Principles of Instructional Design

Fourth Edition

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2 Designing Instructional Systems

An *instructional system* may be defined as an arrangement of resources and procedures used to promote learning. Instructional systems have a variety of particular forms and occur in many of our institutions. Public schools embody the most widely known forms of instructional systems. The military services have, perhaps, some of the largest instructional systems in the world. Businesses and industries have instructional systems that are often referred to as *training systems*. Any institution that has the express purpose of developing human capabilities may be said to contain an instructional system.

Instructional systems design is the *systematic* process of planning instructional systems, and instructional development is the process of implementing the plans. Together, these two functions are components of what is referred to as *instructional technology*. *Instructional technology* is a broader term than *instructional systems* and may be defined as the systematic application of theory and other organized knowledge to the task of instructional design and development. Instructional technology also includes the quest for new knowledge about how people learn and how best to design instructional systems or materials (Heinich, 1984).

It should be evident that instructional systems design can occur at many different levels. One could imagine a nationwide effort at planning and developing instructional systems, as was the case with the Biological Sciences Curriculum Study and the Intermediate Science Curriculum Study funded by the

National Science Foundation. These efforts centered on developing materials within a subject area. It is also worthy of note that some programs for individualized instruction in several subject areas have been undertaken. These systems, Project PLAN (Program for Learning in Accordance with Needs), IPI (Individually Prescribed Instruction), and IGE (Individually Guided Instruction), are described in a book edited by Weisgerber (1971).

Instructional designers don't always have a chance to work on projects of national scope. They generally design smaller instructional systems such as courses, units within courses, or individual lessons. Despite the differences in size and scope, the process of designing an instructional system has features in common at all levels of the curriculum. Instructional systems design of the smaller components is simply referred to as *instructional design* since the focus is the piece of instruction itself, rather than the total instructional system.

INSTRUCTIONAL DESIGN

Several models are suitable for the design of instruction of course units and lessons. One widely known model is the Dick and Carey (1990) model presented in Figure 2-1. All the stages in any instructional systems model can be categorized into one of three functions: (1) identifying the outcomes of the instruction, (2) developing the instruction, and (3) evaluating the effectiveness of the instruction. We shall focus on the activities of instructional design that occur within the nine stages shown in Figure 2-1.

Stage 1: Instructional Goals

A goal may be defined as a desirable state of affairs. For example, at a national level, a desirable goal is that every adult at least be literate at a sixth-grade reading level. Notice that this is also an instructional goal. An example of a noninstructional goal might be that every adult have adequate medical care. This latter goal is not obtainable by instruction. Global instructional goals must be made more specific before systematic instruction can be designed to attain them. One responsibility of an instructional designer is to recognize which goals are instructional goals and which are not. This is especially true in industrial or vocational instructional courses where the goal may be related to employee motivation or job satisfaction. At this stage, the instructional designer must ask, "What goals will represent a desirable state of affairs?"

After goals have been stated, the designer may conduct a *needs analysis*. Recent writers (Burton and Merrill, 1977; Kaufman, 1976) have defined a need as a discrepancy or gap between a desired state of affairs (a goal) and the present state of affairs. Therefore, needs can be determined after the stating of goals and the analysis of the present state of affairs. In the case of public schools, the desired state of affairs is usually established by tradition—a consensus on what

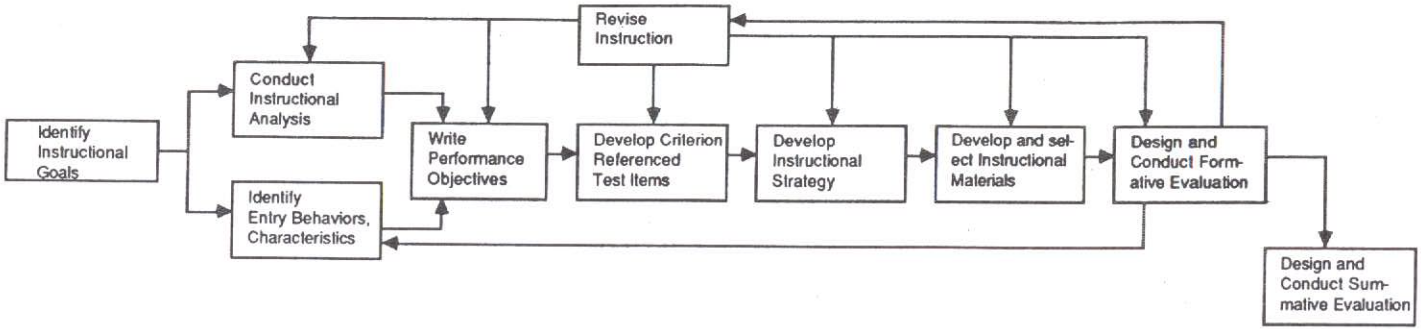

FIGURE 2-1 **A Systems Approach Model for Designing Instruction**

(From W. Dick & L. Carey, *The systematic design of instruction,* 3rd ed., copyright 1990, 1985, 1978 by Scott, Foresman & Co. Reprinted by permission of Harper Collins Publishers.)

school students ought to be learning and how well. Any gap between the students' achievement and the school's expectations identifies a need. For example, for a group of seniors at a particular high school, the mean score on the math portion of the SAT might be an indicator of how well the instructional system at that school was meeting its needs.

Training needs in business or industry may be derived from a job analysis or from data on the productivity of a particular department. Again, a discrepancy between desirable performance and present performance identifies a need (Branson, 1977). Other definitions of need include perceived or *felt* needs. These needs are not the result of any documented gap. Nevertheless, they sometimes are the basis for curricular decisions. As an example, parents may decide that their children should learn computer programming in elementary school. This felt need is not usually determined by an analysis of goal deficiencies. The prevailing view is that the general public should be involved in the process of determining instructional goals, and these are often expressed as needs. Needs and goals are further refined in stages 2 and 3 of the design process, *instructional analysis* and *learner analysis*.

Stage 2: Instructional Analysis

Stages 2 and 3 in the model of Figure 2-1 can occur in either order or simultaneously. We have chosen to discuss instructional analysis first. The purpose of instructional analysis is to determine the skills involved in reaching a goal. For example, if the goal happens to be that every healthy adult will be able to perform cardiopulmonary resuscitation, an instructional analysis would reveal what component skills would have to be learned. In this case, the designer would use a *task analysis* (or *procedural analysis*), the product of which would be a list of the steps and the skills used at each step in the procedure (Gagné, 1977).

Another kind of instructional analysis is an *information-processing analysis*, which is designed to reveal the mental operations used by a person who has learned a complex skill. This analysis makes possible inferences regarding the internal processes involved in an intended skill. It might be necessary to have a learner "talk through" a procedure used in solving a problem to determine whether appropriate skills and strategies are being applied. An important estimate to be made for each decision and action revealed by an information-processing analysis is whether the intended learners enter with these capabilities or whether they must be taught them (stage 3).

An important outcome of instructional analysis is *task classification*. Task classification is the categorization of the learning outcome into a domain or subdomain of types of learning, as described in Chapters 3, 4, and 5. Gagné (1985) describes five major types of learning outcomes and some subtypes. Task classification can assist instructional design in several ways. Classifying the target objectives makes it possible to check whether any intended purpose of an instructional unit is being overlooked. Briggs and Wager (1981) have presented

examples of how target objectives may be classified and then grouped into course units in the form of instructional curriculum maps. The resulting maps can then be reviewed to check whether necessary verbal information, attitudes, and intellectual skills are included in the instructional unit. Learning outcome classification also provides the conditions most effective for different types of learning outcomes.

The final type of analysis to be mentioned is *learning-task analysis*. A learning-task analysis is appropriate for objectives of instruction that involve intellectual skills. If the aim is that fourth graders will be able to make change for a dollar, a learning-task analysis would reveal the subordinate skills needed for adding, subtracting, aligning decimals, carrying, and other skills that are related to this skill. The purpose of a learning-task analysis is to reveal the objectives that are *enabling* and for which teaching sequence decisions need to be made. One possible product of a learning task analysis is an *instructional curriculum map* (ICM) similar to the one shown in Figure 2-2. This ICM shows the targeted objectives and their subordinate objectives for an instructional unit on word processing.

A designer may need to apply any or all of these types of analysis in designing a single unit of instruction. Chapter 7 expands our description of the different types of analysis and the techniques for performing them.

Stage 3: Entry Behaviors and Learner Characteristics

As previously indicated, this step is often conducted in parallel with stage 2. The purpose is to determine which of the required enabling skills the learners bring to the learning task. Some learners will know more than others, so the designer must choose where to start the instruction, knowing that it will be redundant

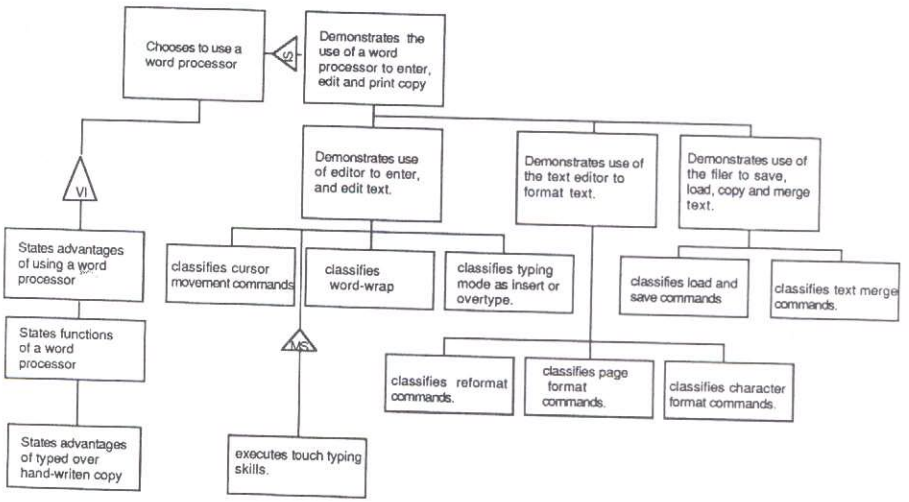

FIGURE 2-2 **An ICM for a Unit on Word Processing**

for some but necessary for others. The designer must also be able to identify those learners for whom the instruction would not be appropriate so that they may be given instruction that remediates. The lack of understanding of a target audience can sometimes be seen in instructional design products. It is usually not sufficient for a designer to guess what the skills of an intended audience will be. A better procedure is to interview and test the skills of the target population until you know enough about them to design the instruction appropriately. Chapter 6 discusses the analysis of learner characteristics in more detail.

In addition to learner qualities such as intellectual skills, which are clearly learned, the designer of instruction may find it desirable to make some provision for learner *abilities* and *traits,* which are usually considered to be less readily alterable through learning. Abilities include such qualities as verbal comprehension and spatial orientation, for example. Instruction designed for learners who are low in verbal comprehension would best deemphasize verbal presentations (such as printed texts). Instruction designed for learners who score high in spatial orientation ability might be able to use this ability to advantage in a course in architecture.

Traits of personality are another aspect of learner capability that may need to be considered in instructional design. Students who score high on the trait of anxiety, for example, may be better able to learn from instruction that is leisurely paced and that permits learners to choose optional next steps. As will be indicated in Chapter 6, learner traits and abilities may affect some of the general qualities of instruction, such as its employment of particular media and its pacing. In this respect, abilities and traits contrast with such learner characteristics as the possession of particular skills and verbal knowledge; the latter has quite specific effects on the content of effective instruction.

Stage 4: Performance Objectives

At this stage, it is necessary to translate the needs and goals into performance objectives that are sufficiently specific and detailed to show progress toward the goals. There are two reasons for working from general goals to increasingly specific objectives. The first is to be able to communicate at different levels to different persons. Some people (for example, parents or a board of directors) are interested only in goals, and not in details, whereas others (teachers, students) need detailed performance objectives to determine what they will be teaching or learning.

A second reason for increased detail is to make possible planning and development of the materials and the delivery system. One thesis of this book is that different types of learning outcomes require different instructional treatments. To design effective instructional materials and choose effective delivery systems, the designer must be able to properly determine the conditions of learning necessary for acquisition of new information and skills. Specification of performance objectives facilitates this task. Once objectives are stated in performance terms, the curriculum can be analyzed in terms of sequence and com-

pleteness and the requirements of prerequisite skills. This work facilitates the planning of an effective delivery system. The size of the system needed can be estimated and development schedules can be planned to coordinate the work of the design team, the teachers, the media production team, and the trainers of teachers.

The final reason for eventually stating all objectives in terms of performance (rather than content outlines or teacher activities) is to be able to measure student performance to determine when the objectives have been reached. Objectives are of such central importance to the design process that an entire chapter of this book (Chapter 7) is devoted to their construction.

Performance objectives are statements of observable, measurable behaviors. Prior to this stage, the designer has given much thought to how the needs and goals may be translated into instructional plans at the course or unit level. It is likely that there have been many drafts of instructional objectives, objective groupings, and unit structures before this stage is reached. These modifications enable the designer to define the performance objectives that are to guide all the later work in developing lesson plans (or modules) and the measures to be used in monitoring student progress and evaluating the instruction.

The functions of performance objectives are to (1) provide a means for determining whether the instruction relates to the accomplishment of goals, (2) provide a means for focusing the lesson planning upon appropriate conditions of learning, (3) guide the development of measures of learner performance, and (4) assist learners in their study efforts. Thus, the intimate relationships among *objectives, instruction, and evaluation* are emphasized. Briggs (1977) referred to these three aspects of instructional design as the *anchor points* in planning, and he emphasized the need to make certain that the three are in agreement with one another.

It is apparent that the objectives should guide the instruction and evaluation, not the other way around. Therefore, the objectives should be determined before the lesson plans or the evaluation instruments. Almost all instructional design models follow this sequence. Practices differ with regard to the step following the development of performance objectives. The model shown in Figure 2-1 places the development of test items before the development of instructional strategies. Briggs (1977) also placed the design of assessment instruments before lesson development, on the grounds that (1) the novice is more likely to stray from the objectives in developing tests than in preparing lessons, and (2) a designer who had just finished developing lesson material might inadvertently focus on content rather than performance in constructing tests. The experienced designer, however, might choose to develop lessons before developing performance measures.

Stage 5: Criterion-Referenced Test Items

Since the design of measures of learner performance is discussed later on in Chapter 13, we need here only to summarize the purpose of this design stage.

There are many uses for performance measures. First, they can be used for diagnosis and placement within a curriculum. The purpose of diagnostic testing is to ensure that an individual possesses the necessary prerequisites for learning new skills. Test items allow the teacher to pinpoint the needs of individual students in order to concentrate on the skills that are lacking and to avoid unnecessary instruction.

Another purpose is to check the results of student learning during the progress of a lesson. Such a check makes it possible to detect any misunderstandings the student may have and to remediate them before continuing. In addition, performance tests given at the conclusion of a lesson or unit of instruction can be used to document student progress for parents or administrators.

These levels of performance assessment can be useful in evaluating the instructional system itself, either lesson by lesson or in its entirety. Evaluations designed to provide data, whereby instruction is to be improved, are called *formative evaluations*. They are usually conducted while the instructional materials are still being formed and reformed. When no further changes are planned and when it is time to determine the success and worth of the course in its final form, *summative evaluations* are conducted. Types of performance measures suitable for these various purposes are discussed extensively in Chapter 13.

Some planning of performance measures may well be undertaken before the development of lesson plans and instructional materials because one wishes the tests to focus on the performance objectives (what the learner must be able to do) rather than on what the learner has read or what the teacher has done. Thus, the performance measures are intended to determine if students have acquired the desired skill, not to determine if they merely remember the instructional presentation. Early determination of performance measures helps to focus on the goal of student learning and on the instruction needed to facilitate that learning.

Stage 6: Instructional Strategy

Our use of the term *strategy* is nonrestrictive. We do not intend to imply that all instruction must be self-contained instructional modules or mediated materials. Teacher-led or teacher-centered instruction can also benefit from instructional systems design. By instructional strategy, we mean a plan for assisting the learners with their study efforts for each performance objective. This may take the form of a lesson plan (in the case of teacher-led instruction) or a set of production specifications for mediated materials. The purpose of developing the strategy before developing the materials themselves is to outline how instructional activities will relate to the accomplishment of the objectives.

When teacher-led, group-paced instruction is planned, teachers use the instructional design process to produce a guide to help implement the intent of the lesson plan without necessarily conveying its exact content to the learners. The teacher gives directions, refers learners to appropriate materials, leads or

directs class activities, and supplements existing materials with direct instruction. On the other hand, when a learner-centered, learner-paced lesson is planned, a *module* is typically presented to the learner. It usually presents a learning objective, an activity guide, the material to be viewed or read, practice exercises, and a self-check test for the learner. In this case, the instructions or activity guide in the module is written for the student rather than for the teacher. Designers can use the process for both teacher-led and modular materials.

The purpose of all instruction, according to the view presented in this book, is to *provide the events of instruction*. As discussed in Chapter 10, these events are communications external to the learner that support the internal processes of learning. They include such widely recognized functions as *directing attention, informing the learner of the objective, presenting the stimulus material,* and *providing feedback*. It matters little whether these events are performed by teachers or materials, so long as they are successfully performed. It may be noted further that these events of instruction are applicable to all domains of learning outcomes, although the details of how they are implemented imply somewhat different sets of conditions for learning (see Chapters 4 and 5 of this text; Gagné, 1985).

What will become evident as this book progresses is that different instructional media have different capabilities for providing the various events of instruction. For example, teachers are unbeatable for providing learning guidance and feedback; however, videotape can be used to present stimulus situations (for example, a tour of Florence) that would be difficult for the classroom teacher to present in any other way. It may now be appreciated that the *choice of the delivery system* indicates a general preference for emphasizing certain agents to accomplish instructional events; within such a general preference (such as for individualized, learner-paced modules), specific agents or media can be assigned, event by event, objective by objective. That is what we mean by developing a strategy for instruction.

The planning of an instructional strategy is an important part of the instructional design process. It is at this point that the designer must be able to combine knowledge of learning and design theory with his experience of learners and objectives. Needless to say, creativity in lesson design will enhance this other knowledge and experience. Perhaps it is this component of creativity that separates the art of instructional design from the science of instructional design. It is clear that the best lesson designs will demonstrate knowledge about the learners, the tasks reflected in the objectives, and the effectiveness of teaching strategies. To achieve this combination, the designer most often functions as part of a team of teachers, subject-matter experts, script writers and producers, and perhaps others.

Stage 7: Instructional Materials

The word *materials* here refers to printed or other media intended to convey events of instruction. In most traditional instructional systems, teachers do not

design or develop their own instructional materials. Instead, they are given materials (or they select materials) that they integrate into their lesson plans. In contrast, instructional systems design underscores the selection and development of materials as an important part of the design effort. Teachers can be hard-pressed to arrange instruction when there are no really suitable materials available for part of the planned objectives. Often, they improvise and adapt as best they can. Most often, however, teachers do find suitable materials. The danger is that teachers sometimes choose existing materials for convenience, in effect changing the objectives of the instruction to fit their available materials. In such circumstances, the student may be receiving information or learning skills that are unrelated to instructional goals.

The more well established are the objectives and hence the more precisely determined the content of the materials, the more likely it is that suitable materials will already be on the market. Nevertheless, such materials are more likely to be referenced by content than by objective (to say nothing of their failure to address the events of instruction they provide). It is possible that available materials will be able to provide some of the needed instruction. In this case, a module could be designed to take advantage of the existing materials and could be supplemented with other materials to provide for the missing objectives. Materials production is a costly process, and it is desirable to take advantage of existing materials when possible.

A few general principles begin to emerge. First, the more innovative the objectives, the more likely it is that a greater portion of the materials must be developed since they are not likely to be available commercially. Second, developing materials for a particular delivery system is almost always more expensive than making a selection from those available. Third, it is possible to save development expenses by selecting available materials and integrating them into a module providing coverage of all the desired objectives of instruction. Fourth, the role of the teacher is affected by the choice of delivery system and the completeness of the materials because the teacher will have to provide whatever missing events may be needed by the learners.

Some new curricula and instructional systems have intentionally been planned from the outset either to develop all new materials or to make as much use as possible of existing materials. The reason in the first instance is probably to ensure that a central concept, method, theme, or body of content is carefully preserved. Since such programs are often recognized as experimental, the added development costs may be justified to preserve purity of the original concept. In the case of a decision to make maximum use of existing materials, cost is likely to be the primary consideration. An example of this latter kind of decision was that of Project PLAN (Flanagan, 1975). The design of that individualized system called for maximum use of available materials so that funds would be available for designing implementation plans, for performance measures to monitor student progress, and for computer costs to save teachers' time in scoring tests and keeping records.

It is beyond the scope of this book to describe how design teams operate to

accomplish the various stages of instructional systems design including the development of materials. Carey and Briggs (1977) and Branson and Grow (1987) give a general account of the process, and Weisgerber (1971) gives some of the details for specific systems.

Stage 8: Formative Evaluation

Formative evaluation provides data for revising and improving instructional materials. Dick and Carey (1990) provide detailed procedures for a three-level process of formative evaluation. First, the prototype materials are tried *one on one* (one evaluator sitting with one learner) with learners representative of the target audience. This step provides a considerable amount of information about the structure and logistic problems the learners may have with the lessons. The designer can interview the learner or have him "talk through" the thoughts he has while going through the material. It has been estimated that the effectiveness of instructional materials could be improved 50 percent simply through the use of a few one-on-one evaluations. The second level is a small group tryout, in which the materials are given to a group of six to eight students. Here, the focus is on how the students use the materials and how much help is requested. This information can be used to make the lesson more self-sufficient. It will also give the designer a better idea of the materials' probable effectiveness in a large group, the mean scores of the students being more representative than the scores from the one-on-one student trials. The final step is a field trial in which the instruction, revised on the basis of the one-on-one and small-group trials, is given to a whole class.

The purpose of formative evaluation is to revise the instruction so as to make it as effective as possible for the largest number of students. This stage in materials development is probably one of the most frequently overlooked because it comes late in the design process and represents a significant effort in planning and execution. However, the use of systems feedback to correct the system represents the essence of systems philosophy. Instructional design without formative evaluation is incomplete. The feedback loop in Figure 2-1 shows that formative evaluation data may call for the revision or review of products because of information derived from any of the previous stages of design.

Stage 9: Summative Evaluation

Studies of the effectiveness of a system as a whole are called *summative evaluations,* the basic form of which is described more fully in Chapter 16. As the term implies, a *summative evaluation* is normally conducted after the system has passed through its formative stage—when it is no longer undergoing point-by-point revision. This may occur at the time of the first field test or as much as five years later, when large numbers of students have been taught by the new system. If there is expectation that the system will be widely used in schools or class-

rooms throughout the country, summative evaluations need to be conducted under an equally varied range of conditions.

A national agency, the Joint Dissemination Review Panel (JDRP), conducts such reviews. The JDRP meets periodically to review evidence of effectiveness of educational products identified as potentially "exemplary" and suitable for dissemination. This is a form of summative evaluation, in which a team of evaluators audits a pilot project to judge evidence of its effectiveness. "The evidence must be shown to be valid and reliable, the effects must be of sufficient magnitude to have educational importance, and it should be possible to reproduce the intervention and its effects at other sites" (Tallmadge, 1977; p. 2). If the project passes the panel's scrutiny, it may qualify for funds to support dessemination from the National Diffusion Network.

EDUCATIONAL SYSTEM DESIGN

Many different models may be used to describe the process of instructional design as applied to total educational systems. Models for the most comprehensive level must include analyses of needs, goals, priorities, resources, and other environmental and social factors affecting the educational system. The model outlined in Table 2-1 lists 14 stages in the design of instruction for total systems of education.

In contrast to the nine-stage model we just described (Figure 2-1), Table 2-1 makes it apparent that additional factors and stages must be dealt with in

Table 2-1 **Stages in Designing Instructional Systems**

System Level

1. Analysis of needs, goals, and priorities
2. Analysis of resources, constraints, and alternate delivery systems
3. Determination of scope and sequence of curriculum and courses; delivery system design

Course Level

4. Determining course structure and sequence
5. Analysis of course objectives

Lesson Level

6. Definition of performance objectives
7. Preparing lesson plans (or modules)
8. Developing, selecting materials, media
9. Assessing student performance (performance measures)

System Level

10. Teacher preparation
11. Formative evaluation
12. Field testing, revision
13. Summative evaluation
14. Installation and diffusion

planning instruction for large curriculum design efforts and for total educational systems. These include the analysis of resources, constraints, alternative delivery systems, teacher preparation, and the installation and diffusion of newly developed instruction.

Resources, Constraints, and Alternative Delivery Systems

Once needs and goals are identified, instructional planners need to consider issues such as: How will students learn the skills implied by the goals? From whom will they learn? Where will they find the resources, materials, or help they need? What resources will it take to teach the goals? Are the resources available? Do we want to spend that much? Can the present system do this? Will instructor training be needed? and, What alternative systems might be used? Once questions such as these are pursued, some alternative delivery systems suggest themselves.

A delivery system includes everything necessary to allow a particular instructional system to operate as it was intended and where it was intended. Thus, a system can be designed to fit a particular physical plant or to require a new one. The basic decision about instructional delivery can directly affect the kind of personnel, media, materials, and learning activities that can be carried on to reach the goals. Can any of the resources or constraints be altered? This is a key question at several stages of planning, including this one.

Should the new set of goals appear out of reach of any of the available delivery systems, no further planning is possible until (1) some goals are changed, (2) some resources and constraints are changed, or (3) another delivery system can be conceived. Failure to do this may lead to piecemeal planning with generally unsatisfactory results. Lack of resolution of these issues may lead to various kinds of waste including (1) equipment and materials sitting unused because of lack of supporting personnel, (2) laboratories not used because supplies were not budgeted for, (3) learning activities disrupted because of bad scheduling, and (4) goals not achieved because essential prerequisite learning experiences were not provided.

Often, the estimate of resources and constraints call for the goals to be achieved within a currently existing delivery environment. In the case of schools, this generally means the teacher-led classroom. In industry, it could mean the use of videotaped instruction because the delivery system is already in place. What must be considered is whether the existing delivery system is capable of providing the environment needed for learning the new skills. Further discussion of this point is contained in later chapters.

Teacher Preparation

The term, *teacher preparation,* as used here does not refer to the initial education and training of new teachers, but rather to the special training of current

teachers in the development and dissemination of new instructional systems. Teachers, as noted earlier, are generally important members of the design team. They assist in all the stages of design and become trainers of other teachers or demonstration teachers. If a new instructional system requires special skills beyond those already possessed by teachers in service, special training must be designed as part of the instructional systems design process to provide those new skills. Special workshops are one common mode for such training, but visits to schools where the system is first operating as a pilot test are an important alternative. The teachers need to perceive that the new system will work in their environment. Teachers are often skeptical of new approaches, and it is time-consuming to switch to new curricula and materials; accordingly, teachers must approach the task with a positive attitude toward the new system. In visits to schools adopting an individualized system of instruction, Briggs and Aronson (1975) discovered that most teachers felt they needed a year of experience beyond their initial training for them to prefer new systems of instruction over their prior practices.

The basic principle we want to stress is that teachers need to be prepared before materials are distributed in order for a new unit of instruction to be adopted. The more input teachers have along the way, the more likely new materials will fit into the existing system, and the more likely they will be adopted (Burkman, 1986).

Installation and Diffusion

This stage of instructional systems development was mentioned in some of the preceding discussion. After an acceptable degree of merit is shown in one or more summative evaluations, the new system (course, or curriculum) is ready for widespread adoption and regular use.

In the course of operational installation, a number of practical matters receive final attention or adjustment. For example, materials may have to be stored differently in some schools than in others, owing to differences in building design and available space. Time schedules for a new set of instruction may require modifications to fit within existing patterns for a particular school. There are inevitable logistical problems: the duplication and distribution of expandable materials, for example. Even more important, according to Heinich (1984), is the need to be aware of the nature of the system into which the innovation is to be introduced. New technology is often perceived as a threat to the existing system and is often blocked by those who should use it.

A frequent problem is securing enough adoptions of a new instructional system to amortize the costs of development, marketing, and maintenance (an often overlooked cost). Techniques relevant to the diffusion of educational systems and innovations have generated a great many research studies. It is beyond the scope of this book to discuss the merits of relevant techniques. As a follow-up to the JDRP, the U.S. Office of Education created the National

Diffusion Network (NDN) in 1974 for the purpose of providing ed with information about exemplary programs. The NDN supports dem tion projects that provide training, materials, and technical assistance t who adopt their programs. The NDN also has "facilitators" in each state, within the state's Department of Education; these are persons who help suitable NDN programs. NDN estimates that it presently supports ov programs in more than 15,000 public schools. As a result of NDN's more than 50,000 teachers and administrators have received in-service t which may in turn have affected over 1.5 million students (National D Network, 1986).

If diffusion is one of the goals of a development project, it must be con early in the design process. Collaboration with a publishing company approach, but the operating procedures of the company may put constra what the final product or delivery system can be. For example, a chosen system may be unacceptable to a publisher, and the design team may accept a less desirable delivery system in order to achieve the adoption This may require rethinking the instructional goals, needs, or system objectives.

SUMMARY

The term *instructional system design* was defined along with a general desc of the design process. Stages of design are often presented as a flow diag model to be followed in the design of instructional materials. The instru systems approach is a process of planning and developing instruction tha use of research and learning theory and employs empirical testing as a me the improvement of instruction.

The nine-stage model of design described in this chapter represents on possible ways of conceptualizing the process. All design models focus at on the three "anchor points" of instruction: performance objectives, ma and evaluation instruments. The purpose of lesson planning, as we see ensure that the necessary instructional events are provided to the learn steps in the planning process include (1) classifying the lesson object learning type, (2) listing the needed instructional events, (3) choosing a m of instruction capable of providing those events, and (4) incorporating priate conditions of learning into the prescriptions indicating how eac will be accomplished by the lesson. Some events may be executed by the some by the materials, and some by the teacher.

The design process is iterative, and many of the earlier stages have revisited and the products reworked based on findings or new infor uncovered during later stages. There is, then, much working back and f the total design work progresses. The entire design approach outlined considered to be internally consistent and in agreement with research f

on how learning takes place. The resulting designs are amenable to both formative and summative evaluations. Each design objective is stated in testable form so that the success of the design can be evaluated.

More comprehensive levels of systematic instructional design are encountered in efforts to develop courses or curricula for entire educational systems. At such levels, as many as 14 stages of analysis and development may be involved. Procedures of design at this level usually include considerations of resources and constraints, requirements for teacher education, and techniques for installation and diffusion. Evaluation of an entire system involves assessing the effectiveness and viability of components of the system as a whole.

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