The Systematic Design of Instruction

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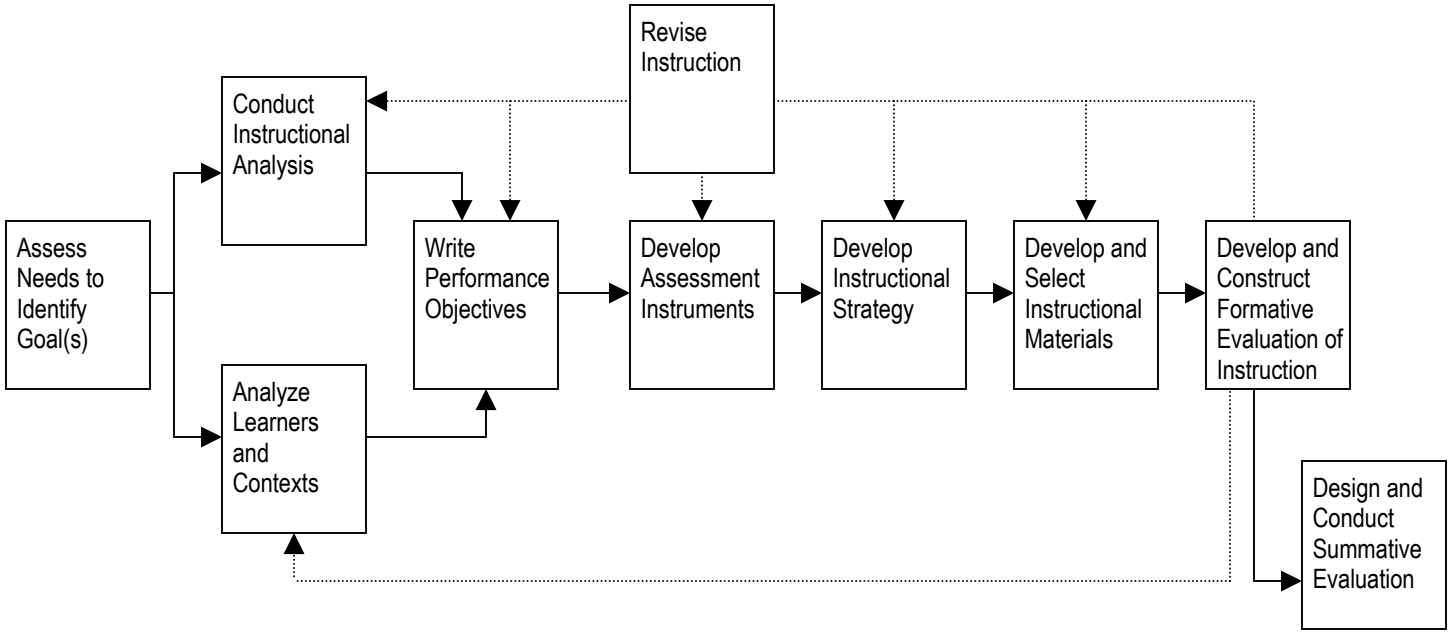
Chapter 1

Introduction to instructional design



The Dick and the Carey Systems Approach Model for Designing Instruction

The instructional process, or *teaching,* has traditionally involved instructors, learners, and textbooks. The content to be learned was contained in the text, and it was the instructor's responsibility to "teach" that content to the learners. Teaching could be interpreted as getting content from the text into the heads of learners in such a way that they could retrieve the information for a test. With this model, the way to improve instruction is to improve the instructor (i.e., to require the instructor to acquire more knowledge and to learn more methods for conveying it to learners).

A more contemporary view of instruction is that it is a systematic process in which every component (i.e., teacher, learners, materials, and learning environment) is crucial to successful learning. This perspective is usually referred to as the *systems point of view,* and advocates of this position typically use the systems approach to design instruction.

Let's consider what is meant by a system, and then consider the systems approach. The term *system* has become very popular as more and more of what we do is interrelated with what other people do. A system is technically a set of interrelated parts, all of which work together toward a defined goal. The parts of the system depend on each other for input and output, and the entire system uses feedback to determine if its desired goal has been reached. If it has not, then the system is modified until it does reach the goal. The most easily understood systems are those we create rather than those that occur naturally. For example, you probably have a heating or cooling system in your home that consists of various components that work together to produce warmth or coolness. The thermostat is the feedback mechanism through which the thermometer constantly checks the temperature and signals the system when more heat or cold is needed. When the desired temperature is reached, the system shuts itself off.

How is this related to instruction? First, the instructional process itself can be viewed as a system. The purpose of the system is to bring about learning. The components of the system are the learners, the instructor, the instructional materials, and the learning environment. These components interact in order to achieve the goal. For example, the instructor reviews sample problems in the textbook or manual with the learners in a quiet classroom. To determine whether learning is taking place, a test is administered. This is the instructional system thermostat. If learner performance is not satisfactory, then changes must be enacted to make the system more effective and to bring about the desired learning outcomes.

The result of using the systems view of instruction is to see the important role of all the components in the process. They must all interact effectively, just as the parts in a heating or cooling system must interact effectively in order to bring about the desired outcomes. There is not an overemphasis of any one component in the system, but a determination of the exact contribution of each one to the desired outcome. And it is clear that there must be both an assessment of the effectiveness of the system in bringing about learning and a mechanism to make changes if learning fails to occur.

Thus far, our discussion of the instructional process has focused on the interactive component of the process-namely, the time instructors and learners come together with the hope that learning will occur. But what about the preparation for the instructional process? How does the instructor decide what to do, and when? It is not surprising that someone with a systems view sees the preparation, implementation, evaluation, and revision of instruction as one integrated process. In the broadest systems sense, a variety of sources provide input to the preparation of the instruction. The output is some product or combination of products and procedures that are implemented. The results are used to determine whether the system should be changed, and, if so, how.

The purpose of this book is to describe a systems approach model for the design, development, implementation, and evaluation of instruction. This is not a physical system such as a furnace or air conditioner or heat pump (which will do both) but a procedural system. We will describe a series of steps, all of which will receive input from the preceding steps and will provide output for the next steps. All of the components work together in order for the user to produce effective instruction. The model includes an evaluation component that will help determine what, if anything, went wrong and how it can be improved.

While our model will be referred to as a systems approach model, we must emphasize that there is no single systems approach model for designing instruction. A number of models bear the label *systems approach,* and all of them share most of the same basic components. The systems approach model presented in this book is less complex than some but includes the major components included in other models. Collectively, these design models and the processes they represent are referred to as *Instructional Systems Development (ISD)*.

Typically the major phases of ISD are analysis, design, development, implementation, and evaluation. Our particular model does not emphasize the first phase, analysis. Before instruction is created, it is necessary to deter- mine the need for that instruction in terms of what problem within the organization will be solved through the use of new skills, or what opportunity can be seized because of new skills in the organization. This step *is* critically important to the success of the design process; however, there are excellent books that describe the performance analysis and needs

assessment processes (see Kaufman, 1991, and Rossett, 1999). We will give only a brief description in Chapter 2 of the analysis process in order to create a context for the remainder of the model.

Note that the term *instructional design* is used as an umbrella term that includes all the phases of the ISD process. The term *design* is included in the general name of the process and is also the name for one of the major sub- processes. When we use the term *instructional design,* we will be referring to the entire ISD process. We will not belabor the issue of terminology further at this point. It will all become clear as you begin to use the instructional design process.

Instructional design models are based, in part, on many years of research on the learning process. Each component of the model is based on theory and, in most instances, on research that demonstrates the effectiveness of that component. The model brings together in one coherent whole many of the concepts that you may have already encountered in a variety of educational situations. For example, you undoubtedly have heard of performance objectives and may have already developed some yourself. Such terms as *criterion-referenced testing* and *instructional strategy* may also be familiar .The model will show how these terms, and the processes associated with them, are interrelated and how these procedures can be used to produce effective instruction.

The instructional strategy component of our model describes how the designer uses the information from the analysis of what is to be taught to formulate a plan for presenting instruction to learners. Our original approach to this component of the model was heavily influenced by the work of Robert Gagné as found in his book *The Conditions of Learning,* first published in 1965. Gagné's early work in the 1940s and 1950s was based on assumptions from behavioral psychology, where instruction is the reinforcement of appropriate learner responses to stimulus situations set up by the teacher. If students have learned, then it is more likely that they will exhibit a desired behavior in a given situation. Gagné's first edition of *The Conditions of Learning,* however, incorporated cognitive information-processing views of learning. In this view most behavior is assumed to be very complex and controlled primarily by a person's internal mental processes rather than external stimuli and reinforcements. Instruction is seen as organizing and providing sets of information and activities that guide, support, and augment students' internal mental processes. Learning has occurred when students have incorporated new information into their memories that enables them to master new knowledge and skills. Gagné further develops cognitive views of learning and instruction in later editions of *The Conditions of Learning* (1970, 1977, 1984).

Constructivism is a relatively recent branch of cognitive psychology that has had a major impact on the thinking of many instructional designers. Constructivist thinking varies broadly on many issues, but the central point is that learning is always a unique product "constructed" as each individual learner combines new information with existing knowledge and experiences. Individuals have learned when they have constructed new interpretations of the social, cultural, physical, and intellectual environments in which they live. Because learning in the constructivist view is so entwined with one's experiences, a primary role of the teacher is creating appropriate learning environments, sometimes called problem scenarios, in which students' learning experiences are authentic representations of real practices in applied settings.

Throughout this text, readers will find elements of behaviorist, cognitivist, and constructivist views adopted and adapted as appropriate for the varieties of learners, learning outcomes, learning contexts, and performance contexts that are discussed. The Dick and Carey Model incorporates an eclectic set of tools drawn from each of these three major theoretical positions of the past fifty years.

One additional comment may help clarify distinctions regarding the learning theories that underlie this instructional design model. As you read through the following chapters you will find the term *behavior* frequently used in all of its forms in a variety of different contexts. On finding repeated uses of the term, one might infer that the predominant theoretical foundation of the text is behaviorism. This would be a wrong assumption that arises from a confusion between the learning theory called behaviorism and the tools used by behaviorist psychologists and all other psychologists to study learning. The behaviorist views learning as a change in the probability of a response, but can only determine that a change in probability (i.e., learning) has occurred by observing the behavior. The tool used by the behaviorist (observation of behavior) is shared by all psychologists who study learning. Thus, the term *behavior* will be used frequently in this text, but it should not be concluded

that we recommend either the classical conditioning models of early behaviorists or the operant conditioning models of later behaviorists as the primary theoretical foundations for designing and implementing instruction.

The model, as it is presented here, is based not only on theory and research but also on a considerable amount of practical experience in its application. We suggest that the novice instructional designer use the model principally in the sequence and manner presented in this chapter because students who have done so have been successful. On the other hand, we acknowledge that in particular circumstances and with increased design experience, you might need to change the model, or to perform the steps out of sequence. Also, we expect that more research and experience will help amplify the procedures associated with each component of the model.

In the section that follows, we will present the general systems approach model in much the same way as a cookbook recipe-you do this and then you do that. When you begin to use a recipe in your own kitchen, however, it takes on greater meaning, just as the model will when you begin to develop your own instruction: You select a topic for which instruction is needed, you develop your own instructional resources, you select your own set of learners, and 80 on. Your perspective on the model will probably change greatly. In essence, your use of your own kitchen, your own ingredients, and your own personal touch will result in a unique product.

The model that will be described in detail in succeeding chapters is presented on pages 2 and 3. The model includes ten interconnected boxes and a major line that shows feedback from the next-to-last box to the earlier boxes. The boxes refer to sets of procedures and techniques employed by the instructional designer to design, develop, evaluate, and revise instruction. The steps will be briefly described in sequence below and in much greater detail in subsequent chapters.

Components of the Systems Approach Model

ASSESS NEEDS TO lDENTIFY GOAL(S)

The first step in the model is to determine what it is that you want learners to be able to do when they have completed your instruction. The instructional goal may be derived from a list of goals, from a needs assessment, from practical experience with learning difficulties of students, from the analysis of people who are doing a job, or from some other requirement for new instruction.

CONDUCT INSTRUCTIONAL ANALYSIS

After you have identified the instructional goal, you will determine step-by- step what people are doing when they perform that goal. The final step in the instructional analysis process is to determine what skills, knowledge, and attitudes, known as *entry behaviors,* are required of learners to be able to begin the instruction. A diagram will be produced that depicts the relationships among all of the skills that have been identified.

ANALYZE LEARNERS AND CONTEXTS

In addition to analyzing the instructional goal, there is a parallel analysis of the learners, the context in which they will learn the skills, and the context in which they will use them. Learners' current skills, preferences, and attitudes are determined along with the characteristics of the instructional setting and the setting in which the skills will eventually be used. This crucial information shapes a number of the succeeding steps in the model, especially the instructional strategy.

WRITE PERFORMANCE OBJECTIVES

Based on the instructional analysis and the statement of entry behaviors, you will write specific statements of what the learners will be able to do when they complete the instruction. These statements, which are derived from the skills identified in the instructional analysis, will identify the skills to be learned, the conditions under which the skills must be performed, and the criteria for successful performance.

DEVELOP ASSESSMENT INSTRUMENTS

Based on the objectives you have written, develop assessments that are parallel to and measure the learners' ability to perform what you described in the objectives. Major emphasis is placed on relating the kind of behavior described in the objectives to what the assessment requires.

DEVELOP INSTRUCTIONAL STRATEGY

Based on information from the five preceding steps, identify the strategy that you will use in your instruction to achieve the terminal objective. The strategy will include sections on pre-instructional activities, presentation of information, practice and feedback, testing, and follow-through activities. The strategy will be based on current theories of learning and results of learning research, the characteristics of the medium that will be used to deliver the instruction, content to be taught, and the characteristics of the learners who will receive the instruction. These features are used to develop or select materials or to develop a strategy for interactive classroom instruction.

DEVELOP AND SELECT INSTRUCTIONAL MATERIALS

In this step you will use your instructional strategy to produce the instruction. This typically includes a learner's manual, instructional materials, and tests. (When we use the term *instructional materials* we are including all forms of instruction such as instructor's guides, student modules, overhead transparencies, videotapes, computer-based multimedia formats, and web pages for distance learning. We intend the term *materials* to have this broad connotation.) The decision to develop original materials will depend on the type of learning to be taught, the availability of existing relevant materials, and developmental resources available to you. Criteria for selecting from among existing materials are provided.

DESIGN AND CONDUCT TBE FORMATIVE EVALUATION OF INSTRUCTION

Following the completion of a draft of the instruction, a series of evaluations is conducted to collect data that are used to identify how to improve the instruction. The three types of formative evaluation are referred to as *one-to- one evaluation, small-group evaluation,* and *field evaluation.* Each type of evaluation provides the designer with a different type of information that can be used to improve the instruction. Similar techniques can be applied to the formative evaluation of existing materials or classroom instruction.

REVISE INSTRUCTION

The final step (and the first step in a repeat cycle) is revising the instruction. Data from the formative evaluation are summarized and interpreted to attempt to identify difficulties experienced by learners in achieving the objectives and relate these difficulties to specific deficiencies in the instruction. The line in the figure on pages 2 and 3 labeled "Revise Instruction" indicates that the data from a formative evaluation are not simply used to revise the instruction itself, but are used to reexamine the validity of the instructional analysis and the assumptions about the entry behaviors and characteristics of learners. It is necessary to reexamine statements of performance objectives and test items in light of collected data. The instructional strategy is reviewed and finally all this is incorporated into revisions of the instruction to make it a more effective instructional tool.

DESIGN AND CONDUCT SUMMATIVE EVALUATION

Although summative evaluation is the culminating evaluation of the effectiveness of instruction, it generally is not a part of the design process. It is an evaluation of the absolute and/ or relative value or worth of the instruction and occurs only after the instruction has been formatively evaluated and sufficiently revised to meet the standards of the designer. Since the summative evaluation usually does not involve the designer of the instruction but instead involves an independent evaluator, ibis component is not considered an integral part of the instructional design process per se.

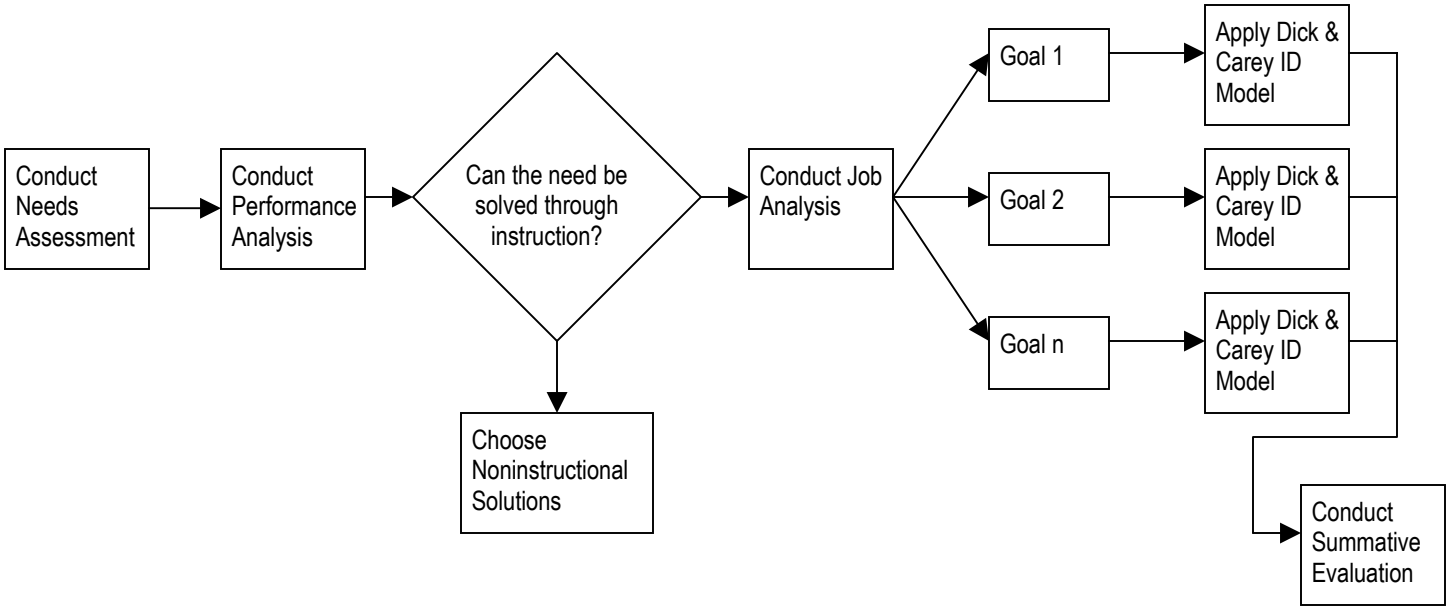


Figure 1.1 The Role of the Dick and Carey Model in the Broader Curriculum Development Process

The nine basic steps represent the procedures that one employs when the systems approach is used to design instruction. This set of procedures is referred to as a systems approach because it is made up of interacting components, each having its own input and output, which together produce pre-determined products. Data are also collected about the system's effectiveness so that the final product can be modified until it reaches the desired quality level. When instructional materials are being developed, data are collected and the materials are revised in light of these data to make them as effective and efficient as possible.

Before concluding our discussion of the systems approach model, it should be made clear that, as it stands, this is not a curriculum design model. In order to design a curriculum many more steps would be required before identifying the instructional goals. Some of these techniques are known as needs assessment and job analysis. One should use the model in curriculum development projects after the instructional goals have been derived. Figure 1.1 illustrates how the Dick and Carey Model would fit into a broader curriculum development process.

Using the Systems Approach Model

Now that you have read about this model, you should consider several very important questions about its use. These are discussed in the sections that follow.

WHAT ARE THE BASIC COMPONENTS OF SYSTEMATICALLY DESIGNED INSTRUCTION?

When the systems approach is used, some form of instructional materials is almost always created. These materials were initially referred to as programmed instruction. As the format changed, they became learning activity packages (LAPs) and modules. We will simply refer to *instruction.* A module is usually a self-instructional printed unit of instruction that has an integrated theme, provides students with information needed to acquire and assess specified knowledge and skills, and serves as one component of a total curriculum. While printed modules are still quite popular as a format for

instruction, more and more designers are choosing to use computers, and specifically the Internet, as the mechanism for delivering selected modules, a complete unit of instruction, or a total curriculum.

Systematically designed instruction requires learners to interact actively with the instructional materials rather than simply allowing them to read the materials passively. The learners are asked to perform various types of learning tasks and receive feedback on that performance. Some type of testing strategy informs the learners whether they achieved mastery of the content and what they should do if they did not.

Based on the description of prior paragraphs, how would you recognize a module if you saw one? In its most simple form, a module might include a statement to students that says what it is they are about to learn and how they will be tested. It would provide printed instructional materials as well as some practice exercises. A self-test that might be used prior to taking a terminal test could also be included.

A more complex module might contain all of the items listed above, but might also incorporate a number of alternative sets of materials from which the learner could choose the one most appropriate. Alternative media forms such as a web site or videotapes could also be included. In addition, the learner might go to a laboratory to conduct an experiment or go outside the learning environment to gather information.

Keep in mind two important points. First, it is not possible to examine instructional materials and decide whether they contain all the components of systematically designed instruction. Many factors enter into the design decisions that determine what is and is not included. Second, you cannot determine by inspection whether instruction has been systematically designed. The systems approach is a process that is followed by designers, but it is not necessarily apparent by reviewing instructional materials. For example, simply inserting a set of objectives at the beginning of each chapter in a textbook does not mean that the textbook has been systematically designed!

FOR WHICH INSTRUCTIONAL DELIVERY SYSTEM IS THE SYSTEMS APPROACH APPROPRIATE?

The systems approach to the design of instruction includes the planning, development, implementation, and evaluation of instruction. As a part of this process, the delivery method of the instruction must be chosen. In some instances, it is most appropriate to have an instructor deliver the instruction, while in other situations, a variety of media may be employed. Most recently it seems that every new instructional effort tends to include a computer. In every instance, the systems approach is an invaluable tool for identifying what is to be taught, determining how it win be taught, and evaluating the instruction to find out whether it is effective.

The procedure described in this text for developing an instructional strategy is a generic one. It is applicable to the development of print instruction that is still favored in many instances for portability and production cost. The procedure can be easily used, however, to fit the requirements of any selected medium of instruction. Materials developers in video or multimedia, for example, could use the instructional strategy statements to create storyboards, screen displays, or flow charts for hyper linking interactive sequences. The use of the systems approach prevents the designer from trying to create instruction for a medium prior to a complete analysis of what is to be taught and how. Most research suggests that it is the analysis process and the instructional strategies, rather than the delivery mode, that determine the success of the instruction. The systems approach is a generic planning process that ensures that instructional products developed for any delivery system are responsive to the needs of learners and effective in achieving the desired learning outcomes.

DOES THE USE OF THE SYSTEMS APPROACH IMPLY THAT ALL INSTRUCTION WILL BE INDIVIDUALIZED?

From our discussion of the development of printed modules and computer- based instruction, the reader might assume that systematically designed instruction is the same as individualized instruction; it is not. Let's assume, for the sake of discussion, that individualized instruction permits learners to progress at their own rate. (This is considered the minimal definition of individualized instruction!) A

well-designed print module or computer-based lesson could certainly be used in this manner. So the systems approach can be used to design individualized instruction. However, it can also be used to design group-based instruction if we may use this term in contrast with individualized instruction. The systems approach can be used, as already noted, to develop all types of instructor-led and interactive group activities. In fact, it is often the case that these are precisely the conditions that are most effective and efficient for bringing about the desired learning outcomes.

The reader should be careful to distinguish between the process of designing instruction and the delivery of that instruction. The systems approach is basically a design process, whereas instructors, modules, computers, and televisions are delivery mechanisms. These delivery mechanisms can be used with one or many learners at the same time. A major part of the design process is to determine how the instruction can be delivered most effectively.

The beneficiary of the application of the systems approach to the design of instruction is the individual learner. Careful attention is paid to determining what must be learned and what learners must already know in order to begin the instruction. The instruction is focused on the skills to be learned and is presented under the best conditions for learning. The learner is evaluated fairly with instruments that measure the skills and knowledge described in the objectives, and the results are used to revise the instruction so that it will be even more effective with succeeding learners. Following this process causes the designer to focus on the needs and skills of the learners and results in the creation of effective instruction.

WHY USE THE SYSTEMS APPROACH?

Few formal research studies address the question of the overall total effectiveness of the systems approach to designing instruction. Although much research has been done on various components of the model, rigorous studies that involve the total model are extremely rare because they are 80 difficult to conduct. The few studies that have been published tend to provide strong support for the approach. The primary support for the model, however, comes from designers who have used the process and have documented their success with learners.

It appears that there are a number of reasons that systematic approaches to instructional design are effective. The first is the focus, at the outset, on what learners are to know or be able to do when the instruction is concluded. Without this precise statement, subsequent planning and implementation steps can become unclear and ineffective.

A second reason for the success of the systems approach is the careful linkage between each component, especially the relationship between the instructional strategy and the desired learning outcomes. Instruction is specifically targeted on the skills and knowledge to be taught and supplies the appropriate conditions for the learning of these outcomes. Stated another way, instruction does not consist of a range of activities only some of which may be related to what is to be learned.

The third and perhaps most important reason for the success of the systems approach is that it is an empirical and replicable process. Instruction is designed not for one delivery, but for use on as many occasions as possible with as many learners as possible. Because it is reusable, it is worth the time and effort to evaluate and revise it. In the process of systematically designing instruction, data are collected to determine what part of the instruction is not working, and it is revised until it does work.

Because of these characteristics, the systems approach is valuable to instructors who are interested in successfully teaching basic and higher level competencies to learners. The competency-based approach has been widely adopted among educators; however, the most numerous applications of the systems approach may be found in industry and in military services. In these environments there is a premium on both efficiency of instruction and quality of student performance. The payoffs in both situations are quite obvious.

WHO SHOULD USE THE SYSTEMS APPROACH?

As you study the instructional design model and, we hope, use it to design some instruction, you will find that it takes both time and effort. You will probably find yourself saying, "I could never use this process to prepare all my instruction," and you would probably be correct. The individual instructor

who has day-to-day instructional responsibilities can use the process to develop only small amounts of written or mediated instruction at any given time. The process can also be used effectively and efficiently to select from among existing materials and to design instruction that is not materials based.

We have found that almost every instructor who has studied the process has come away with two reactions. The first is that they will certainly begin immediately to use some of the components in the model, if not all of them. The second reaction is that their approach to instruction will never be the same because of the insights they have gained from using the process. (The reader may be somewhat skeptical at this point; be sure to consider your own reactions *after* you have used this approach.)

A second group of users of the ISD approach is growing quite rapidly. They are typically referred to as *instructional designers,* since they are trained to use a systematic approach to designing new instructional systems or improving already existing systems. Their full-time job is to create replicable instructional programs that are effective with a particular learner population.

In contrast to the instructor who may be working alone, the instructional designer often works with a team of specialists to develop the instruction. The team would typically include a content specialist, a media production specialist, an evaluation specialist, and a manager. (When the instructor works alone, he or she usually must fill all of these roles.) The team approach draws on the expertise of specialists to produce a product that none could produce alone. In these settings there is a premium placed on interpersonal skills because seemingly everyone has ideas on how best to do what needs to be done.

This book has been written for both the instructor who would like to know more about the systems approach to instructional design and the beginning instructional designer who may pursue a career in this field. The book is also intended for the public school teacher, the university professor, the industrial trainer, and the military instructor. We are convinced that the model and procedures are equally applicable in both school and non school settings.

In our examples of various aspects of the application of the systematic design process, we have included instruction that is intended for all age groups, from young children to mature adults. We will use the terms *teacher*, *instructor*, and *designer* interchangeably throughout the book because we truly believe they are interchangeable.

As you read through the chapters that follow, you will find an instructional design example on training Neighborhood Crime Watch leaders. The example is carried through each step of the design model. You should also note that Appendices A through K contain an instructional design example for a school subject that is carried through each step of the model (using a variety of sentence types in writing paragraphs).

References and Recommended Readings

At the end of each chapter, several carefully selected references are listed. The books and articles supplement the description in the chapter or focus in more detail on an important concept that has been presented.

The references listed for this first chapter are somewhat different. These are books in the field of instructional design or ones that have direct implications for the practice of instructional design. Many of the topics in this book also appear in these references. The books vary in depth and breadth of coverage of topics, but they should all help to expand your knowledge and understanding of the instructional design field.

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