reproduction by the diazo process to make additional transparencies in color.

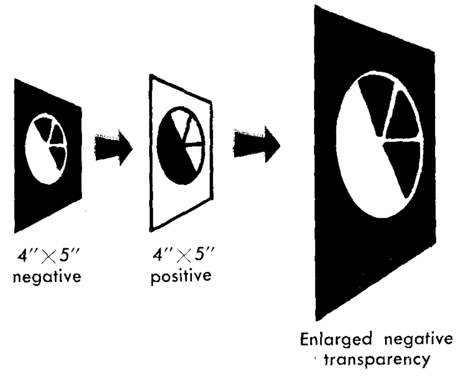
• Separate a subject into its components for preparing overlays by making a number of negatives of the subject equal to the number of overlays needed. Block out all but necessary areas on each negative by opaquing. Print each one, in the enlarger, onto a separate sheet of high-contrast film.



• Add color to areas on a transparency with colored adhesives. Apply it to the base (shiny) side of the transparency.

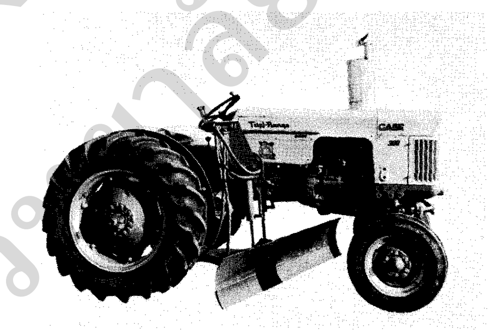


• Prepare a negative rather than a positive transparency by contact printing the original camera negative onto a piece of high-contrast film and then using this positive in the enlarger to make a negative transparency. Color clear areas of the final transparency with transparent water colors. Or, if a copy camera 8” x 10” or larger is used, the negative prepared with it can be used directly as a transparency.



• Add special stressed plastic to areas of a transparency and use it in conjunction with a rotating polarizing disk to create simulated motion or other unusual effects an on-and-off blinking motion, an effect of turbulence, a swirling effect, a rotating effect, a flow effect, and a radiation effect. The plastic material is most easily applied to negative transparencies for which careful cutting is not important. See sources for this material and special equipment .

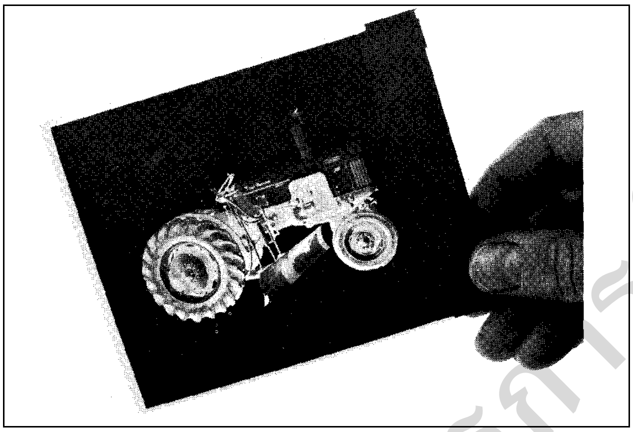
Half-tone and continuous-tone subjects In this category of subjects are halftone illustrations printed in books and magazines , photographs, and original works of art which contain shades of gray varying from white to black. Be sure to recognize the difference between such subjects and high-contrast subjects, which consist only of black marks on white paper.



A halftone (or continuous-tone) subject

Although high-contrast film is used primarily for reproducing line subjects, it can be adapted to prepare continuous-tone transparencies from negatives of halftone and continuous-tone subjects. It is necessary to change the developer used in the first processing step from the normally used high-contrast developer to a regular photographic paper developer (Dektol or equivalent), diluted one part to 12 parts of water.

Materials and equipment: halftone or continuous-tone subject for reproduction; regular continuous-tone black-and-white film, film developer, high-contrast sheet film, paper developer, stop bath, fixer, cardboard mount; camera and darkroom accessories.



Negative of continuous-tone subject

1. Prepare a negative of the subject using regular black-and- white film.

2. Process the film as recommended.

Transparency of continuous-tone subject

3. Enlarge the negative onto a sheet of high-contrast film. Make tests, as correct exposure time will be less than when enlarging a regular high-contrast negative.

4. Process the film under a red safelight in *paper developer* (diluted 1: 12 with water). Development proceeds rapidly and should be completed in 1 minutes. Completion is indicated by the appearance of the full image on the base side of the film, but judge quality only under white light. The use of stop bath, fixer, and wash are the same as in the regular high-contrast process.

Filing Transparencies

If your transparencies are in mounts 1O"X 12" or smaller, they will *fit* in the drawer of a standard filing cabinet. File them under appropriate subject, unit, or topic headings.

Completing and filing transparencies

Mounting Tape simple one-piece transparencies to the under side of a cardboard mount, using masking tape. If the transparency consists of. a base and overlays, tape the base to the back of the mount and tape the overlays to the *front.* Position each overlay, then fasten it with a masking-tape hinge along one edge.

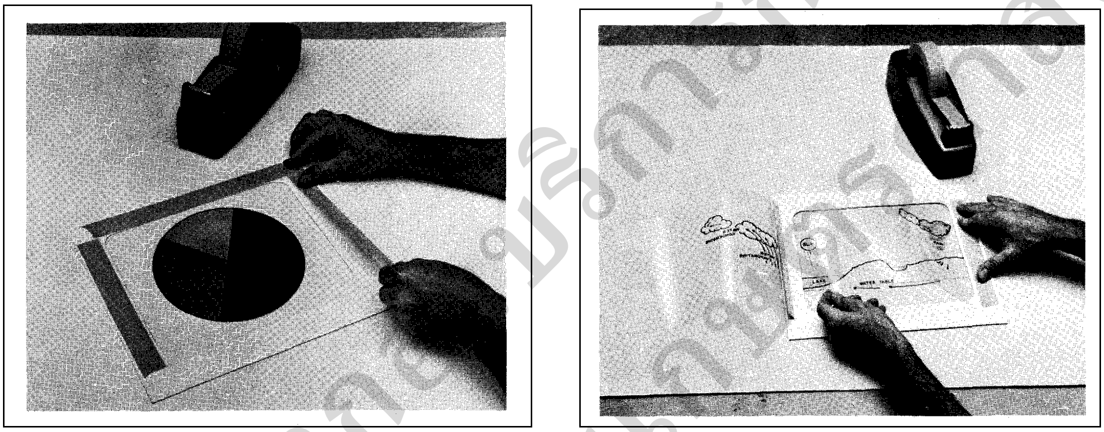


Figure 14: Mounting

Masking To control a presentation and focus attention on specific elements of a transparency, use a paper or cardboard mask as was mentioned on page 103. The mask may be a separate unit, or may be a hinged opaque overlay.

Adding notes Write brief notes along the margin of the cardboard mount for reference during projection.

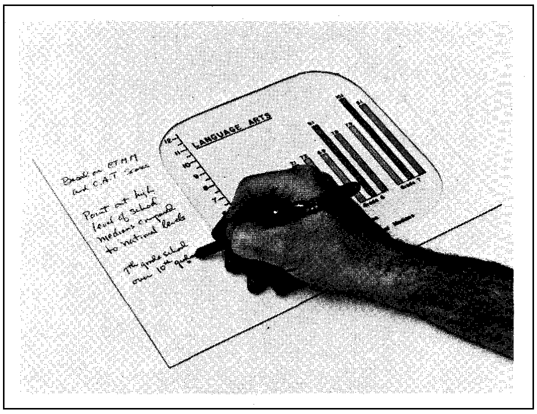


Figure 15: Adding notes

Prepare to use your transparencies

Remember that the success of your transparencies will depend not only on their content and quality, but also on the manner in which you use them before an audience. Follow the suggestions you prepare to use your transparencies.

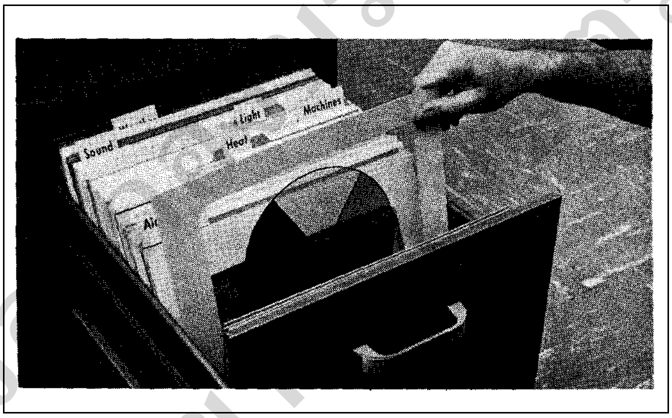


Figure 16: Prepare to use your transparencies

Summary of Methods for Preparing Transparencies

Method	Equipment	Special skills	Cost of materials (approxi- mate)	Time for preparation	Evaluation
Directly on plastic					
1. On clear acetate	none	none	20	short	Suitable for quick preparation and temporary use; quality poor.
2. On treated acetate	none	none	300	moderate	Substitutes for plain acetate when regular inks used; requires careful work; quality fair.
3. On frosted (matte) acetate	none	none	150	moderate	Frosted surface permits easy use of a variety of drawing and coloring agents, results in pleasing effects; requires careful use of spray; quality fair-good.
As reproductions of prepared	diagrams				
1. With spirit duplicator	duplicator	none	200	moderate	Good way to make simple transparencies in color; requires both care and practice when passing acetate through machine and when spraying; also easy to make paper copies for distribution.
2. On diazo film	diazo printer and developer	none	250	moderate	Excellent method for preparing color transparencies; requires translucent originals; a variety of applications of the process are possible.

As reproductions of illustrations—with no size change					
1. On heat-sensitive film	Thermo-fax machine	none	23	very brief	Good method for rapid prep aration of one-color trans parencies from single sheets: can provide additional papel copies.
2. On diffusion-trans- fer (photocopy) film	Photocopy printer and developer	none	23	short	Good method for transferring printed material from single sheets or bound volumes to film; may require washing and drying film before use; provides copies on paper and in other forms for further duplication.
3. On picture-transfer film (Thermo-fax)	Thermo-fax machine	none	18	moderate	Converts any magazine picture printed on clay-coated paper to a transparency; a simple process to apply; resuits are very effective if suitable original pictures are available.
4. On picture-transfer film (Seal)	Dry-mount press	none	25	moderate	Similar to above process, but takes a few minutes longer; equipment often available in school or graphic production center.
As reproductions of illustrations—with size change					
1. On high-contrast film	Camera and darkroom	photography	25	long	Most complex process in terms of skills, equipment, facilities and time; but essential when original materials must be changed in size; results in high-quality transparencies.
2. On high-contrast film	Camera and darkroom	photography	25	long	Similar to above process; extends the use of high-contrast materials to preparing transparencies from color and gray tone subjects.

Reference

Dale, Edgar. 1954. **Audio-visual methods in teaching**. New York: The Dryden Press.

Davies, Ivor Kevin. 1972. **Contributions to an educational technology.** New York: Crane, Russak.

Gunter, Mary Alice. 1995. 2nd ed. **Instruction: a models approach. Boston**. Allyn and Bacon.

Heinich, Robert. 1985. 2nd ed. **Instructional media and the new technologies of instruction.** New York: Macmillan.

Kemp, Jerrold E. 1985. **The instructional design process**. New York: Harper & Row.

_____________. 1975. 3rd ed. **Planning and producing audiovisual materials**. New York, N.Y.: Thomas Y. Crowell.

Kueter, Roger A**.** 1981. **Slides.** Englewood Cliffs, N.J.: Educational Technology.

Lasley, Thomas J. 2002. 2nd ed. **Instructional models: strategies for teaching in a diverse society**. Australia: Wadsworth.

Newby Timothy J. et al. 1996. **Instructional technology for teaching and Learning: designing instruction, integrating computers, and using media**. Englewood Cliffs, N.J. : Merrill.

Seels, Barbara. 1998. 2nd ed. **Making instructional design decisions.** Upper Saddle River, N.Y.: Merrill.

Sparks, Jerry D. 1981. **Overhead projection**. Englewood Cliffs, N.J.: Educational Technology.

Wittich Walter Arno. 1962. 3rd ed. **Audio-visual materials: their nature and use.** New York: Harper & Row.

APPENDIX

Intensive Course for Producing Instructional Media
6 - 8 March 2006
At Champasak University

By Neranuch Pachanatip
Director of Education Service Division, Kasetsart University

1

Professional Presentation
7 March 2006
At Champasak University

By… Neranuch Pachanatip
Director of Education Service Division, Kasetsart University

2

Course Outline

Producing Instructional Media

- Teaching and Learning
- Course Syllabus
- Educational Technology

3

Course Outline

Producing Instructional Media

- Systematic Planning for the use of media
- Media and Instruction

4

Course Outline

Producing Instructional Media

- Kind of Materials
- Slides
- Transparencies

5

Course Outline

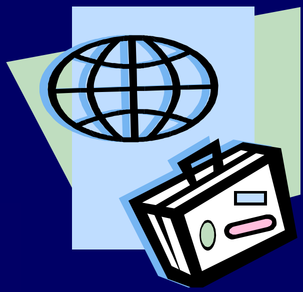
Producing Instructional Media

- Professional Presentation
- Transparencies Production

Total 15 hours

6

Globalization



7

Effects

- Competition
- Higher Education Need
- Higher Life Quality Need
- Technology Change

8

Importance of Instructional Media

- Comprehensive Learner
- Interesting Lesson
- Interactive Learning

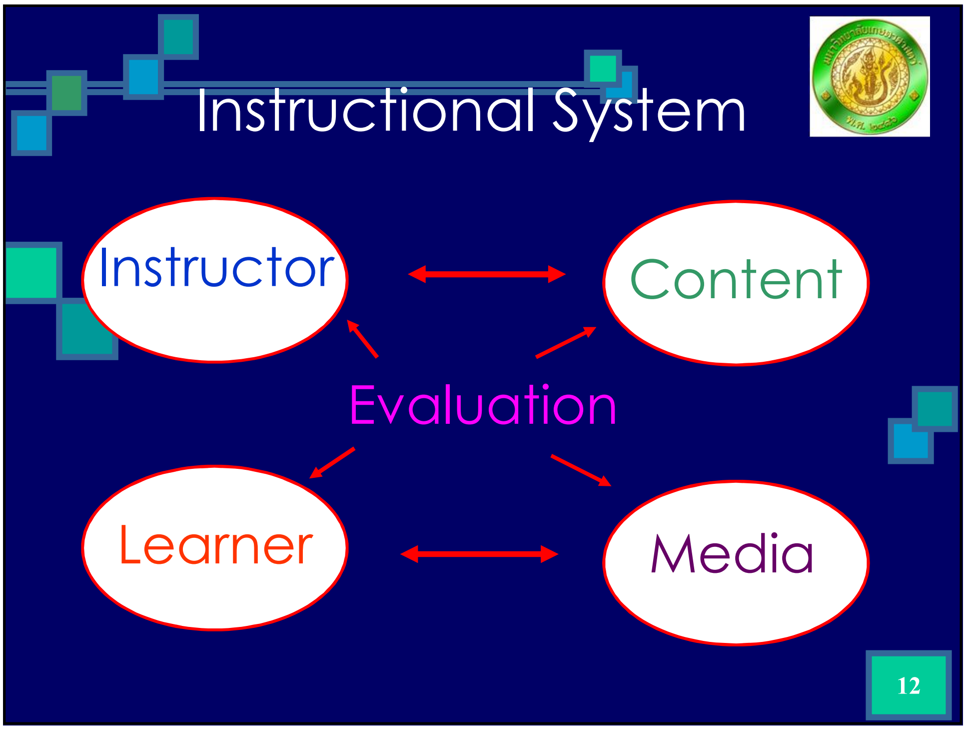
9

Importance of Instructional Media

- Improve and fulfill Instructional Process
- Effective Learning

10


Teaching and Learning Goal
Student Center
• Process
• Environment
• Activities
11


Instructional System
Instructor
Content
Evaluation
Learner
Media
12

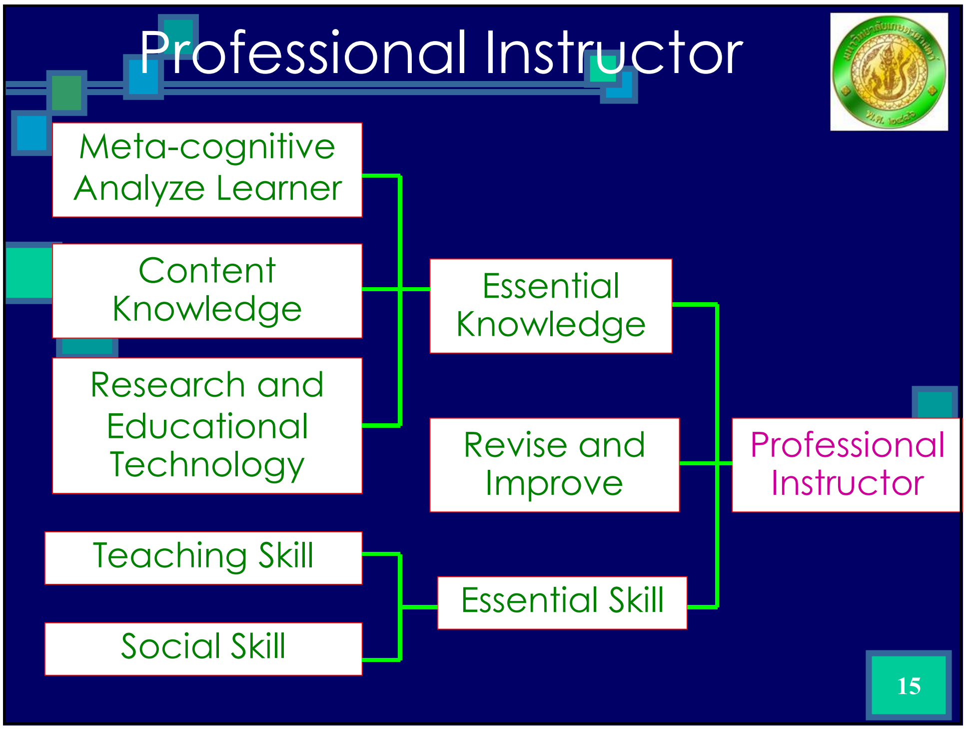
Effective Instruction Plan

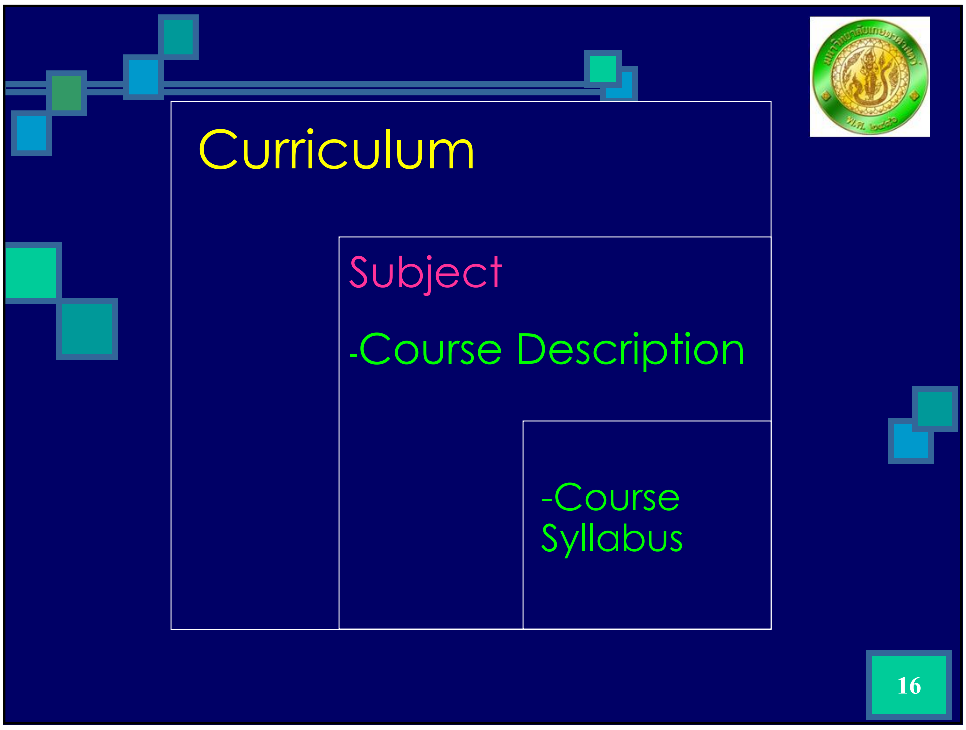
13

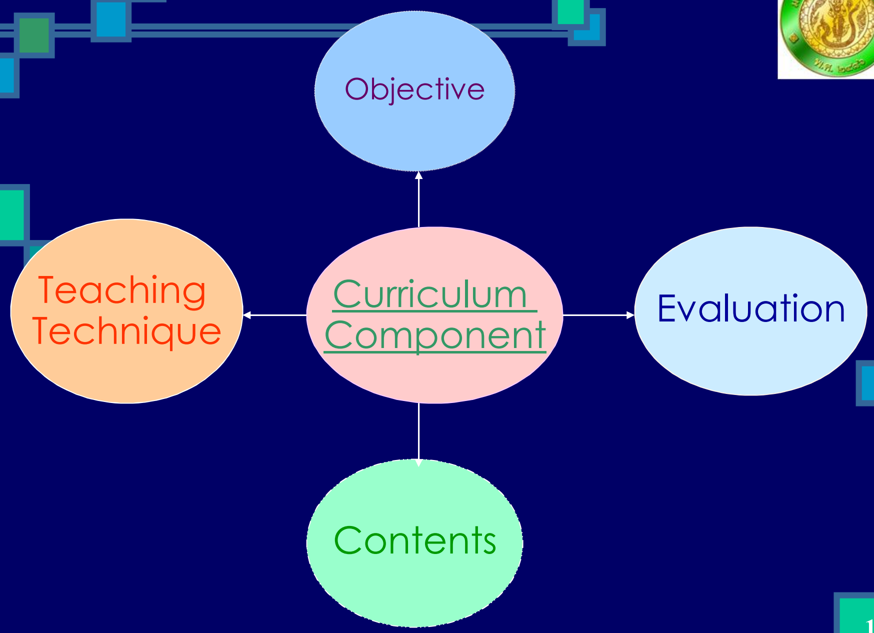
Effective Instruction Plan

- Curriculum
- Course Syllabus
- Suitable Instruction Technique Selection

14


Professional Instructor
Meta-cognitive Analyze Learner
Content Knowledge
Research and Educational Technology
Essential Knowledge
Revise and Improve
Professional Instructor
Teaching Skill
Social Skill
Essential Skill
15


Curriculum
Subject
-Course Description
-Course Syllabus
16



17

What is curriculum goal ?

Content	Skill
Affective	Process

18

Curriculum Development Factors

Economic

Technology

Environment

Politic

Social

19

Course Description Writing

- subject objective
- contents to teach
- how to evaluate

20

How to write
Course Syllabus ?

How to write course syllabus ?

- Code and Subject
- Credits /Lecture -Lab
- Duration
- Instructor
- Goal / Aim
- Objective
- Sequence of Contents

How to write course syllabus ?

- Prerequisite
- Materials / Media
- Course Description
- Teaching Learning Process
- Activities
- Evaluation
- Resources

23

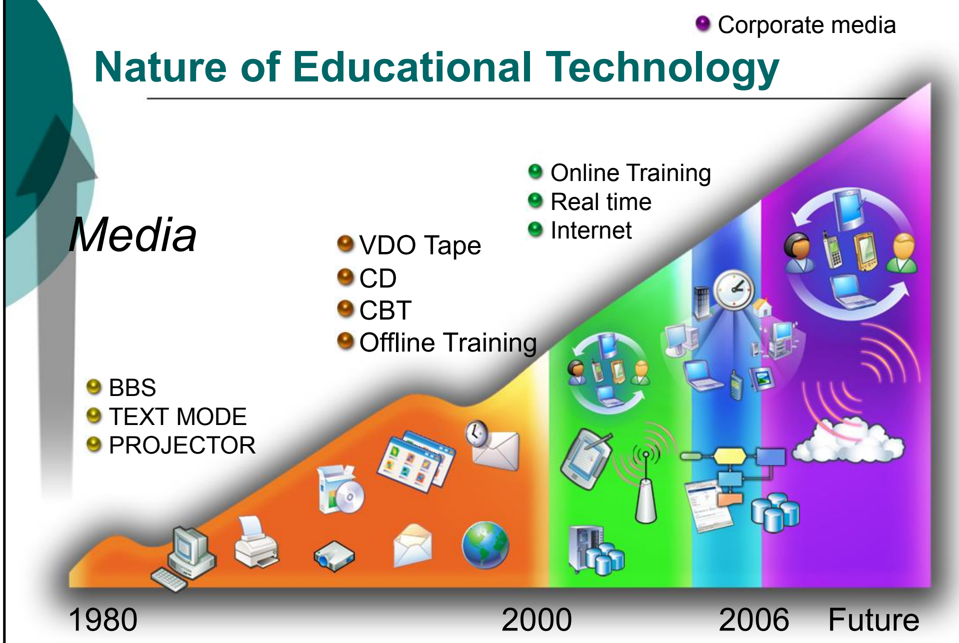
Thank you

24

Educational Technology

**By Neranuch Pachanatip et al.
Director of Education Service Division, Kasetsart University**

Nature of Educational Technology



The Two Educational Technologies

1. Educational Technology refers to the application of engineering principles or technology to instrumentation useful to the process of teaching.

The Two Educational Technologies

2. Educational Technology refers to the application of scientific principles to instruction.

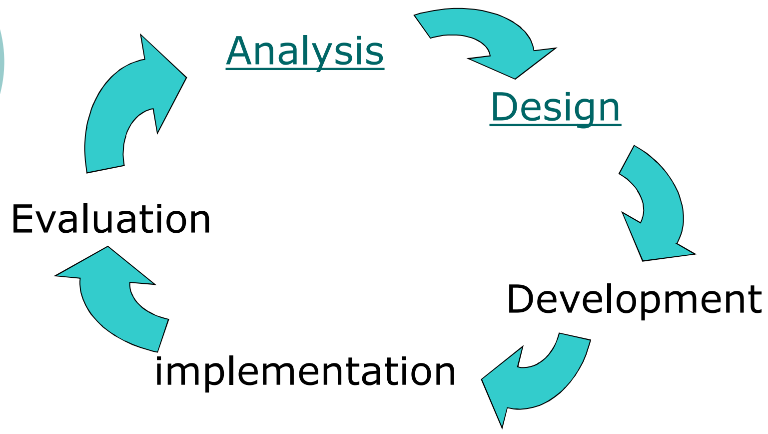
The New Educational Technology

- The distinctive qualities of modern organization theory are all framed in an overall philosophy that believes that the only meaningful way of looking at organization is to study it as a system.

A Theory of Teaching

- Edward L. Thorndike
  - The Law of Exercise or Repetition
  - The Law of Effect
  - The Law of Readiness
- Maria Montessori
  - Nourishing

Technology of Instruction



Background for The Instructional Design Concept

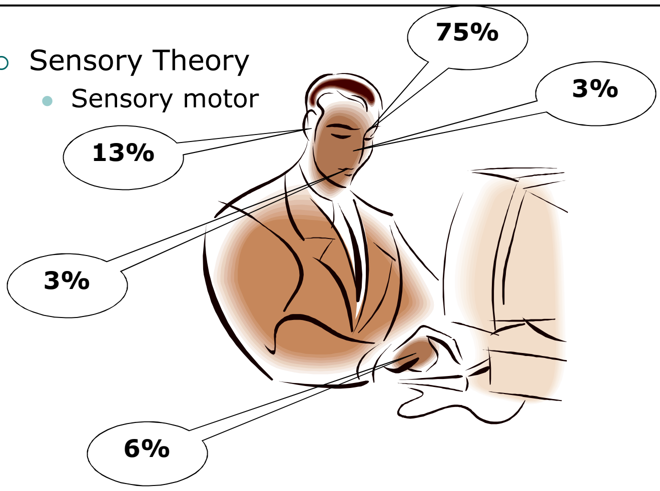
- Sensory Theory
- Learning
  - Behaviorism
  - Cognitive

Background for The Instructional Design Concept

- Sensory Theory
  - Sensory motor
  - Nature of sensory
    - Want
    - Stimulus
    - Response
    - Reward
  - Sensory process
    - experiences
    - understanding
    - thinking

Background for The Instructional Design Concept

- Sensory Theory
  - Sensory motor



Background for The Instructional Design Concept

- Learning
  - Behaviorism
  - Cognitive

Summary

- Educational Technology for teaching
  - Educational Management Functions
  - Educational Development
  - Learning Resources
  - Learner

Analysis

- Needs Analysis
- Content / Task Analysis
- Teaching Analysis

Design

- What is objective?
- GOAL!
- How can we do that?
- Content / Sequence / Present

Systematic planning for the use of media

By Miss Neranuch Pachanatip
Miss Sirikanya Maneenil
Education Service Division,
Kasetsart University

Analyze Learners

If instructional media are to be used effectively, there must be a match between the characteristics of the learner and the content of the lesson and its presentation.

Analyze Learners

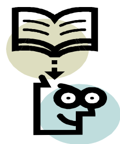
•General Characteristics

•Specific Entry Competencies

•Learning Styles

•Factor of Motivate

•Factor of Psychology



Require Learner Performance

•Require learners performance of activities that build toward the objective

•Provide opportunity for learners to practice the capability being taught

Require Learner Performance

- Learners to respond and to receive feedback on the appropriateness

- Make learners participation a central part of a process

Writing Objective

What is Objective ?

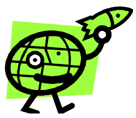
The goal of the instructional is to plan the experiences that will change current behavior or cognition to some new, as yet unlearned behavior or mental processing.

Objective = Learning Outcome

Writing Objective

Domain in Education

- Cognitive Domain
- Psychomotor Domain
- Affective Domain



Cognitive Domain

Evaluation

↑

Synthesis

↑

Analysis

↑

Application

↑

Comprehension

↑

Knowledge

Psychomotor Domain

Non discursive communication

Skill movement

Physical activities

Perceptual

Basic fundamental movement

Reflex movement

Affective Domain

Characterization by value or value set

Organization

Valuing

Responding

Receiving

Writing Objective

When writing objective must to have ABCD

A → Audience

B → Behavior

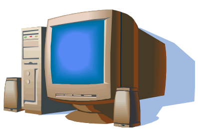
C → Condition

D → Degree

Media and Materials Selection

1. Choosing a Media Format

2. Obtaining Specific Materials



Media and Materials Selection

= << Choosing a Media Format = >>

Within most media selection models the instructional

Situation or setting

Learner variables

The nature of the objective

Media and Materials Selection

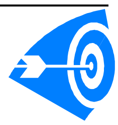
= << Obtaining Specific Materials = >>

1. Selecting available materials
2. Modifying existing materials
3. Designing new materials

Utilize Materials

- Preview the Materials
- Practice the Presentation
- Prepare the Environment
- Prepare the Audience
- Present the Material

Evaluate Assessing Learning



Three that we will discuss here are

1. evaluation of learner achievement
2. evaluation of media and methods
3. evaluation of the instructional process

Evaluate Assessing Learning

Evaluation of Learner Achievement

When you formulated your objectives, including in that statement of objectives a *degree* or *criterion* of acceptable performance. You now want to assess whether the learner's new skill meets that criterion.

Evaluate Assessing Learning

Evaluation of Media and Methods

Did the media assist the students in meeting the objectives? Were they effective in arousing student interest? Did they provide meaningful student participation? Class discussions, individual interviews, and observation of student behavior should be used to sound out evaluation of instructional media and methods

Evaluate Assessing Learning

Evaluation of the Instructional Process

Evaluation is an ongoing process. Evaluations are made before, during, and after instruction.

Evaluation is not the end of instruction. It is the starting point of the next and continuing cycle of our systematic for effective use of instructional media

Thank you

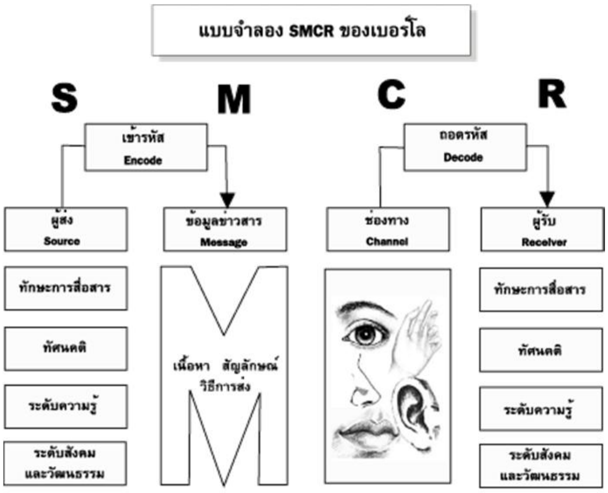
Media and Instruction

By Neranuch Pachanatip et al.
Director of Education Service Division, Kasetsart University

Instructional communication

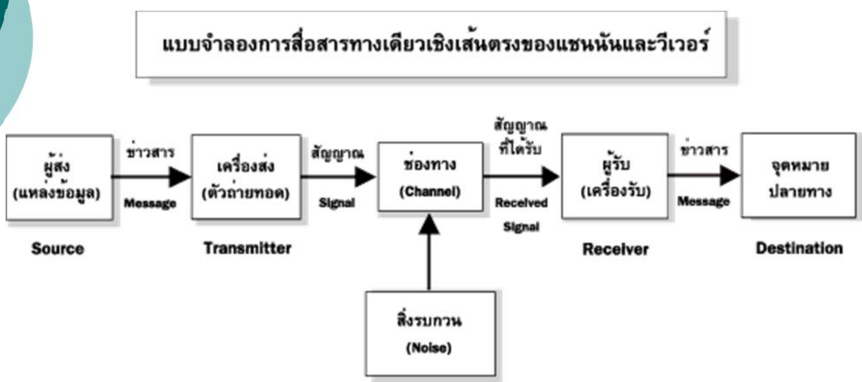
- Communication Models
- Field of Experience

Communication Models



ที่มา : ที่มาจากหนังสือเทคโนโลยีการศึกษาและนวัตกรรมของ กิดานันท์ มลิทอง

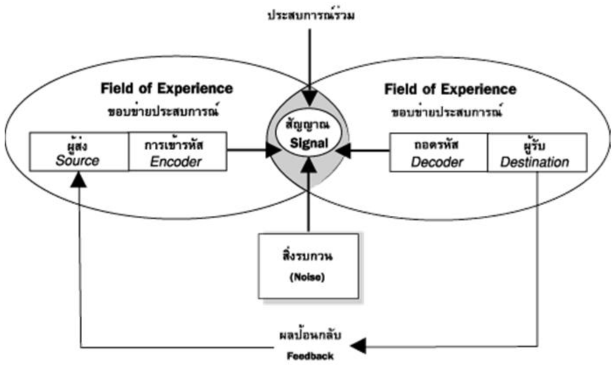
Communication Models



ที่มา : ที่มาจากหนังสือเทคโนโลยีการศึกษาและนวัตกรรมของ กิดานันท์ มลิทอง

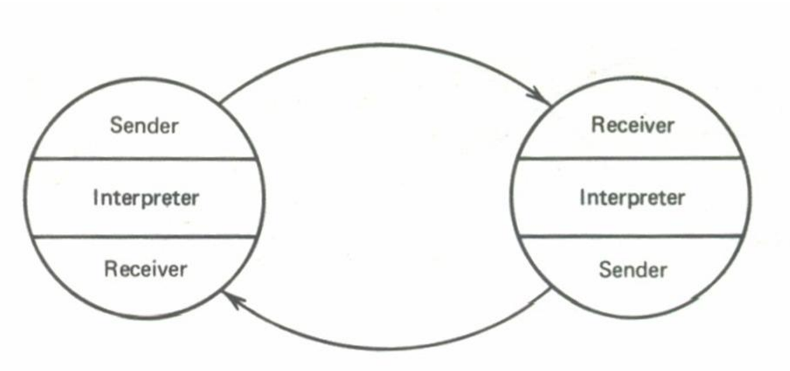
Field of Experience

รูปแบบจำลองการสื่อสารของชแรมม์



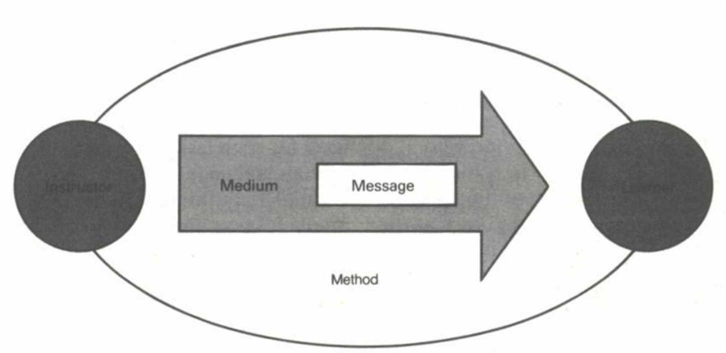
ที่มา : ที่มาจากหนังสือเทคโนโลยีการศึกษาและนวัตกรรมของ กิดานันท์ มลิทอง

Transactional nature of communication



Media, Messages and Methods

- **Instructional Media**
- **Messages**



▲ *Figure 1.8*

Media, Messages and Methods

- **Methods**
  - ***Presentation***
  - ***Demonstration***
  - ***Drill-And-Practice***
  - ***Tutorial***
  - ***Gaming***
  - ***Simulation***
  - ***Discovery***
  - ***Problem Solving***

Why use instructional media

- Schemata
- Assimilation
- Accommodation
- The Concrete—Abstract Continuum

The role of media in instruction

- Media
- Instructor-Based Instruction
- Instructor-Independent Instruction
- Distance Education
- Special Education

Technologies of instruction

Up to this point we have been discussing ways in which audiovisual media and methods can help improve communication and thereby improve instruction. The emphasis has been on the "things" of instruction—the *products* of technology. But instruction is more than communication alone, and technology *as a process* is a powerful tool for analyzing and solving instructional problems.

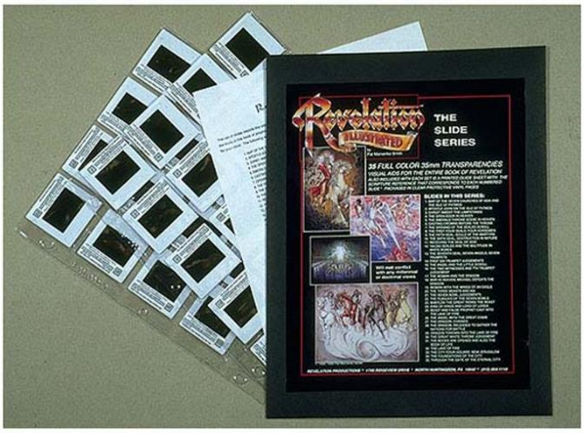
The Kinds of Materials

By Neranuch Pachanatip et al.
Director of Education Service Division, Kasetsart University

The Kinds of Materials

Consider the specific contributions and special requirements of these six audiovisual materials: photographs, slides, filmstrips, large transparencies, motion pictures, and visual materials for television. Then select those most appropriate for your purposes.

Slide Series



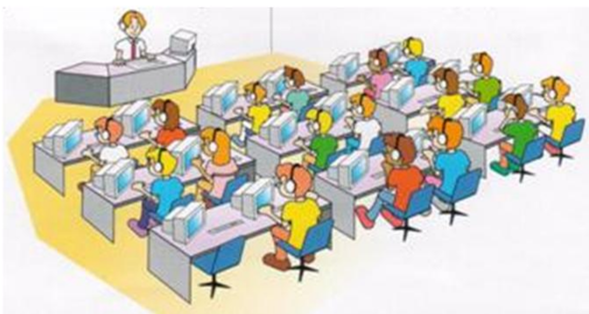
Filmstrips or Slide films

Transparencies for Overhead Projection

Motion Picture

Television Materials

Combined Visual Materials



Slides

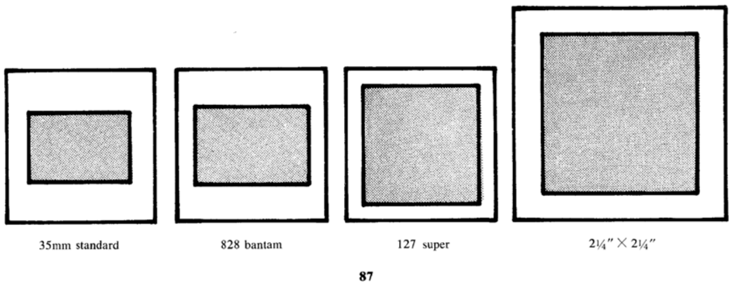
By Miss Neranuch Pachanatip
Miss Sirikanya Maneenil
Education Service Division,
Kasetsart University

Slides

The term slide refers to a small-format photographic transparency individually mounted for one-at-a-time projection

Dimension

The size of slides most frequently use is 2 by 2 inches (metric equivalency either 50 by 50 millimeters or 5 by 5 centimeters)



Before Making Slides

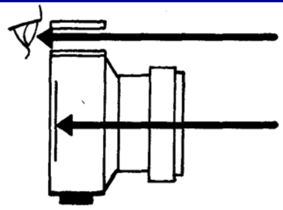
- Have you clearly expressed *your idea* and limited the topic?
- Have you stated the *purposes* your slide series should serve?
- Have you prepared a *content outline*?
- Have you written a *treatment* to help organize the material and then sketched a *storyboard* to assist in your visualization of the content?

Advantages

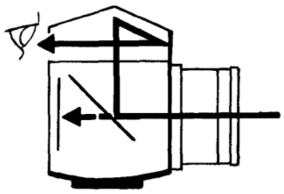
- Slides can be arranged and rearranged into many different sequences
- Most automatic projectors also offer the convenience of remote control advancing of slides, allowing the presenter to remain at the front of the room or off to a side
- Slides have been use a large group, small group, and individual study

Equipment

Camera



Separate viewfinder—parallax



Single-lens reflex—no parallax

Equipment

Camera Accessories

A photographic light meter

A tripod to steady the camera

A flash gun or photoflood lights

A close-up attachment to photograph

Equipment

Film

Positive color film 35 mm.

Equipment

Film Exposure

Correct exposure is based on proper camera settings for the film used and for the general conditions under which pictures are to be taken

Equipment

Lighting

Avoid heavy or deep shadows contrasted with brilliant highlight areas

No.1 = 250 w.

No.2 = 500 w.

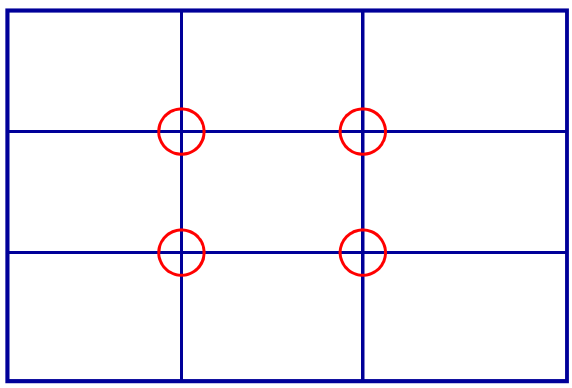
No.4 = 1,000 w.

Equipment

Close-up and Copy work

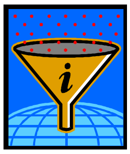
close-ups of objects, for details in a process, or for copies of maps, pictures, and diagrams

Composition



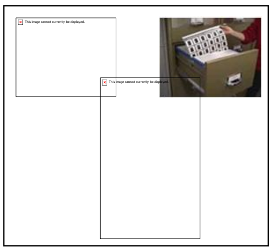
Processing Film

One advantage and convenience for using reversal color film is that after exposure. a roll may be sent to a film-processing laboratory



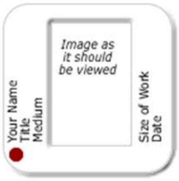
Preparing Slides

Slides may not need the protection of glass or plastic for protect the surface of film



Thumbspots

Thumbspots, help you to arrange slides correctly for viewing and for projection

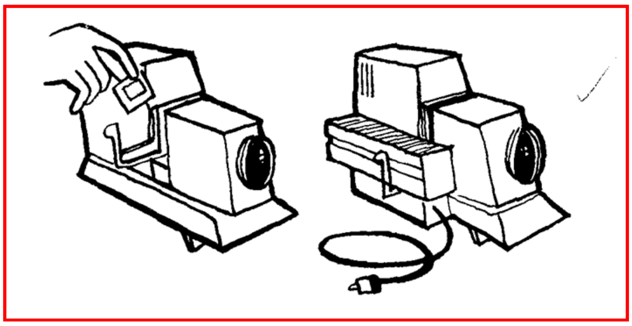


Record Narration

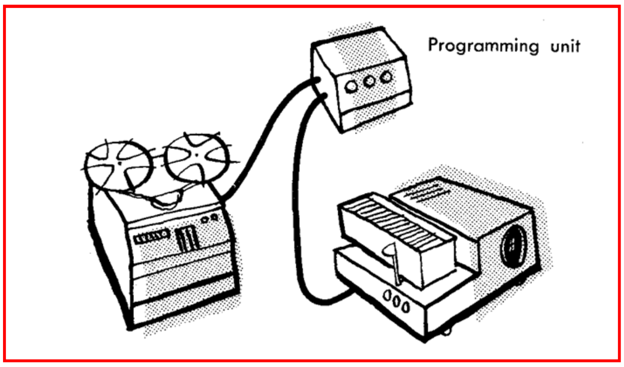
Duplicating Slides

Selecting Projector

The projector, remove it by hand, and continue with each slide in the series

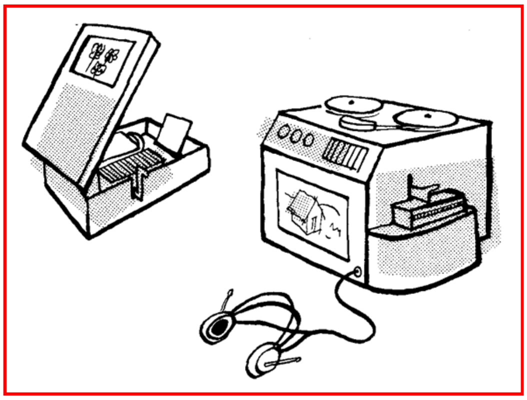


Selecting Projector



Selecting Projector

Slide Projector

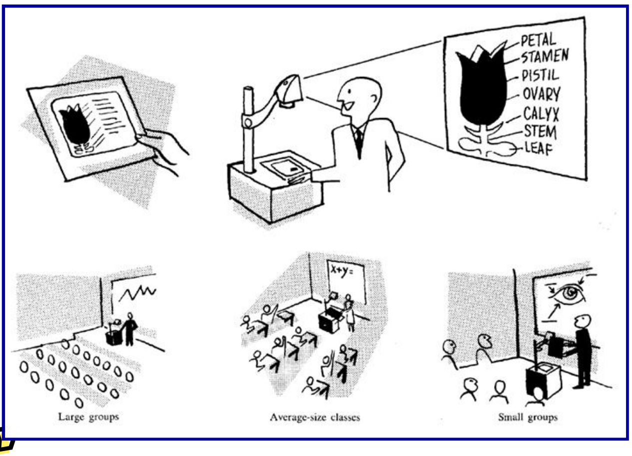


Thank you

Transparencies

By Miss Neranuch Pachanatip
Miss Sirikanya Maneenil
Education Service Division,
Kasetsart University

Transparencies



Before Making Transparencies

- What *purposes* will your transparencies serve?

- What factors are important to consider about the *audience* which will see the transparencies?

Before Making Transparencies

- Have you prepared an *outline* of the content to be included?

- Are transparencies the best medium to accomplish your purposes and to convey the content? Might they even be combined with other media for greater effectiveness?

Advantages

- The overhead projection can be used in *normal room lighting*

- The projector is operated from the front of the room with the presenter facing *the audience,* allowing direct eye contact to be maintained

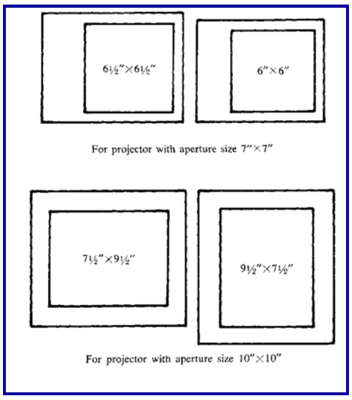
Advantages

- You can point to important items, highlight them with colored pens, add details during the lesson

- Instructors can easily prepare their own transparencies. Information that might otherwise have to be placed on a chalkboard during a class session

Dimension of The Working Area

Square and either 10" X 10" or 7" X 7". It is usually well to work within a rectangle having a height-to-width ratio of about 4:5.



Processing Transparencies

- Making transparencies directly on plastic
- Making transparencies on diazo film
- Making transparencies on photocopy film

Processing Transparencies

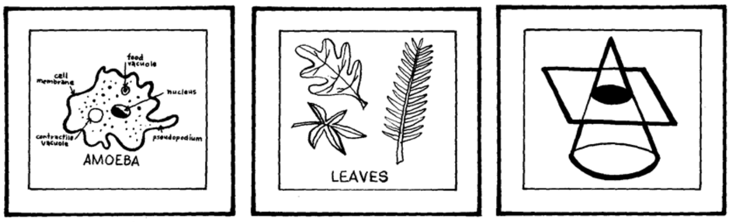
- Making transparencies on high-contrast subjects

- Making transparencies on halftone and continuous-tone subjects

Materials

- Transparence
- Pen
- Tissue paper
- Frame
- Scissors
- Scot tape

Making transparencies directly on plastic

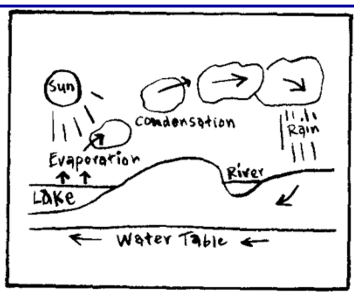


Drawn with grease pencil — Drawn with pen and plastic inks — Drawn with felt-tipped pens

Overlay transparencies

For successive presentation of elements of a diagram

Original sketch



Filling Transparencies

Mounting Tape simple one-piece transparencies to the under side of a cardboard mount, using masking tape

Prepare to use your transparencies

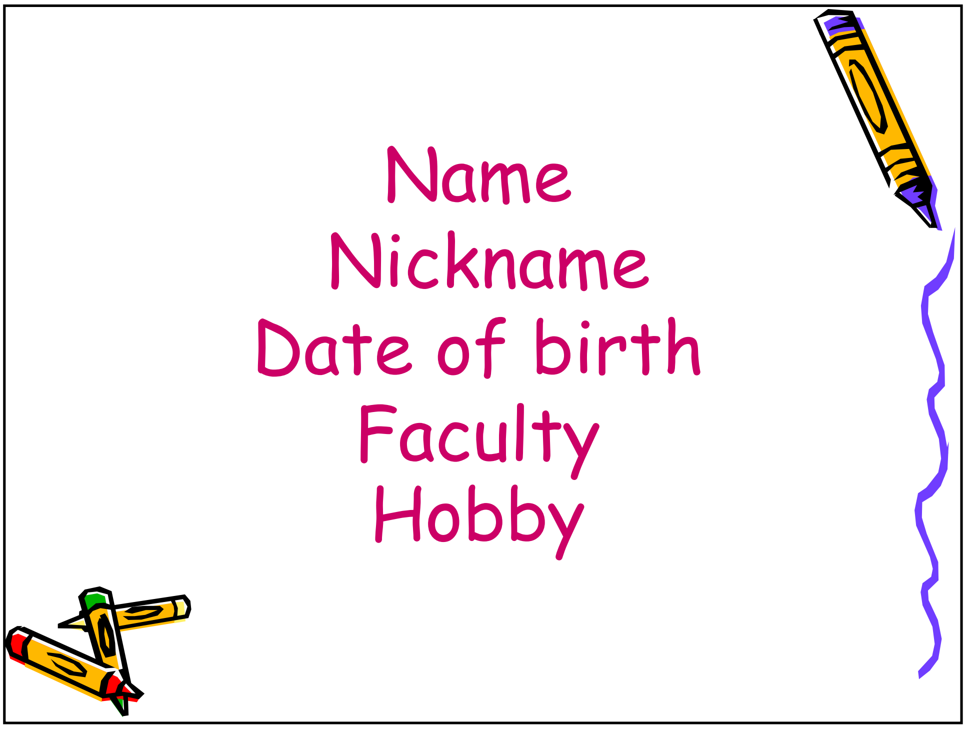
Remember that the success of your transparencies

Content

Quality

Good Presentation

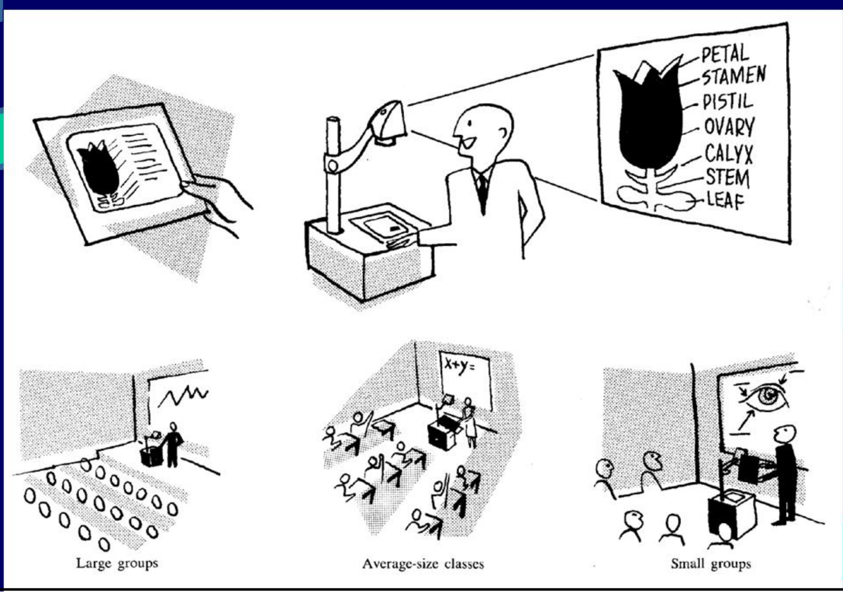

Thank you


Name
Nickname
Date of birth
Faculty
Hobby

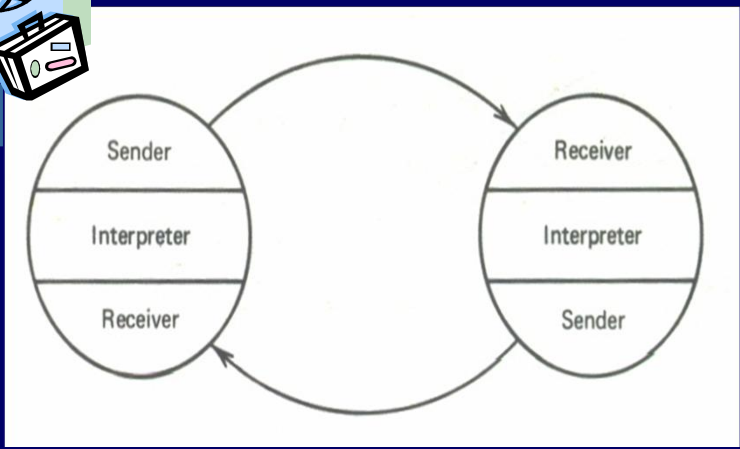
Professional Presentation
7 March 2006
At Champasak University

By… Neranuch Pachanatip
Director of Education Service Division,
Kasetsart University

Professional Presentation



Communication



3

What is communication?

- Verbal ; spoken language
- Nonverbal ;gesture,facial expression,posture,communication behaviors

4

Preparing for Presenting Your Speech

5

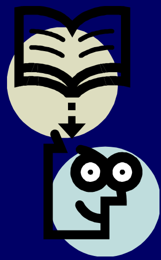
Preparing for Presenting Your Speech

- Speech Outline
- Posture/Gesture
  - -Eye Contact
  - -Enthusiasm
  - -Articulation
  - -Breathe
  - -Stay calm)

6

Preparing for Presenting Your Speech

- Tone
- Dress
- Language
- Smile



7

Professional Presentation

- Practice your speech
- Practice using visual aids
- Practice with actual speaking outline/speech dressed

8

Professional Presentation

- Control time
- Record VDO tape
- Don't put keys in your pockets
- Do not stand with arms crossed or your hands in your pockets ect…

9

VISUAL AIDS

- Design and use good visual aids
- Practice designing and using visual aids

10

when you give a public speaking…

- Don’t use visuals to repeat you can say with words
- Don’t overcrowd visuals with too much information

11

when you give a public speaking…

- Visual aids should be simple
- Use visuals to support or summarize what you say
- Choose the right kind of visual (graph, table, picture, words, etc.)

12

when you give a public speaking…

- Use color (but not to much)
- Don’t use too many visuals
- Don’t read from the visual

13

when you give a public speaking…

- Use a pointer and/or masking techniques where appropriate
- Face the audience as much as possible
- Don’t block the audience’s view

14

COMMUNICATION TECHNIQUES

Flip Chart & Whiteboard

- Big& bold
- Use drawings
- Use color
- Face audience, talk, write, talk
- Flip over/wipe off

15

COMMUNICATION TECHNIQUES

Overhead Projector

- Use a mask to show one point at a time
- Use a pen or pointer on the machine
- Switch it off so they focus on you

16

COMMUNICATION TECHNIQUES

Making Transparencies

- Use software and/or write with special pens
- Use landscape Max. 8 lines
- Use keywords
- Use pictures

17

Thank you

18

Evaluation

By Neranuch Pachanatip
Director of Education Service Division,
Kasetsart University

Evaluation

Topic / Group	1	2	3	4	5	6
Meeting process						
Interesting topic						
Content selection						
Interesting of transparencies layout						
Presentation						

Workshop Grouping

By Neranuch Pachanatip
Director of Education Service Division,
Kasetsart University

Workshop Grouping classified by birth month

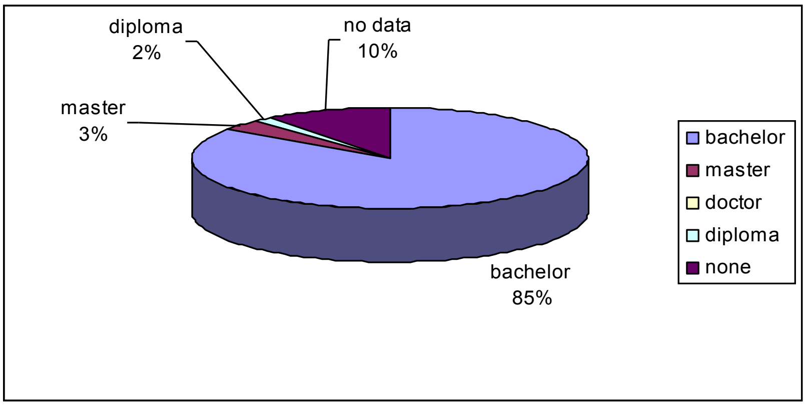
of LPDR Champasak University Lecturers

Jan(4) + Feb(3) + Dec(3)

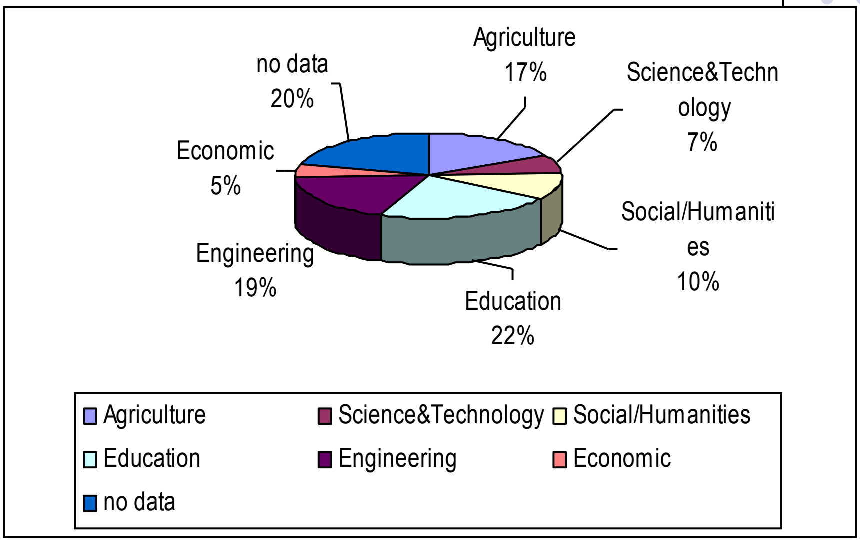
- Mar(7) + Jun(3)
- Apr(8) + Jul(2)
- May(6) + Nov(3)
- Aug(9) + Sep(1)
- Oct(8) + Sep(2)

Results of questionnaire

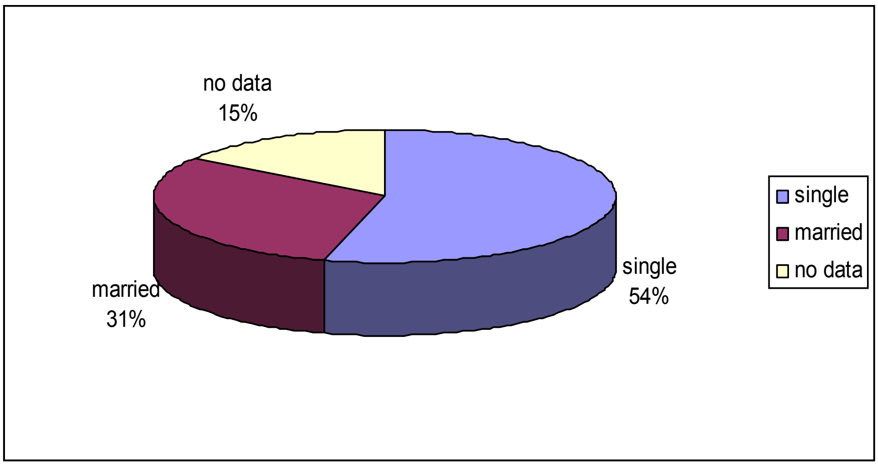
Highest Graduate



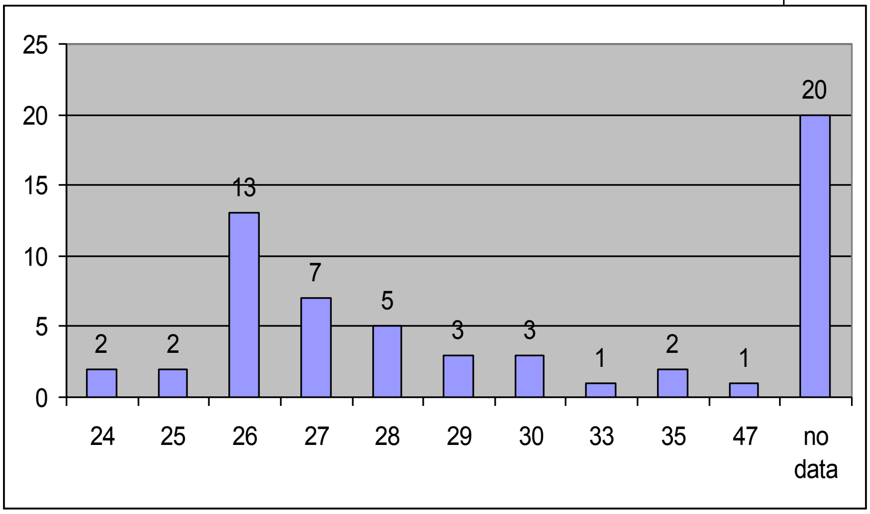
Field



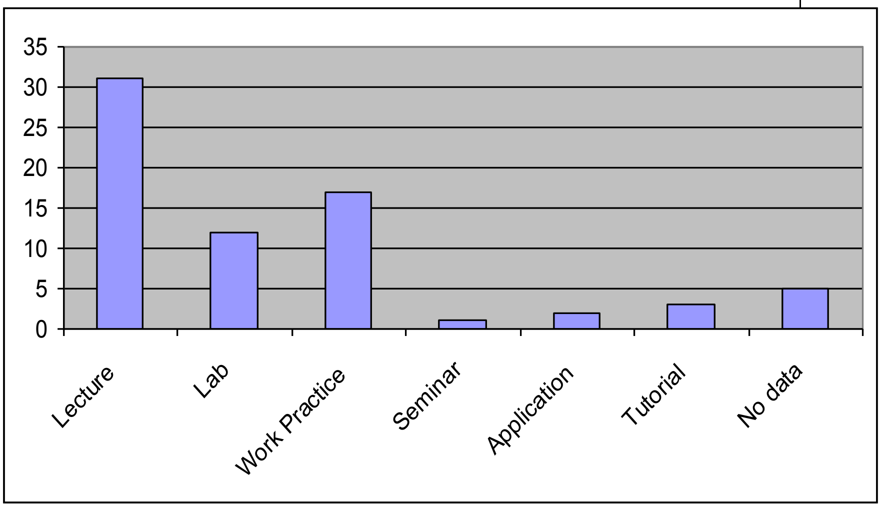
Status



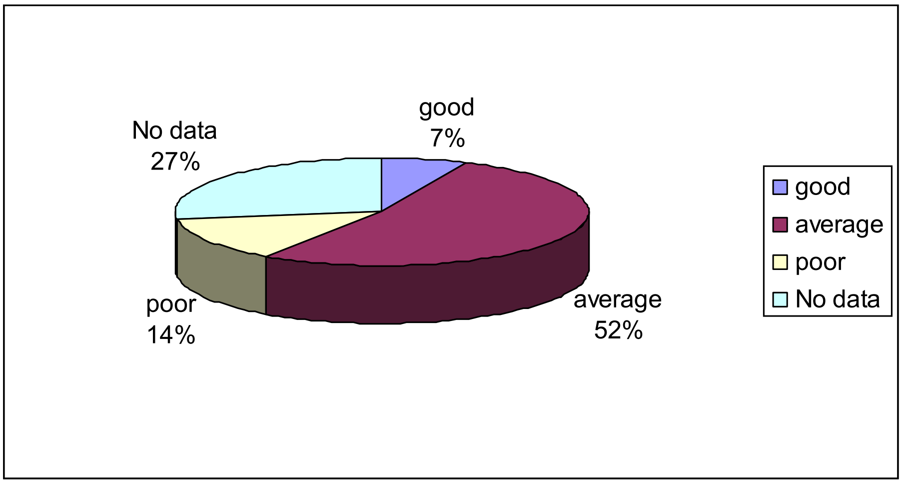
Age



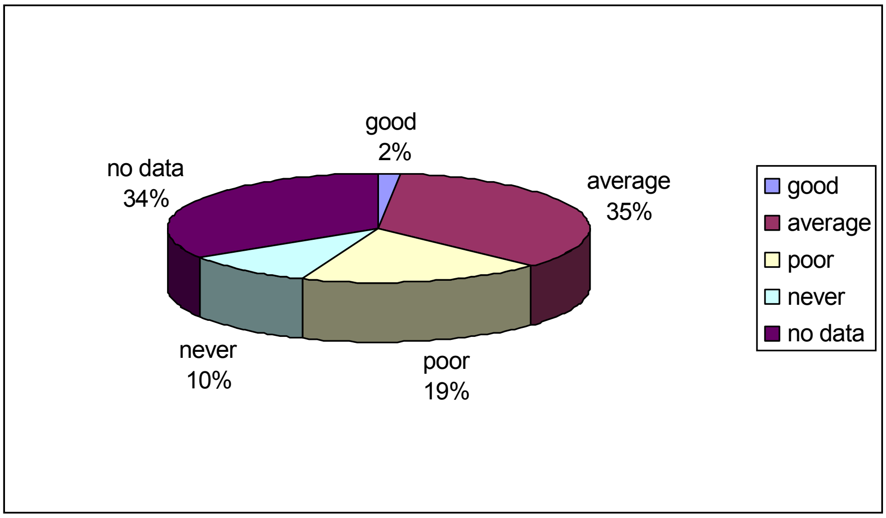
Type of your responsibility subject



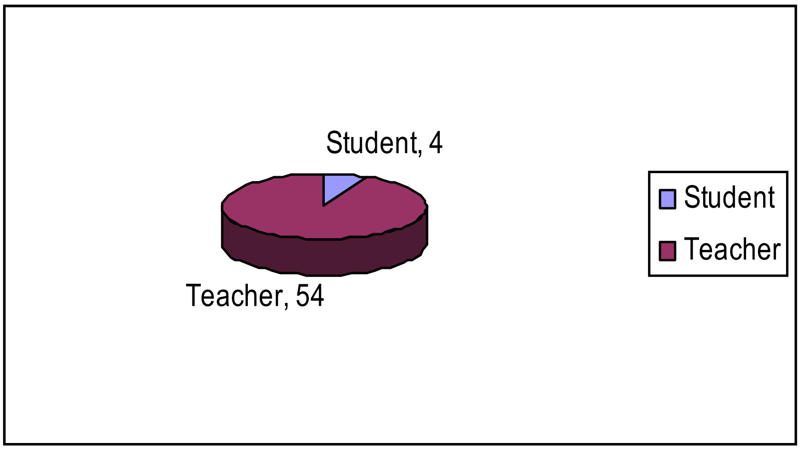
Abilities for using computer



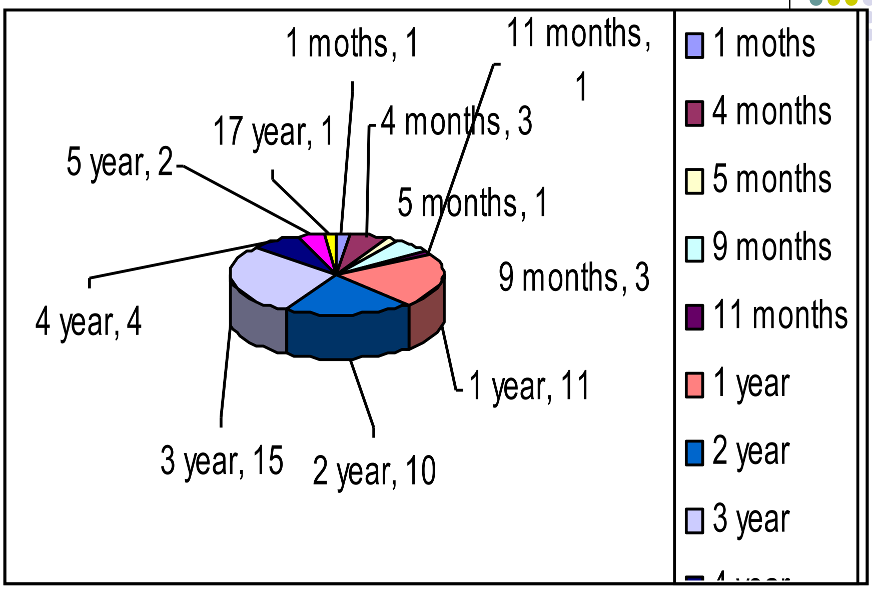
Knowledge in instruction media



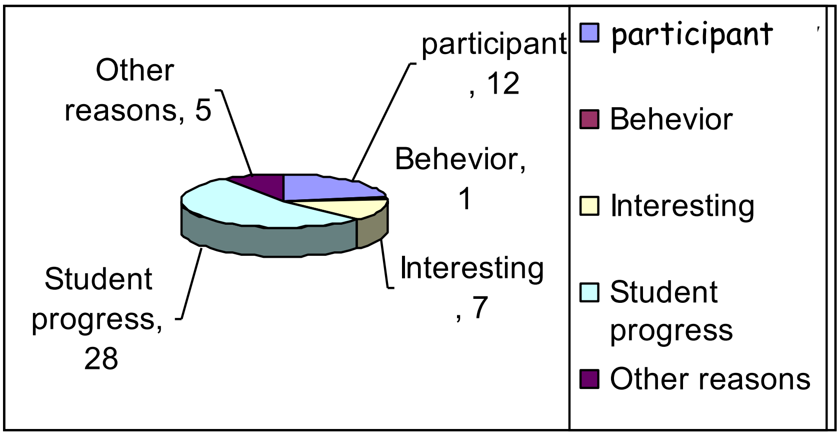
Purpose to learn this course



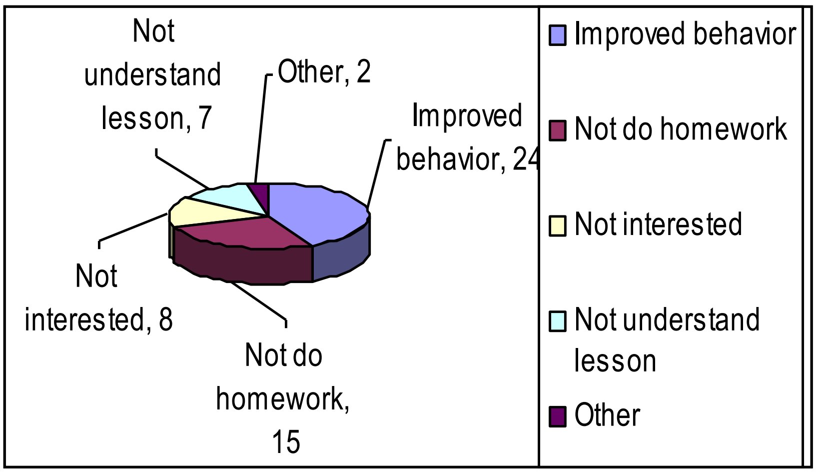
Experience



Expectation in student



I can't stand it when my students



I like…

1. Student interested in class
2. Student do homework and work hard
3. Teaching
4. Student attended to study
5. To prepare lesson by doing course syllabus

I dislike

1. Students don't study unconcern in class
2. Lazy students noisy when learning
3. Don't do homework
4. To teach a lot of lectures
5. Who tell a lie

I.....

1. I like to do activities in a class
2. I love job very much
3. I get more after teaching, can use visual aids
4. I hope student to be good man in the future
4. I want to teach about work practice
5. I want instructor teach again

Thank you

ประวัติผู้เขียน

นางสาวนีรนุช ภาชนะทิพย์

ผู้อำนวยการกองบริการการศึกษา มหาวิทยาลัยเกษตรศาสตร์

e-mail : pneranuch@hotmail.com

ประวัติการศึกษา

- มัธยมศึกษาตอนปลาย สายศิลป์-ภาษา (ฝรั่งเศส) จากโรงเรียนเตรียมอุดมศึกษา ปี 2527
- ปริญญาตรี สาขาวิชาภาษาต่างประเทศ (ฝรั่งเศส) จากคณะศิลปศาสตร์ มหาวิทยาลัยธรรมศาสตร์ ปี 2531 (ระหว่างการศึกษาได้รับทุนและเข้าร่วมโครงการแลกเปลี่ยนนักศึกษา ณ มหาวิทยาลัย Nantes สาธารณรัฐฝรั่งเศส)
- ปริญญาโท สาขาวิชาพื้นฐานการศึกษา จากคณะครุศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย ปี 2534
- ปริญญาเอก สาขาวิชาการบริหารการศึกษา คณะศึกษาศาสตร์ มหาวิทยาลัยเกษตรศาสตร์ ปี 2557

ประวัติการทำงาน

- ปี 2534-2545 นักวิชาการศึกษา หัวหน้างานบริการการศึกษา หัวหน้าหน่วยทะเบียนและประเมินผลการศึกษา หัวหน้าหน่วยส่งเสริมและพัฒนาทางวิชาการและหัวหน้าศูนย์การเรียนรู้ด้วยตนเอง (Self Learning Center) คณะวิศวกรรมศาสตร์ มหาวิทยาลัยเกษตรศาสตร์
- ปี 2545 นักวิชาการศึกษา ระดับ 7 ผู้อำนวยการกองบริการการศึกษา
- ปี 2546 นักวิชาการศึกษา ระดับ 8 ผู้อำนวยการกองบริการการศึกษา

ผลงานวิจัยซึ่งได้รับการตีพิมพ์เผยแพร่

- ทัศนคติที่มีต่อการฝึกอาชีพของหญิงในสถานสงเคราะห์บ้านเกร็ดตระการ และบ้านนารีสวัสดิ์ ที่มีภูมิหลังแตกต่างกัน (Attitudes Towards Occupational Training of The Socially Handicapped Women with with Different Backgrounds in Ban Kredtrakan and Ban Nareesawad) ซึ่งได้รับคัดเลือกเป็นผลงานวิจัยระดับดีมาก (very good) จากคณะครุศาสตร์และบัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ปี 2534
- การติดตามผลการดำเนินการจัดการเรียนการสอนวิชาบูรณาการ หมวดวิชาศึกษาทั่วไปของมหาวิทยาลัยเกษตรศาสตร์ (Followed up the Results of Integrated Courses Management, General Education of Kasetsart University) ได้รับทุนสนับสนุนการวิจัยจากสถาบันวิจัยและพัฒนาแห่งมหาวิทยาลัยเกษตรศาสตร์ ปี 2547
- การติดตามผลการเข้าร่วมโครงการสหกิจศึกษาของนิสิตมหาวิทยาลัยเกษตรศาสตร์ (Follow up the Results of Co-operative Education Project's Attendance of Students at Kasetsart University) ได้รับทุนสนับสนุนการวิจัยจากสถาบันวิจัยและพัฒนาแห่งมหาวิทยาลัยเกษตรศาสตร์ ปี 2547
- ระบบฐานข้อมูลสหกิจศึกษา มหาวิทยาลัยเกษตรศาสตร์ (Cooperative education database system of Kasetsart University) ปี 2549
- ความต้องการในการพัฒนาศักยภาพของอาจารย์มหาวิทยาลัยเกษตรศาสตร์ (The Necessary Demand in Competency Development of Lecturers at Kasetsart University) ปี 2549 ได้รับทุนสนับสนุนการวิจัยจากสถาบันวิจัยและพัฒนาแห่งมหาวิทยาลัยเกษตรศาสตร์

ประวัติผู้มีส่วนร่วมเขียน

ชื่อ นางสาวสิริกัญญา มณีนิล Sirikanya Maneenil

ประวัติการศึกษา

ระยะเวลาการศึกษา	วุฒิที่ได้รับ	สถาบัน
2546 – 2547	ศึกษาศาสตรมหาบัณฑิต (เทคโนโลยีการศึกษา)	ม.เกษตรศาสตร์
2542 – 2545	ศึกษาศาสตรบัณฑิต (เทคโนโลยีและสื่อสารการศึกษา) เกียรตินิยมอันดับ 2	ม.เทคโนโลยีราชมงคลธัญบุรี

ประวัติการทำงาน

ระยะเวลา	สถานที่ทำงาน	ตำแหน่ง
2548 – ปัจจุบัน	กองบริการการศึกษา สำนักงานอธิการบดี มหาวิทยาลัยเกษตรศาสตร์	นักวิชาการโสตทัศนศึกษา

ประวัติการเป็นวิทยากร / ผู้ช่วยวิทยากร

ตำแหน่ง	เนื้อหาการสอน / หัวข้อการอบรม	ผู้เข้ารับการอบรม
ผู้ช่วยวิทยากร	การจัดทำ e-book	คณาจารย์ ม.เกษตรศาสตร์
วิทยากร	การใช้โปรแกรม PowerPoint Presentation	นิสิตปริญญาโท-เอก คณะเกษตร ม.เกษตรศาสตร์
วิทยากร	การจัดเตรียมเอกสารเพื่อการนำเสนอด้วยโปรแกรม Microsoft PowerPoint	นิสิตปริญญาตรี คณะเกษตร ม.เกษตรศาสตร์
วิทยากร	การจัดเตรียมเอกสารเพื่อการนำเสนอด้วยโปรแกรม Microsoft PowerPoint	นิสิตปริญญาตรี คณะเกษตร ม.เกษตรศาสตร์

ประวัติผู้มีส่วนร่วมเขียน

ชื่อ นายพลวัฒน์ ตันหัน

ประวัติการศึกษา

ระยะเวลาการศึกษา	วุฒิที่ได้รับ	สถาบัน
2544 – 2546	วิทยาศาสตร์มหาบัณฑิต (เทคโนโลยีสารสนเทศ)	ม.ศรีปทุม
2537 – 2541	วิทยาศาสตร์บัณฑิต (จิตวิทยา)	ม.เกษตรศาสตร์

ประวัติการทำงาน

ระยะเวลา	สถานที่ทำงาน	ตำแหน่ง
2548 – ปัจจุบัน	กองบริการการศึกษา สำนักงานอธิการบดี หาวิทยาลัยเกษตรศาสตร์	นักวิชาการคอมพิวเตอร์
2547 – 2548	โครงการจัดทำสารบบคดีและวิธีการเพื่อความปลอดภัย สำนักงานอัยการสูงสุด	นักวิเคราะห์ระบบ
2546 – 2547	สถานบันพัฒนาครูและบุคคลากรอาชีวศึกษา	เจ้าหน้าที่เครือข่ายคอมพิวเตอร์
2541 – 2546	บ.อิน-ไลน คอมพิวเตอร์	เจ้าหน้าที่เทคนิค

ประวัติการเป็นวิทยากร / ผู้ช่วยวิทยากร

ตำแหน่ง	เนื้อหาการสอน / หัวข้อการอบรม	ผู้เข้ารับการอบรม
ผู้ช่วยวิทยากร	การจัดทำ e-book	คณาจารย์ ม.เกษตรศาสตร์
ผู้ช่วยวิทยากร	ระบบเครือข่ายคอมพิวเตอร์เบื้องต้น	คณาจารย์ ม.เกษตรศาสตร์
ผู้ช่วยวิทยากร	การป้องกันเครื่องคอมพิวเตอร์แม่ข่าย	คณาจารย์ สำนักงานการอาชีวศึกษา
วิทยากร	คอมพิวเตอร์เบื้องต้น โปรแกรมสำนักงาน Microsoft Office และ pladao Office	เจ้าหน้าที่สำนักงานอัยการ เขต 1 – 9
วิทยากร	อินเตอร์เน็ตและ คอมพิวเตอร์เบื้องต้น	ผู้ประสานงานโครงการศูนย์ ICT ชุมชน
วิทยากร	อินเตอร์เน็ตและ คอมพิวเตอร์เบื้องต้น	ผู้ประสานงานโครงการศูนย์ ICT ชุมชน
วิทยากร	Microsoft Access	ผู้ประสานงานโครงการศูนย์ ICT ชุมชน