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The Instructional Systems Development (ISD) Model: A Review of Those Factors Critical to Its Successful Implementation

Barbara L. McCombs

Barbara L. McCombs is a senior research scientist with the Denver Research Institute, Social Systems Research and Evaluation, University of Denver, University Park, Denver, CO 80208-0452

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The Instructional Systems Development (ISD) Model is a systems approach for the orderly and comprehensive design, development, and management of both instructional materials and instructional systems. Its generality derives from the use of analytical, problem-solving, and decision-making skills in an iterative and cybernetic process which begins with an analysis of system (or training) requirements and culminates in a fully evaluated instructional system (or set of training materials) that performs to specified standards and requirements. The procedures in the model are organized to carry out a problem-solving process for achieving the goal of more effective and efficient instruction (Andrews & Goodson, 1980; Briggs & Wager, 1981; Logan, 1979). As such, the ISD model has applicability to a broad range of instructional systems problems and utility for a variety of personnel who develop and manage education and training.

For those in the business of supporting instructional system and training material design, development, implementation, and evaluation efforts, the ISD model has provided a means for not only effectively managing large-scale design and development efforts but also a means for ensuring quality control over products developed (Branson, 1978; Earle, 1985; Malcolm, 1982; Montague, Ellis, & Wulfeck, 1983; Oxford-Carpenter & Schultz-Shiner, 1984; Reid, 1984). By their very nature, the steps in the ISD process provide a "checklist" against which progress can be assessed, and through the feedback of internal and external evaluation data (formative and summative evaluation processes), assessments of the effectiveness or quality of developed products are continuously provided. In addition, because the ISD process is typically implemented by a team of instructional designers and subject matter experts, the common language established by the model and its procedures facilitates communication among team members (Logan, 1979; Noel & Hewlett, 1981).

One thing that most, if not all, persons involved in the design and development of instructional materials or training systems can agree upon is that the basic ISD model and its underlying systems approach to instructional development is sound. Reid (1984), for example, has pointed out that the field of instructional design is ". . . founded on the premise that materials designed in accordance with the steps of a systems model will be most effective and efficient in accomplishing an instructional task" (p. 2). This premise derives much of its support from the theories of learning (e.g., Briggs, 1982; Gagne, 1977; Merrill, 1983; Reigeluth & Stein, 1983) and general systems theory (Banathy, 1968) that provide the basis for the steps in the systems approach. Features of the approach which distinguish it from traditional methods of instructional design and development are that (a) an instructional analysis is performed, (b) criteria to which the final product must conform are established, and (c) a formative evaluation and revision process is conducted (Davies, 1981; Hannum & Briggs, 1982; Reid, 1984; Reigeluth, Van Patten, & Doughty, 1981). In the performance of an instructional or task analysis, hierarchies of steps the learner must take to achieve required skills or knowledge are identified, thereby revealing an hypothesized pathway for learning and a corresponding strategy for instruction. In specifying standards or criteria for instructional products, justification for and verification of specific learning principles and design procedures are possible. In conducting a formative evaluation, the opportunity is provided to collect data concerning the quality of instruction and to determine whether or not the materials can effectively teach the target skills, knowledge, or tasks prior to final materials production and evaluation.

Advocates of the ISD model also argue that our growing knowledge base—generated from research related to the design and delivery of instruction—has allowed us to move toward a science of instruction (Reigeluth, 1984; Reigeluth et al., 1981). That is, research on the application of ISD principles has resulted in increased knowledge about specific methods for optimizing different kinds of learning outcomes as well as increased knowledge about how to develop these methods. Even with this growing knowledge base, however, ISD advocates recognize that the "science approach" inherent in the model is an evolving one, requiring a creative blend of art, craft, empiricism, and science (e.g., Davies, 1981, 1983; Medsker, 1981; Noel & Hewlett, 1981; Reigeluth et al., 1981; Sachs, 1981). As Reigeluth et al. (1981) have argued, the "scientificness" of any ISD effort is the result of a crucial and synergistic combination of a scientific process and a scientific knowledge base. Thus, implementation of the ISD model is not without its problems.

It will be argued that the single most important factor in the successful implementation of the ISD model is the use of highly trained, skilled, and knowledgeable personnel, particularly in the first step of the ISD process—the analysis phase. It is the results of a careful analysis and assessment of training or training system requirements that form the basis for subsequent steps in the ISD process—design, development, implementation, and quality control evaluations. The purpose of this selective review is not to review the relative merits of various kinds of ISD models, as this has been done in several recent reviews (e.g., Andrews & Goodson, 1980; Dick, 1981; Durzo, Diamond, & Doughty, 1979; Gustafson, 1982). Rather, the purpose of this review is to explore the factors leading to the successful implementation of the ISD model and to derive implications for the design of an ISD users training program. The review concludes with recommendations for further research and development in this area.

ISD Implementation History

The roots of ISD have been traced to the fields of psychology and communications (Dick, 1981; Logan, 1979; Wileman & Gambill, 1983), with foundations in learning theory, systems engineering, instructional technology, and empirical research (Burton, 1981; Earle, 1985; Reid, 1984). Although a variety of ISD models have appeared in the literature in the past 20 years, there are many similarities in their components. In fact, after careful analysis of 40 instructional design models, Andrews and Goodson (1980) concluded that the similarities represent a consensus of steps in the model. Dick (1981) made the further point that this consensus yields a generic model which represents the theory of instructional design, including a descriptive and prescriptive sequence of steps whose execution results in predictable learning outcomes. This generic model, as described by Andrews and Goodson (1980) and Dick (1981), consists of the following steps or components:

- needs assessment
- specification of broad goals and detailed objectives or learning outcomes
- development of criterion-referenced tests for assessing goals and objectives
- analysis of goals and objectives to determine types and sequencing of skills
- analysis of learner characteristics
- specification of instructional strategies based on task and learner analyses
- selection of media to implement strategies
- development of courseware based on strategies and media selected
- formative evaluation and revision of materials
- installation and maintenance of programs

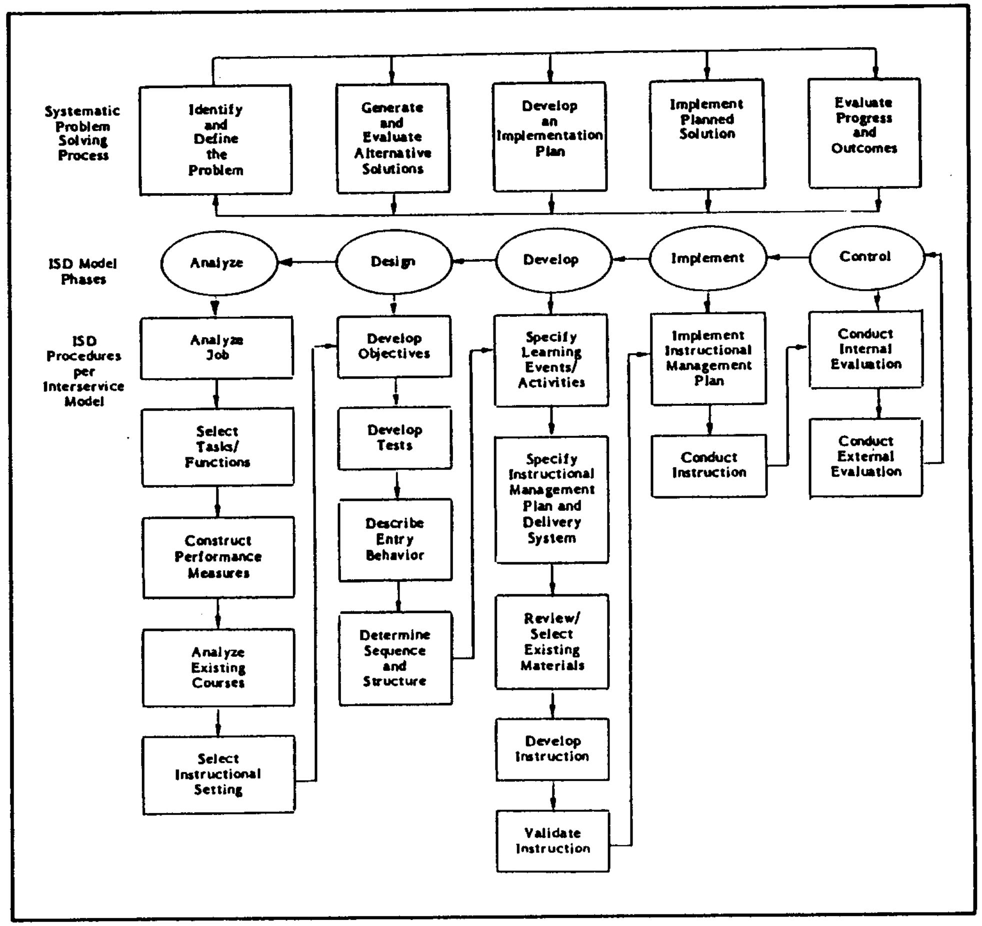
Commonly accepted ISD models may include more (e.g., Branson, 1978; Briggs & Wager, 1981), or fewer (e.g., Dick & Carey, 1978, 1985) than the preceding 10 generic steps. The point is, however, that ISD represents a generalized and logical flow of steps in a systematic problem-solving process that has broad application in the worlds of education and training. An understanding of this inherent nature of ISD as a systematic problem-solving process helps one understand its somewhat "checkered" implementation history in civilian and military contexts.

In reviewing historical accounts of the large-scale implementation of formal ISD models, most of these accounts credit attempts within the military to systematize the planning, development, conduct, and evaluation of training with the formal development and implementation of an ISD Model and associated set of procedures (e.g., Branson, 1978; Logan, 1979; Vineberg & Joyner, 1980). According to these accounts, psychologists working in the context of military training during the 1960s began applying principles from behavioral technology and systems engineering to the solution of military training problems. These systems approach principles can be traced to operations research initiated following World War II. As these principles became disseminated among academic peers and civilian professionals, a wide variety of formalized ISD models began to emerge in the professional literature during the late 1960s and early 1970s (Andrews & Goodson, 1980).

One of the most widely implemented ISD models for large-scale instructional development in the military is the model developed for the Army, Navy, Air Force, and Marines as an effort to improve interservice training (Branson, 1978, 1979). The model is called the Interservice Procedures for Instructional Systems Development (IPISD) and has provided a major planning and management function for the Army and Navy, in particular, since 1975. As with most commonly accepted ISD models, this model represents the type of systematic problem-solving process shown in Figure 1. Features of this systems model which distinguish it from more traditional or artistic approaches to instructional development are the specification of basic inputs, processes, outputs, their interfaces, and feedback control processes (Branson, 1978).

Prior to the emergence of the interservice ISD model, however, each of the military services was implementing its own systems models for training development (Vineberg & Joyner, 1980). By the 1960s, these models began receiving increased attention within the Department of Defense. For the Air Force, this interest culminated in the issuance of Regulation 50-2, Instructional Systems Development, which outlined a step-by-step model for instructional design to be utilized for the self-pacing of a majority of Air Force courses (Back & McCombs, 1984). This regulation was subsequently revised in 1975 and 1979 in keeping with the interservice model (Olsen & Bass, 1982). Similarly, in the Navy and Marines, the implementation of a systematic approach to instruction during the 1960s soon became interwoven with research and development in programmed and computer-aided instruction (Zajkowski, Heidt, Corey, Mew, & Micheli, 1979). In the Army, the first attempt at systematic instructional development during the 1960s was called systems engineering, which later evolved into the interservice or IPISD model for the development of programmed and computer-aided instruction (Branson, Raynor, Cox, & Furman, 1976).

FIGURE 1
ISD As a Problem-Solving Process



As with military implementations of systems models for instructional development, a majority of applications of ISD principles in civilian contexts were in the design of self-paced or individualized instruction, usually in the form of programmed texts. Although the intended application of these systems principles in both the military and civilian worlds was at the total instructional system or macro level, a notable phenomenon was the fact that these implementations were most often directed at a course or micro level and at the development of programmed text materials in particular (Hannum & Briggs, 1982). It was this type of restrictive application of ISD that overshadowed the advantages of a complete systems approach and that has been documented as the "failure of ISD" among military and civilian professionals alike (e.g., Back & McCombs, 1984; Baker, 1984; Branson, 1984; McCombs, Back, & West, 1984; Montague, 1984; Vineberg & Joyner, 1980, 1983). In fact, Oxford-Carpenter and Schultz-Shiner (1984) report that although ISD had been widely acclaimed and accepted as the best approach to training development on both philosophical and operational grounds, it lost support from some high level military leaders in 1984 primarily because of the perceived failures of self-pacing. This equating of ISD with individualization and self-pacing has been a problem in the history of ISD implementation which Vineberg and Joyner (1980) suggest was due to its emergence at about the same time as the national trend toward these technologies.

Despite these problems in the military context, the implementation of ISD in civilian contexts has been somewhat more successful. Some of this success may be attributed to the fact that large-scale instructional development efforts undertaken by university and industry personnel are accomplished by experienced and well-prepared teams who usually adhere closely to model procedures (McCombs, 1985). In addition, many of the models commonly used in civilian efforts, such as the Dick and Carey (1978, 1985) or Briggs and Wager (1981) models have well-specified theoretical underpinnings. Reid (1984) points out, however, that although the general task flow of ISD models has remained stable for the past 10 to 15 years, the specific approaches and methodologies applied within each step are still evolving. From a theoretical standpoint, this type of evolution is understandable and even desirable. For example, behaviorism is often credited with providing the principles of behavioral science and technology that formed the early (and continuing) base for instructional design models (Burton, 1981). As dominant theories of learning have evolved away from a focus on external behaviors to a focus on internal perceptions, cognitions, and motivations, however, more cognitively oriented approaches to steps in the ISD model have evolved. It is, in fact, an underlying premise of ISD models that their procedures be based on current theory and research to the greatest degree possible, supplemented by logic, experience, and frequent reviews (Andrews & Goodson, 1980; Briggs & Wager, 1981; Dick, 1981; Hannum & Briggs, 1982; Merrill, 1985).

The preceding brief historical overview of ISD implementation suggests that there have been some fairly major discrepancies between what are posited as systems principles and models that should guide instructional development and actual implementation practices. Particularly in military applications of ISD models, the problem has been one of failure to maintain a total systems perspective and of reducing the problem focus to the development of self-paced or individualized materials. The following section discusses in more detail related ISD implementation problems and identifies those factors that have been consistently related to the successful implementation of ISD.

FACTORS CRITICAL TO THE SUCCESSFUL IMPLEMENTATION OF ISD

Overview of ISD Implementation Problems

Although O'Neil, Faust, and O'Neal (1979) have noted that there is a growing trend in military, industrial, and academic settings toward the rigorous application of theory and research-based systems models to the development of instructional programs, existing ISD models tend to provide only general design considerations at the expense of specific prescriptive and detailed ISD procedures. They further argue that this lack of prescriptive and detailed procedures is directly related to inconsistencies in the implementation of the ISD process and difficulties in implementing an effective quality control system. These problems, in turn, are said to contribute to reduced accountability of the instructional development team. Similarly, Montague, Ellis, and Wulfeck (1983) have argued that ISD is long on "what to do" but short on "how to do it." This lack of detailed prescriptive procedures is in large part a function of the evolving nature of underlying theories of instructional design that provide specific constructs to guide each step of the ISD process. As Andrews and Goodson (1980) have pointed out, the nature of the systematic process is such that it logically makes use of relevant learning theories in the direct design of instruction, after the specification of outcomes and before final evaluations.

Related to the problem of a lack of specificity and detailed theoretical prescriptions in many ISD models is the problem of inadequacies in the knowledge base of those applying the model with respect to both the ISD process and relevant theories (Andrews & Goodson, 1980; Braden, 1984; Davies, 1983; Dick, 1981; Martin, 1984; McCombs, 1985; Merrill, 1985; Montague et al., 1983: Reid, 1984; Reigeluth et al, 1981; Sachs, 1981). That is, those who identify this problem generally address knowledge base deficiencies related to the *depth* of understanding of (a) the principles of the systems approach and their application and (b) the range of learning and instructional principles and how they can be applied to individual steps in the ISD process as well as to the process as a whole. In addition, the concern is expressed that this depth of knowledge be accompanied by a depth of experience with the implementation of ISD models, such that the expertise necessary for the successful and effective implementation of ISD principles is available individually and collectively in ISD team members for use in the solution of instructional development problems. It is this type of expertise that has led some educators to conclude that the successful implementation of ISD is an art or craft—not a science—that is dependent on the developer's judgment, sensitivity, creativeness, and inventiveness (e.g., Medsker, 1981; Montague, Wulfeck & Ellis, 1983; Noel & Hewlett, 1981; Sachs, 1981).

The problem of the level of expertise needed to apply the ISD process effectively is particularly apparent in the analysis phase. Dick (1981) has argued that the complexities of executing various types of "front end analysis" such as job analysis, task analysis, learner analysis, and hierarchical analysis make this the most difficult phase of ISD both to teach and to learn. There is growing recognition that, first, the analysis of instructional requirements must include an understanding of the role of the learner and the teacher in the overall learning process (e.g., Glaser, 1982; McCombs, 1984, 1985; Wang & Lindvall, 1984). Second, the analysis process must include an understanding of how knowledge is organized in students' minds and the role of knowledge in different stages of learning (e.g., Anderson, 1978; Glaser, 1984; Lindvall, Tamburino & Robinson, 1982; Wang & Lindvall, 1984). Third, analysis procedures must include a total systems perspective, wherein not only learning tasks and learner characteristics are analyzed, but where learning environments and social contexts are analyzed as well (e.g., McCombs et al., 1984; Paris, Newman & Jacobs, in press; Resnick, 1983; Webb, 1982).

In addition to an expert knowledge base regarding the preceding factors, those who apply the ISD model to training and training system design must also be cognizant of new approaches to task analysis which take into account cognitive and developmental requirements of the task (e.g., Bond, Eastman, Gitomer, Glaser & Lesgold, 1983; Glaser, 1982; Greeno, 1976; Landa, 1983; Resnick, 1976, 1983; Sandieson, 1984; Scandura, 1983; Vineberg & Joyner, 1983). Drawing upon these expert knowledge bases, ISD users then must be able to apply high level skills for integrating new analysis methodologies with principles of instructional design such as those specified by Merrill (1983) and Reigeluth (1983b). Reigeluth (1983a) makes the further point that different analysis procedures are needed to provide different kinds of information important to effective instructional design (e.g., information for selecting content to be taught, for deciding how to sequence that content, for deciding how to synthesize the content, and for deciding how to prescribe teaching strategies). That is, those using the ISD process need to understand these alternative methodologies and possess the decision-making skills needed to evaluate the conditions under which they are appropriate. It is clear, then, that the effective implementation of ISD is highly dependent on the use of highly trained, skilled, and knowledgeable personnel.

Perhaps because of that requirement, and others such as time, cost, and resource needs, researchers have noted that the principles and procedures most often compromised in ISD implementations are those associated with the analysis phase of the model (e.g., Malcolm, 1982; McCombs, 1985; Oxford-Carpenter & Schultz-Shiner, 1984; Pharris, 1984; Vineberg & Joyner, 1980; Wileman & Gambill, 1983). Wileman and Gambill (1983), in particular, argue that analysis is the "neglected" phase of instructional design, due both to its dependence on complex cognitive skills and competencies and to insufficiencies in existing methodologies for the tasks involved in the analysis phase of ISD. An even stronger position is taken by Pharris (1984), who argues that all phases of ISD are "neglected" in the sense of being inadequately implemented. This type of neglect is evident in reports of ISD implementations in military training, wherein ISD procedures were frequently found to be incompletely and/or inappropriately implemented in all the services (Montague et al., 1983; Oxford-Carpenter & Schultz-Shiner, 1984; Vineberg & Joyner, 1980). For example, Montague et al. (1983) reported that steps are frequently left out or ignored because of time and cost constraints, and internal reviews are used to replace formative evaluation. This sublimation of various "systems" aspects to resource constraints has been found to contribute to a narrow definition of ISD which emphasizes the application of particular training technologies such as programmed texts (Back & McCombs, 1984; McCombs et al., 1984; Vineberg & Joyner, 1980).

A final problem that has been reported concerning ISD model implementations is closely related to the preceding problems: overproceduralization of complex ISD steps and processes to the point that they are trivialized. Shettle (1983) contends that when tasks requiring higher order thinking and problem-solving skills (e.g., task analysis) are overproceduralized, the process becomes distorted and misrepresented and the results are of little use. Within the military, in particular, the ISD process has been supported by proceduralized guidebooks or "cookbooks" that undermine the quality of products developed (Montague et al., 1983). Earle (1985) warns that an inherent danger in implementations of an ISD process is the potential development of a narrow, mechanistic perspective that impedes the use and development of higher order generic reasoning skills in ISD users. Similarly, Andrews and Goodson (1980, p. 13) have stated that many ISD models ". . . represent a series of mechanical or linear steps rather than the complex and rigorous analytical and cybernetic process required for effective application of the general systems approach to instructional design." As Davies (1983) has pointed out, ISD is more than a step-by-step set of procedures for solving problems. Rather, it is a process that requires a systematic or larger and more demanding systems view of training and training materials development.

In summary, this overview of problems in the implementation of ISD has highlighted four primary problem areas: lack of detailed and theoretically based prescriptive ISD procedures, inadequacies in the knowledge and experience bases of those who apply the ISD model, incomplete and inadequate applications of ISD steps and procedures, and overproceduralization of complex ISD steps and processes. Now that this "dirty laundry" of ISD problems has been aired, it is time to turn our attention to those factors in the literature that have been empirically identified as critical to the successful implementation of ISD.

Empirically Identified Factors in the Successful Implementation of ISD

In a study of factors critical to the success or failure of self-pacing in Air Force technical training, we recently found that successful self-paced courses were those that had more effectively and fully implemented the ISD process (Back & McCombs, 1984; McCombs et al., 1984). This full implementation was more likely to occur where self-paced courses had strong management support, a good balance of mediated and printed materials as well as individual and group activities, high instructor dedication and motivation, and adequate instructional resources (McCombs et al., 1984). To the extent that these factors critical to the success of self-pacing are an adequate reflection of an effective ISD process, many of these factors should be mirrored in studies that directly examine those factors contributing to successful ISD implementations.

One such study was reported by Branson (1979). He described the results of military (Army and Navy) case studies which addressed implementation issues in ISD and derived implications regarding factors related to successful implementation. These factors included the availability of the necessary financial, human, and physical resources, dedication at high organizational levels, a sound and realistic management plan, proper training in the use of ISD principles, and maintenance of the team effort. Thus, many of the same factors identified by the McCombs et al. (1984) study of self-pacing were also identified in the Branson (1979) study. In addition, Branson (1983; Branson, Raynor, Cox & Furman, 1976; Branson, Raynor & Furman, 1976) has also contended that different categories of ISD users require different types and levels of ISD training. In his work for the Interservice Committee for Instructional System Development, separate ISD workshops were designed for ISD technicians (the "doers"), managers of ISD technicians, and senior managers based on analyses of differing job tasks and skill requirements for ISD application by these personnel categories.

Oxford-Carpenter and Schultz-Shiner (1984) evaluated actual Army job training development procedures as compared to procedures specified in the ISD model. Although their findings generally indicated that certain parts of the ISD model were implemented in a less than ideal way, a number of implications were derived relevant to factors for the successful implementation of ISD. These included (a) that the ISD model be followed closely and consistently and not allowed to vary from implementation to implementation, (b) that adequate training at all levels be provided to ISD developers and product users, and (c) that procedures used in the implementation of the model be carefully documented to aid communication and accountability.

In the civilian sector, Stiehl and Streit (1984) report on the implementation of an ISD model at the University of Idaho for the design of independent learning activities. The factors they identify as a result of their analysis of the model over a 13-year implementation period include the following: ensuring that the model is fully explained and understood by all users, carefully specifying necessary resources and finding means to make these resources available, continually tuning the model to changing needs, continuous and effective management of the ISD process, providing adequate training to ultimate users of the model's products (e.g., students, instructors), and providing sufficient levels of staffing during implementation and evaluation phases.

Briggs (1982) addressed factors from his experience that contribute to the strength or success of ISD implementations. Among these is primary attention to the analysis, need assessment, or planning phase of the process in order to adequately define needs, goals, and objectives which provide the basis for subsequent decisions in the process. Other factors he discusses include the incorporation of a theory and research base, flexibility in the implementation of techniques and formats, the use of highly knowledgeable and experienced developers, adequate incorporation of group activities in training materials and systems, careful and systematic analyses of appropriate media, continual integration of evolving theories and methodologies into model procedures, and an emphasis on evaluation and evolving models of evaluation. With respect to this latter concern, Borich (1979) also emphasizes the role of evaluation in ISD applications and argues for a systems approach to the evaluation component such that evaluation concerns are addressed and met throughout the ISD process.

Of those military and civilian studies that have examined factors critical to the successful implementation of ISD, then, a number of commonalities can be noted. First, it has been recognized that the successful implementation of ISD requires different amounts and kinds of training, depending on one's specific responsibilities with the ISD process. It has also been recognized that the effectiveness of the process generally, and the analysis phase in particular, is dependent on higher-order thinking and problem-solving skills. Related to this is the requirement that implementers of the process have the expert knowledge bases, skills, and experiences needed to apply the process effectively, including a thorough understanding of the "systems" philosophy, relevant learning and instructional theories, and staff and resource requirements for the complete execution of each step of the ISD process. Additional critical factors include high level and strong management support, consistent applications of standardized procedures while maintaining flexibility in decision making, careful documentation of implementation procedures, continual tuning of the model to changing needs, continual integration of evolving theories and methods, and incorporation of a systems view of evaluation.

In analyzing these factors for successful ISD implementations and integrating this information with the information reviewed on problems with ISD implementation, it is clear that the provision of a carefully designed and differentiated ISD training program for various classes of ISD users that focuses on higher order knowledge and skills would go a long way towards accommodating the factors for success. One of our biggest responsibilities as researchers in this area is to bring our own expertise to bear on the problem of designing such a course that can produce the categories of experts required. The following section derives implications for the design of an ISD users training program, beginning with a review and preliminary analysis of the types of skills and knowledge required.

IMPLICATIONS FOR THE DESIGN OF AN ISD USERS TRAINING PROGRAM

Types of Skills Required of ISD Users

Ideally, we should define the underlying higher order analytical and problem-solving skills needed to apply the ISD process, using the latest analysis methodologies. Current theories of learning and instructional design should then be used to define the training program such that it can become the experiential model that trainees can apply in their own subsequent ISD efforts. It is not just the knowledge of the ISD steps and procedures that need to be taught, but also the underlying knowledge base in learning and instructional design and analysis and basic problem-solving skills involved in planning, decision making, and evaluation of alternatives relevant to each step. Other critical skill components of a successful ISD training program include a focus on strategies and methods for enhancing user motivation and commitment to the continuing use of ISD principles in their jobs and a focus on a well-designed user orientation and role training program. In my own work with theoretical role training for instructors in computer-based environments, there is support for the position that providing role-relevant training in itself enhances user motivation (McCombs & Dobrovolny, 1980; McCombs, Dobrovolny & Lockhart, 1983; McCombs & Lockhart, 1984).

In analyzing the general skill and knowledge requirements, several generic reasoning skills emerge that are applicable to all categories of ISD users. Earle (1985), for example, argues that various basic or generic skills of problem solving are essential to effective decision making within each step of the ISD process. These generic skills are especially important for analyzing the learning task, assessing learner needs, selecting and implementing appropriate instructional methods and media, and evaluating learner performance (Earle, 1985). Generic problem-solving and decision-making skills are also critical in what Wileman and Gambill (1983) describe as the ISD processes of exploring, selecting, and synthesizing information in order to select optimum instructional alternatives. In addition, supporting evidence for the importance of reasoning and information-processing skills in the application of problem-solving concepts can be found in areas such as the study of the differences in novices and experts. This literature indicates that it is not only content knowledge that differentiates beginners from experts, but it is also the problem conceptualization and information-processing strategies used by experts that subsequently lead to superior performance (Atwood & Jeffries, 1980; Chi, Glaser, & Rees, 1981; Glaser, 1983; Hayes-Roth, 1980).

A significant aspect of skill requirements is what Martin (1984) has called "internalizing" instructional design. By this she means that the ISD process and its principles become part of the designer's way of thinking and behaving. In essence, this internalization process is one in which designers—through acquisition of the necessary knowledge bases and the accumulation of practical ISD application experiences—achieve a level of automaticity that contributes to expert applications of the process. Furthermore, internalization implies that some level of commitment to the value of the process exists, such that the internalization occurs at both habitual and conscious commitment levels. Martin's (1984, p. 16) description of this internalized understanding is ". . . the ability and desire to incorporate the philosophy of instructional design and a systems perspective into the fiber of an instructional situation." Additional attributes Martin identifies include a goal orientation, sufficient preparation, and commitment to ongoing and continuous evaluation activities. It is this type of cognitive base that she contends forms ". . . the backbone for an enlightened and intuitive use of the process" (Martin, 1984, p. 18). The process is no longer an inhibiting, step-by-step process; the designer becomes free from a set pattern and is able to realize the full potential of the technology.

This conceptualization of the underlying skill and knowledge requirements in ISD implementation is shared at least in part by others. Medsker (1981), for example, stresses that an ISD experience base allows for and even requires creativity at appropriate places in the implementation process. This mix of intuitive judgment and practical experience is what Medsker claims allows for creative decisions regarding specific approaches to instructional strategy design. Reid (1984) also acknowledges the importance of expertise (ability and experience) in ISD and its procedures as well as considerable interdisciplinary effort. In addition, Sachs (1981) emphasizes the importance of judgment and interpretation as skill components in design decisions and the application of ISD techniques.

It can also be argued that various metacognitive processes such as planning, goal setting, self-questioning, and self-evaluation constitute skill requirements critical to effective ISD applications. Wileman and Gambill (1983) have even suggested the use of self-questioning techniques as a method for stimulating the types of higher order reasoning and thinking skills needed in the problem identification and analysis phases of ISD. They further suggest that designers can be taught to use questioning techniques from the perspective of what the learner needs and should experience. In my own work with theoretically based instructor role training, we have used similar techniques to teach a variety of metacognitive and cognitive strategies and skills that are part of the problem-solving and decision-making necessary for effective instructional planning, analysis, and evaluation (McCombs, 1985; McCombs & Lockhart, 1984). These are considered to be generic skill components that, when appropriately integrated into a meaningful functional context (e.g., the development of effective instruction), can provide users of ISD principles with a high level understanding of and commitment to the significance of various activities.

In general, then, the types of skills required for effective ISD applications include not only those specific skills involved in such activities as defining objectives or writing criterion measures, but more importantly include those higher order reasoning and problem-solving skills that allow for creative and flexible applications of our expanding knowledge base in learning and instructional theory and methods. Ideas for how one might go about the design of an ISD users training program that incorporates these higher order processes and skills are addressed next.

Design Considerations for an ISD Users Training Program

Some guidelines for the design of such a training program can be derived from the literature. With respect to the knowledge base for this training, Noel and Hewlett (1981) have argued for the inclusion of both heuristics and scientific principles. The heuristics have the purpose of informing users about *how* something works, while scientific principles have the purpose of informing users about *why* it works that way. Within this framework, heuristics can be used to provide the experience base derived from practice with the model, in the form of general practical guidelines. For example, some practical heuristic guidelines which Noel and Hewlett (1981) suggest include: once an ISD model has been selected for use, spend time initially adapting the model to the particular application; begin at the outset of the project to develop a good dissemination strategy that ensures initial and continued use of the product to be developed; develop well-formulated plans for initiating and maintaining continued involvement of all potential users of products to be developed; when planning how long each ISD activity will take, expect inevitable delays and extend the time periods; and build sufficient flexibility into all plans such that options are kept open. In an ISD users training program, heuristics such as these could become the meaningful, experience-based context in which our evolving scientific knowledge base could be organized and integrated with training on the generic problem-solving skills applicable to each step of the process.

In terms of other content areas currently not well-addressed in ISD training, Dick (1981) suggests that increased attention be given to the role and functions of instructors and teachers as these impact instructional materials and systems design, implementation, and evaluation. This concern with more attention to human functions in instructional systems, particularly advanced computer-based systems, has been a concern of my own work (McCombs, in press) and is a content area that should be addressed within discussions of the total systems perspective and analyses of the instructional environment. At the same time, ISD trainees could also be introduced to higher-order theoretical concepts regarding group processes as well as teacher roles that need to be attended to in the design of effective instruction. Broader perspectives would be encouraged by such considerations, thereby reducing the tendency for those trained in ISD principles to restrict their applications to narrow or mechanistic solutions to instructional problems.

There is a growing number of prescriptive scientific principles that are also important content areas in an ISD training program. Although these have certainly been incorporated into a number of models and the training programs for these models, their introduction and treatment has not typically emphasized the selective and judgmental processes underlying their use in particular instructional design contexts. This is an area in which ISD trainees need to be taught the importance of relying on their own analytical and problem-solving skills in the selection of particular theoretical or scientific principles, rather than being given the impression that these principles should be blindly applied in every situation. This is not to say that there are no "tried and true" principles. The problem is more one of adapting and extending these principles to fit particular instructional problems or learner needs. For example, Reigeluth et al. (1981) offers a number of such proven scientific principles, including "to facilitate acquisition of an idea at the application level of cognitive processing, provide examples and practice in addition to a statement of the idea" (p. 20). He recognizes, however, that although these types of principle are helpful, bases for prescribing them across different kinds of conditions need to be taught. Thus, ISD trainees would be provided with a higher level set of considerations or decision rules that they could use in the selection of particular principles.

Earlier it was argued that an ideal ISD users training program should be designed to address different categories of ISD users. In large training organizations such as the military, levels of users have been differentiated in terms of organizational management of the ISD implementation process, and different training programs have been designed for senior managers, first-line supervisors, and technical staff (e.g., Branson, 1979). Managers are generally familiarized with the model and its procedures, supervisors are trained in how to schedule, inspect, critique, and approve products developed, and the technical staff is trained in the specific ISD procedures and principles to be used in the development of training materials. For large-scale ISD implementations within complex organizations, this is a reasonable and reportedly effective approach (Branson, 1979).

In addition to the guidelines discussed above, however, I would add that further differentiation of training is desirable within the technical user group. This is, since these technical groups are usually composed of instructional design experts, subject matter experts, and technical writers, a different depth and breadth of training in both higher order problem-solving principles and specific development procedures is desirable. I believe this to be true because in practice different responsibilities are given to different members of the technical team. For example, the more experienced and educated instructional design and/or subject matter experts are usually given the responsibility for early analysis and definition phases, whereas the technical writer staff is usually given the responsibility for actual materials development. For this reason, although general familiarity and training in general systems and other theoretical principles, higher order problem-solving skills, and evaluation philosophies and methods are desirable for all categories of ISD users, more depth and breadth of coverage of specific development procedures are needed by those responsible for the actual development of materials. In addition, it is desirable to teach development team members concepts about working together as a team and how this team process is most effectively accomplished.

The foregoing guidelines and suggestions are by no means complete. They are intended to stimulate further thinking within our research community about what should be included in an ideal ISD users training program. More work needs to be done, some of which is given in the form of research recommendations in the concluding section.

CONCLUSION

This review has focused on problems that have been identified in the implementation of ISD methodologies and on those factors that are critical to its successful implementation. On the basis of this review, it can be concluded that successful implementations are those in which the needed expertise and commitment were present to effectively and consistently perform each step of the process. Less successful implementations are not due to a fault inherent in the ISD methodology, but rather are centered on the issue of whether users have adequate understanding and training in higher-order problem-solving principles and skills such that the necessary expertise can be applied in the process. It has been argued that not only do implementors of ISD need to understand the specifics of the process, but they also need to know how to apply teachable higher order cognitive skills to the instructional design process.

Some preliminary guidelines to be considered in the design of an ISD users training program have been presented. Potentially fruitful research and development that can help make such a training program a reality include the following. First, there is the need to conduct research on refinements necessary to analytical processes that support the ISD process—in terms of more carefully delineating both the range of analyses needed and the underlying user skills and processes required in each type of analysis activity. Related to this is further research on the differentiation of these skills for various categories of ISD users.

Second, there is a need for continued research on automated aids that can assist ISD developers with complex ISD tasks. It is encouraging to note that progress is currently being made in the design and development of automated aids, particularly the design of aids for task analysis. Our own work in this area at the Denver Research Institute is part of the solution to providing ISD expertise through artificial intelligence applications (Richardson, Kemner-Richardson, Keller, Anselme, & Moul, 1984). This, combined with well-defined ISD training programs that help users develop the necessary higher order knowledges and skills to apply the process effectively, promises to greatly contribute to effective ISD implementations.

Finally, there is need for research on implementation strategies for effective ISD application in different contexts. It is clear that ISD models need to be modified and adapted to different instructional problems and needs. Research on adaptation considerations and the delineation of decision rules and parameters guiding the adaptation process could greatly assist more effective implementations.

Our continued dedication to research in the above areas and to the development of an ISD users training program that is sensitive to the issues raised in this review will assist us in furthering instructional design theory for the ISD model in general and for each step in particular. This progress, in turn, will get us closer to our goal of optimal instruction and instructional systems. It is by viewing ISD as a problem-solving process that we can begin to understand and apply our growing knowledge of the underlying cognitive, metacognitive, and affective processes and their supporting knowledge bases to the design of a truly effective ISD users training program that produces the expertise necessary for the effective implementation of this process.

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