Origins and Evolution of Instructional Systems Design

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CHAPTER THREE

Origins and Evolution of Instructional Systems Design

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INTRODUCTION

This historical survey strives to synthesize existing accounts about the origins and evolution of instructional design—such as Dick's (1987), Saettler's (1990), Reiser's (1987, 2001, 2007), Schrock's (1991), and Molenda's (1997), to add several first-person reports (for example: Briggs, 1980; Diamond, 1980; Hannum, 2005; Popham, 1980; Schuller, 1986), and to place all the accounts into a larger and more coherent framework.

The History of What?

This chapter surveys the history of the concept of instructional design as it is known in the educational technology field. Obviously, there are as many ways of preparing instruction as there are teachers and trainers. Often the approach is more intuitive than deliberate. If deliberate, the approach may follow any of a number of different paradigms. For example, in the early days of audiovisual education most media producers followed a planning process borrowed from commercial film-making—the treatment and script. Nowadays, creators of instructional products may look to design traditions such as those in architecture, graphics, fine arts, software engineering, and product design. Within educational technology, however, the dominant paradigm is the *systems approach* to the design of instruction, the essence of which is ''to subdivide the instructional planning process into steps, to arrange those steps in logical order, then to use the output of each step as the input of the next'' (Molenda & Boling, 2008, p. 104). Those steps are typically given as analysis, design, development, implementation, and evaluation.

To be sure, within the field of educational technology many other approaches have been proposed. Dills and Romiszowski (1997) describe approaches such as cybernetic, behavioral analysis, situated cognition, semiotic, direct instruction, constructivist, existentialist, structural communications, rapid collaborative prototyping, simulations, and intelligent tutoring, among others. Some of these are genuinely divergent ways of thinking about the creation of learning environments, but many are not intended as guides to the whole process of planning instruction, dealing, rather, with strategies and tactics within the ''design'' step of the systems approach model.

All of these approaches have different histories, so it would be impossible to encompass all of them in one grand narrative. Consequently, this chapter focuses on the story of the systems approach version of instructional design, usually referred to as *instructional systems design* or *instructional systems development*. To avoid a hair-splitting argument about which of these two terms is more legitimate (since ''design'' and ''development'' both have persuasive claims to being the broader term), I will use the acronym ''ISD'' to refer to the broad concept of instructional systems design/development. A definition by Leslie Briggs of Florida State University (1977) just as the concept was taking hold proposes several key elements:

A systematic approach to the planning and development. . . .

- All components of the system . . . are considered in relation to each other;
- The resulting delivery system is tried out and improved before widespread use (p. xxi).

As this definition indicates, the term *systems* is meant to connote an approach that is both systematic and systemic.

THE HISTORICAL PRE-CONDITIONS FOR ISD

The Post-War Environment for Education

With the end of World War II in 1945 came the end of rationing restrictions and the return of the millions of men and women from the military services. Among them were many who had experienced first-hand the gargantuan job of ''rapid mass training'' that had been accomplished through the use of motion pictures and other audiovisual media. The pool of highly skilled audiovisual developers and users who returned to civilian life provided a jolt of energy that accelerated the pace of change in education. With their experience of using media to multiply the effect of good teaching, these trainers and educators were open to ideas for increasing the efficiency of instruction as well improving its quality.

By the early 1950s the products of the Baby Boom were entering elementary school, triggering a corresponding school construction boom. With new, modern schools came new, modern technology: classrooms outfitted with electrical outlets at the front and back, permanently mounted projection screens, and shades or blinds for room darkening to accommodate the burgeoning audiovisual media. The expense of constructing and equipping new school buildings was challenging school districts across the United States, but there was another even more daunting challenge facing them—providing the teachers for all these new classrooms. Reports from agencies such as the Fund for the Advancement of Education (1955) were projecting a serious teacher shortage in the coming decade. Educators were fearful there would simply not be enough teachers to go around, at least not enough fully qualified teachers.

Some forward-looking leaders in the audiovisual education field were thinking about the possibilities of using technology to automate some aspects of the educational process, to leverage the human resources that were available. The most visible of these leaders was James D. Finn, a professor at the University of Southern California (USC), who would become president of the Department of Audio-Visual Instruction (DAVI), the predecessor of AECT, in 1960. In a series of articles published between 1957 and 1960 (Finn, 1957a, 1957b, 1960), he proposed the application of the methods of the ''second industrial revolution'' to formal education under the rubric of ''automatizing the classroom.'' However, the political will to undertake such a sweeping change was slow to appear. That would change very shortly.

Sputnik and a Crisis in Education

The U.S. public was shocked to attention on October 4, 1957, when the Soviet Union successfully launched Sputnik I, the world's first artificial satellite. Both the U.S. and USSR had been working on earth-orbiting satellites, but everyone was caught off-guard by the USSR's launching first. The stunning Soviet technological achievements prompted an urgent examination of the U.S. scientific establishment, including educational preparation in areas of science and technology. The U.S. Congress did not take long to come to a consensus that American schools and colleges were not producing the quantity and quality of scientific and technical specialists necessary to keep pace with the Soviet Union.

This perceived crisis propelled Congress to pass a number of emergency measures in 1958, including the National Defense Education Act (NDEA). Until this time, the federal government had not played a substantive role in public education, leaving it to the individual states. But the urgency of the crisis overrode old trepidations, and federal funds, hundreds of millions of dollars, began to be invested in the teaching of science, technology, foreign languages, and other fields related to the Cold War struggle.

NDEA in Action

The new education legislation supported numerous types of activities under different titles of the NDEA. Those with greatest impact on instructional technology were Titles III, IV, VI, and VII.

Title III. This section authorized grants ($70 million per year) for purchase of equipment to strengthen science, math, and foreign language instruction. A sizable portion of these funds was used by schools to purchase AV equipment and materials.

Title IV. This program funded hundreds of fellowships per year to support three years of graduate study for individuals intending to become college teachers. Many of the future leaders in instructional design and technology were educated at NDEA fellowship programs at Syracuse, Michigan State, and USC. Title VI supported research on methods and materials for language teaching and area studies centers at universities. It also provided stipends to teachers to attend summer institutes on methods and materials for teaching. These summer institutes introduced thousands of teachers to the new educational media, many of whom became technology advocates back home.

Title VII. The first part of Title VII promoted ''research and experimentation in more effective utilization of television, radio, motion pictures, and related media for educational purposes.'' As Saettler reports (1990, p. 413), this part of the act was an afterthought, instigated by lobbyists for the audiovisual trade association, National Audio-Visual Association (NAVA). Nevertheless, it provided, in the first year alone, $1.6 million for forty-five research projects at universities across the United States. A comprehensive evaluation of the impact of Title VII activities by Filep and Schramm (cited in Saettler, p. 414) concluded that this program was successful in bringing new researchers into the educational media field, upgrading the quality of research, and encouraging the growth of academic programs in educational media. It also promoted individualized instruction and teacher acceptance of media.

Overall, NDEA programs helped create the infrastructure—the people, hardware, and ideas—necessary to support the dawning idea of a systems approach to the design and implementation of instruction.

CONCEPTUAL UNDERPINNINGS OF ISD: BEHAVIORIST LEARNING THEORY

Teaching Machines and Programmed Instruction

In the midst of growth and change in American education, some radically new concepts were coming to the fore. Behavioral psychologist B.F. Skinner had presented his first teaching machine, based on operant conditioning principles, in 1954 (Skinner, 1954) and major school demonstration projects were underway between 1957 and 1962 (Saettler, 1990, pp. 297–302). Shortly after, Norman Crowder introduced a variant format for teaching machines that was not based on any particular theory of learning, but on a practical concern for efficiency. It featured a more flexible program structure that allowed learners to skip ahead through material that was easy for them or to branch off to remedial frames if they encountered difficulty (Crowder, 1962). His method was quickly dubbed *branching programming* because a schematic outline of the program resembled a tree trunk with multiple branches. Initially, Crowder's programs were used in the AutoTutor teaching machine, but Crowder soon joined the rush to convert programs to book form, and his TutorText series became one of the best-known series of programmed materials.

From PI to Technology of Teaching

As research and field experience accumulated, it became clearer that the ''magic'' of PI was not in the hardware, and possibly not even in the software—the step-by-step breakdown of information followed by questions, responses, and confirmation or correction of the response. Rather, the success of PI could be attributed more to the planning process by which the software was developed. Referring to this process as a ''technology of teaching'' was first proposed by B.F. Skinner (1965) and elaborated in his later book (1968) to describe his view of programmed instruction as an application of the science of learning to the everyday tasks of teaching. This view coincided with the notion promoted earlier by Finn that instructional technology could be viewed as a *way of thinking* about instruction, not just a conglomeration of devices, echoing the recently popularized notion of economist John Kenneth Galbraith's (1967) that technology should be seen as ''the systematic application of scientific or other organized knowledge to practical tasks'' (p. 12).

From Technology of Teaching to Design Methodology

The procedures for creating PI materials followed the prescriptions for operant conditioning experiments: analyzing the task to be learned in order to break it down into a series of small steps, specifying the behavioral indicator of mastery of each step (performance objective), sequencing the behavioral responses in hierarchical order, creating prompts for the desired responses, observing the learner response, and administering appropriate consequences for each response.

Since reinforcement theory called for practicing mostly correct responses, each frame of the program had to be tested for efficacy. In fact, developmental testing was a mandatory specification for materials destined for the military training market. The U.S. Air Force required that ''at least 90 percent of the target population will achieve 90 percent of the objectives'' (Harris, 1964, p. 142). This was known as the 90/90 criterion and was widely accepted as the standard benchmark of effectiveness. This demanded a commitment to evaluation and revision far beyond what had been typical in the past. So the PI development process that evolved was characterized by careful specification of objectives, active responses, immediate feedback, and repeated rounds of testing and revision.

Gradually, PI developers began to realize that it was the painstaking development *process* that made PI successful:

> ''The uniqueness and strength of programmed instruction lies mainly in its production process . . . Programmed instruction is developed through a process which has empirical and analytic qualities.'' (Lange, 1967, p. 57)

The focus on the design process was championed by Susan Meyer Markle, one of Skinner's brilliant associates. She and her partner, Phil Tiemann, proclaimed that ''programming is a process'' (Markle & Tiemann, 1967). That is, it is not the PI *format* that accounts for success, but rather the developmental *process*; she particularly emphasized the importance of developmental testing of prototypes of the lesson (Markle, 1967). At about the same time Michael Scriven, a mathematician and leading theorist in evaluation, coined the term *formative evaluation* to describe procedures for testing and revising prototypes while they were still in development, rather than waiting until the final product was mass-produced and ready for rollout (Scriven, 1967).

Markle and Tiemann's procedural flow chart for PI product development consisted of analyzing learners and learning tasks, specifying performance objectives, requiring active practice and feedback, and subjecting prototypes to testing and revision; it can be seen as a precursor to the analyze, design, develop, implement, evaluate cycle proposed in later ISD models.

In addition to developmental testing or formative evaluation, one of the procedures that was central to both PI writing and ISD was the specification of precise learning objectives. During the heyday of PI, Robert Mager wrote a brief, humorous, branching programmed booklet on how to write—and how *not* to write—objectives. It was so popular that he prepared a more polished version for publication, entitled *Preparing Objectives for Programmed Instruction* (Mager, 1961). As the book's renown spread to broader audiences, including teacher education programs, the publisher reissued it with a more generic title, *Preparing Instructional Objectives* (Mager, 1962). It became a classic, selling over two million copies in the following three decades (Heinich, Molenda, & Russell, 1989, p. 45). For many educators, this would be their closest brush with ISD concepts, hence the importance of this book in promulgating ideas related to ISD. In addition, the book became the anchor of series of brief, breezy, programmed texts by Mager, known as ''The Mager Library,'' packaged as a boxed set, comprising five titles (Mager 1984a, 1984b, 1984c, 1984d, 1984). The series was widely used in corporate train-the-trainer programs and academic programs for teaching about instructional design, and it also constituted the first primer for the nascent field of performance technology.

Individualized Instruction

The dramatic breakthrough of PI was the idea that self-study materials could be structured in such a way that each learner could move through the material at his or her own pace and could even be directed to content that was highly specific to his or her needs. The individualized instruction notion was expanded to include audiovisual materials as PI projects added various types of playback devices under machine control, later under computer control.

At the same time, others were experimenting with self-instructional systems that were not based in behaviorist learning theory. A ''poor man's'' version of multimedia self-instruction was developed by a Purdue University biology instructor, Sam Postlethwait, beginning in 1961, under the label of Audio-Tutorial System. He began very modestly by making audio recordings of his botany lectures for students who missed class (Heinich, Molenda, & Russell, 1989, pp. 318–319). He later enhanced this by placing a tape recorder in each of several learning stations equipped with plants and lab apparatus needed to do experiments. Gradually Postlethwait amplified his lectures with slides, filmstrips, and 8mm film loops. Students could come to the lab at their convenience and listen to his lectures while looking at supporting visual materials, then do experiments and write up their reports. In the fully-developed Audio-Tutorial System, the lab was supplemented with periodic discussion sessions wherein students were responsible for being prepared for questioning by grad assistants. Large-group lectures were scheduled for guest speakers and film showings (Postlethwait, 1968; Postlethwait, Novak, & Murray, 1972). This formula proved so successful that Postlethwait and fellow enthusiasts formed an organization in 1970, the International Audio-Tutorial Congress, which morphed over the years through several identities before arriving at its present name, International Society for Exploring Teaching and Learning (ISETL), while continuing to attract adherents.

Federal funds lure business involvement. Interest in PI and individualized instruction mushroomed in the mid-1960s with the rapid growth of federal government investment in education in connection with President Lyndon B. Johnson's ''War on Poverty.'' The Economic Opportunity Act of 1964 created the Job Corps, which provided general and vocational education, technical training, and work experience at residential centers for young people from poverty backgrounds. Overnight there was a huge market for self-instructional materials and programs for the tens of thousands of learners in dozens of Job Corp centers, and the ''learning industry'' was launched. Companies such as GE, Westinghouse, Litton Industries, and Morton Thiokol established large units to create individualized materials and to manage learning systems. A number of future contributors to the ISD movement, including Robert Morgan, Robert Branson, and Donald Tosti, among others, gained real-world experience working in the learning industry on Job Corps projects (D. Tosti, personal e-mail communication, July 24, 2008).

The financial opportunities prompted a frenetic phase of mergers and acquisitions among hardware and software companies, for example: 3M + *Newsweek*, RCA + Random House, Sylvania + *Reader's Digest*, IBM + Science Research Associates, and General Electric + *Time* (Bern, 1967). Involvement by such big businesses investing such large sums in educational technology directly and indirectly promoted growth in the academic sector of the field. As one small example of an indirect effect, the fees paid by commercial exhibitors at the DAVI (later AECT) conventions provided a majority of the annual budget of the association; this allowed the association to publish journals and hold conferences, allowing scholars to communicate and share ideas.

Federal funding for school technology projects. The Johnson Administration funneled federal funds into formal education as well as into non-formal education programs such as the Job Corps. The Elementary and Secondary Education Act (ESEA) of 1965, among other things, established regional educational laboratories, which in turn supported innovative activities in schools. Two major systems for individualized instruction were tested in schools through such programs. Individually Prescribed Instruction (IPI) was developed by the Learning Research and Development Center (LRDC) at the University of Pittsburgh and implemented at Oakleaf Elementary School near Pittsburgh in 1964. In IPI, students worked through self-instructional units individually, took a post-test, and, if they demonstrated mastery, moved on to the next unit. IPI's independent-study materials and tests became quite widely disseminated through Research for Better Schools, another regional lab, but after about a decade, federal funds were withdrawn, ending the project (Saettler, 1990, p. 305).

In a similar project, American Institutes for Research (AIR) collaborated with the Westinghouse Learning Corporation to develop Project PLAN (Program for Learning in Accordance with Needs), focused on individualizing education and demonstrating how computers could contribute to the process, mainly by keeping track of student progress. Within a decade around one hundred schools were participating, but PLAN ground to a halt after federal funds dried up. Schools were unable or unwilling to pay the cost of participation, and the corporate vendors were unable to make a profit (Saettler, 1990, p. 306).

Professional Associations Support PI

DAVI. A number of scholars in the audiovisual instruction field were quick to recognize the connections between their concerns and the potentialities of PI. The 1959 convention program of DAVI had a single research paper devoted to this topic: ''Teaching Machines and Self-Instructional Materials: Recent

Developments and Research Issues,'' but by the late 1960s the convention offered about a dozen sessions a year on PI.

The concept of a pre-packaged set of materials to be used independently by learners, although new to many educators, fit into a conceptual niche that already existed for audiovisual professionals. By the late 1950s there had already been a number of demonstration projects in which entire courses of study had been presented successfully via film or television (Heinich, 1970, pp. 120–122). For example, the Rocky Mountain Area Project, 1958–1960, demonstrated that a high school physics course on film could be used successfully to substitute for teachers in schools lacking qualified staff (Scott, 1960). During the same period the schools in Hagerstown, Maryland, used closed-circuit television to transmit whole lessons in core subjects via television (Washington County Board of Education, 1963).

Hence, many leaders in the audiovisual profession already had a systemic vision of the classroom of the future, in which the task of presentation of information could be performed by pre-recorded material. The PI notion just went one step further, allowing each student to interact individually with the material.

A special interest group was formed, conducting sessions at the next several DAVI conventions under the name of the Teaching Machine Group. However, researchers quickly realized that the hardware of teaching machines was subordinate to the software, the written materials inside them. DAVI's embrace of these new phenomena was signaled by the publication of a collection of key documents on teaching machines and programmed learning (Lumsdaine & Glaser) in 1960, and then a later compilation of research and commentary (Glaser, 1965b).

NSPI. But DAVI was not the only, or even the primary professional association interested in PI. When Air Force experiments in 1961 demonstrated the dramatic time and cost advantages of PI, military trainers and university researchers quickly formed an informal interest group, which by 1962 became a national organization, the National Society for Programmed Instruction (NSPI). The organization grew to encompass thousands of members in the United States, Canada, and other countries; its periodical, *NSPI Journal*, later *Performance & Instruction*, during the formative years of ISD chronicled the advance of new ideas and newly developed procedures for the improvement of instruction.

In 1973 the society's name was changed to the National Society for Performance and Instruction, reflecting the shift of focus from the PI format to the larger process of creating materials and systems that changed human performance. Decades later, as the interests of members grew and evolved to include all sorts of technological interventions for improved human performance, the name, too, evolved to its current form, International Society for Performance Improvement (ISPI) in 1995.

CONCEPTUAL UNDERPINNINGS OF ISD: SYSTEMS APPROACH

Systems Approach in the Military

Undoubtedly, the most important influences on the emergence of ISD originated in the military services. The titanic military struggles of World War II had ushered in an era of innovation in warfare. An analytical technique that grew out of submarine hunting was called operations research, in which computers were used to make the calculations required. After the war, this approach to man-machine operations, now referred to as *the systems approach*, was applied to the development of training materials and programs. During the post-war period each of the U.S. military services had developed its own model for training development, all of which were based on the systems approach, a ''soft science'' version of systems analysis, itself an offshoot of operations research (McCombs, 1986). Alexander Mood (1964), a pioneer in the application of statistical methods to complex problems, speaking at an early conference on the systems approach in education, explained the distinction. In his view *systems analysis* is the name of a rigorous analytical method involving the construction of a mathematical model of some phenomenon in order to experiment with some of the functions, to determine whether changes lead to desired effects. *Systems approach*, on the other hand:

> ''Is simply the idea of viewing a problem or situation in its entirety with all its ramifications, with all its interior interactions, with all its exterior connections and with full cognizance of its place in its context.'' (p. 1)

The systems approach was viewed in the military as a methodology for combining the human element with machine elements, an antidote to purely mechanistic thinking. They no longer had weapons; they had weapons *systems*.

This concept had a direct impact on training in the 1960s when the U.S. armed forces changed their bidding procedures for new weapons systems, requiring contractors to provide not only the hardware, but the training needed by the operators (Dick, 1987). Defense contractors had to become systems thinkers.

The next step was applying the systems approach to training within the military itself. The systems approach offered the armed forces a way to standardize training procedures and doctrines within very large, complex, and far-flung organizations. Further, PI and other forms of individualized instruction offered a vital lifeline to military training managers. In the late 1960s and early 1970s they were facing a ''crunch'' stemming from three factors: (1) the shift to an all-volunteer military, meaning a higher turnover of lesser skilled recruits, (2) the new military technologies coming on line, requiring ever more sophisticated training, and (3) Defense Department budgets that were not expanding enough to accommodate the needed training as currently designed and delivered

(Hannum, 2005). The military services *had* to find ways to get ''more bang for the buck'' in training. Over the next decades the U.S. armed forces would invest billions of dollars in research, development, and implementation of technology-based training solutions. Many of those dollars went to private corporations, some of the same companies offering services to federally funded school innovation projects.

The U.S. Army had been experimenting with a systems approach to training for several years. For example, Project Minerva within the Army Security Agency developed a ten-stage system design model that contained all the elements found in later ISD models (Tracey, Flynn, & Legere, 1967). By 1968 the U.S. Army had officially adopted a training doctrine called Systems Engineering of Training, CON REG 350-100-1 (Quinn, 1970). The U.S. Air Force adopted a similar doctrine in 1972. This was a ground-breaking development, but not yet the most important in terms of large-scale dissemination beyond the armed forces. That development came a bit later.

Military ISD Model at Florida State

In the early 1970s Robert Morgan and Robert Branson, who had been immersed in the systems approach in Job Corps projects, were now at Florida State University, where they participated in launching a new academic program in instructional systems. The Center for Performance Technology there was selected in 1973 by the U.S. Department of Defense to develop procedures to substantially improve Army training. This team, according to Hannum (2005), was asked by the Army to ''(1) uncover the best approaches for developing and delivery training and (2) develop a set of procedures to guide the implementation of such approaches.'' The team conducted a thorough review of documentation of training across all the armed services and made site visits to key military training installations, and they sought the advice of Robert Gagne regarding theoretical bases of training and instruction (Hannum, 2005, p. 5).

The resulting ISD procedures developed for the Army evolved into a model that was adopted by the Army, Navy, Air Force, and Marines, called the Interservice Procedures for Instructional Systems Development (IPISD). As reported later by Branson (1978), the detailed procedures clustered around five major functions—analyze, design, develop, implement, and control. The IPISD model eventually had enormous influence in military and industrial training because its use was mandated not only in all the U.S. armed services but also among defense contractors.

Systems Approach in Business and Industry

As the military services were experimenting with the systems approach and moving toward specific models of the ISD variety, similar movements were taking place in the private sector, often in businesses that were involved in the defense industry, which helps explain the parallel developments. David Curl, reporting on the emergence of the systems approach in a range of businesses (1967), proposed ''a basic plan to follow in preparing an instructional program or system'' (p. 41); it was an eight-step procedure incorporating the major elements found in later ISD models.

Large corporations were dealing with the same ''crunch'' that the armed forces were—large, complex organizations with thousands of employees engaged in using increasingly sophisticated tools, requiring efficient, effective training that could be standardized across sites. The largest corporations in the United States were among the first to report their tentative steps toward systematic design processes, most notably AT&T and its subsidiaries, as reported by Bumstead (1968), Dyer (1969), and Ford (1970). Meanwhile, Douglas Aircraft (Nicely, Nelson, & Kaufman, 1970) and Kodak (A system to create training systems, 1971) were among the companies that had progressed furthest toward developing a full-fledged ISD models as their training design lodestones. It is no coincidence that the efforts at these last mentioned companies were led, respectively, by Roger Kaufman and Joe Harless, both of whom figure prominently in the history of ISD and human performance technology.

ISD took root in the corporate world because it delivered results: it helped employees gain needed knowledge, skills, and attitudes faster, better, and cheaper than conventional approaches. For large and dispersed organizations it provided a common training doctrine—a standard vocabulary and mindset—across geography and over time.

Systems Approach and the Audiovisual Field

The concept of systems approach probably was first introduced to the leaders of the educational technology field at the Lake Okoboji leadership conference in 1956. This annual conference, to which leading members of the state audiovisual associations were invited, often featured a keynote speaker, of whom perhaps the most influential was the first—Charles F. Hoban, who spoke to the 1956 conference on the topic, ''A Systems Approach to Audio-Visual Communication.'' As it happened, the conference's ''systems approach'' theme coincided with a series of articles by Finn published around the same time (for example, Finn, 1956) on a similar theme. These influences helped create interest in the idea of the systems approach, which eventually—about two decades later—became a hallmark of the field.

The vision that drove ''the systems view'' was expressed succinctly by Phillips (1966): ''to fashion a coherent assemblage of learning resources, specifically designed *from their inception* to be used with and make possible the implementation of a new curriculum'' (p. 373). The idea was to look at the education setting as a total system and to design a coherent package of hardware, software, manpower, facilities, and an implementation plan to most efficiently and effectively pursue the stated goals of the system. The link between the audiovisual education world and the systems world was also explained cogently by Gilpin (1962).

Among the earliest and most authoritative voices to reach educators with the ISD message were Robert Gagne (1962) and Robert Glaser (1962, 1965a). They were advocating instructional improvement from the standpoint of emerging psychological principles, but also placing these principles under a ''systems'' umbrella. These highly influential works are considered *precursors* of ISD inasmuch as they did not attempt to lay out specific detailed procedures or models for ISD.

Robert Corrigan and Roger Kaufman, both of whom had worked on Air Force programmed instruction projects and both of whom were affiliated with Chapman College in southern California in the early 1960s, collaborated in the writing of a brief programmed monograph (1966) on the principles of systems engineering. Although it did not explicitly address educational issues, it made systems engineering concepts accessible to educators. Earlier, both authors had contributed influential papers to the first national conference sponsored by the National Society for Programmed Instruction (NSPI), the predecessor of ISPI, held in 1962 and reported in 1964. Corrigan's paper, ''Programmed Instruction as a Systems Approach to Education'' (1964) demonstrated that a teaching-learning situation employing PI could be viewed as an instructional system for individual learners, just as a classroom situation could be viewed as an instructional system for groups of learners. This perspective allows planners to restructure traditional educational environments, melding the most effective individual and group methods to create a more cost-beneficial hybrid, thus combining behavioral and systems engineering at the level of classroom organization.

Kaufman's paper at the same conference, ''The Systems Approach to Programming,'' (1964) proposed that the production of programmed materials, previously viewed as a steps in a psychological intervention, could be represented as a series of functions in a flow diagram, thus marrying behavioral and systems engineering at the level of lesson planning.

Exploring the Systems Approach in Higher Education

Southern California hotbed. In the early 1960s Leonard C. Silvern, a senior scientist at Northrop Norair was introducing systems engineering concepts at the University of Southern California (USC) as an adjunct instructor in the instructional technology department. There, James D. Finn presided over a program to which he had already introduced widely promulgated ideas about systematizing education (1956, 1957a, 1957b, 1960). Silvern had been working on instructional methods in the Navy since World War II, had done extensive research on fire and safety training, had become expert on the programming of teaching machines, and by the early 1960s was advocating systems engineering as an approach to designing learning environments (Silvern, 1963). In the spring of 1963, as an adjunct professor, he began offering the first course in applying the systems approach to instruction, ''Designing Instructional Systems,'' at USC. He also produced a detailed procedural model (1965) that influenced later model builders.

Robert Heinich, a graduate student in Silvern's first ID course, continued this line of exploration at USC with monographs on systems engineering of education (1965) and a dissertation that was later published (1970) by DAVI as a monograph, becoming one of the foundational works on applying systems thinking to education. Around the time Heinich completed his doctoral studies, there was a surge of interest among textbook publishers in branching into the publication of complete systems of instruction. Heinich became director of the Educational Systems Division of Doubleday and Company in 1967. During his two years there he produced a number integrated learning systems consisting of films, audiotapes, and filmstrip sets. In 1969 he left to join the Instructional Systems Technology faculty at Indiana University, later to become the long-term editor of *Audio-Visual Communication Review*, which became *Educational Communication and Technology Review* under his guidance.

Back in Southern California, at the School of Education at UCLA in 1962 Jim Popham taught the first college course on PI (Popham, 1980). With colleagues including Arthur Lumsdaine, Evan Keislar, Susan Markle, and John McNeil, Popham played a catalytic role in promoting research and development around PI (Popham, 1980).

Michigan State University: Instructional Systems Development project. During the late 1950s and early 1960s the major academic programs in educational technology were groping from their roots in audiovisual media toward theoretical grounding in communication theory and learning theory. By the middle of the 1960s systems theory was emerging as a potential place to stand to look at all the processes entailed in using learning resources in formal and non-formal education and training.

The Instructional Systems Development project, led by John Barson and headquartered at Michigan State University, was a multi-university demonstration and evaluation effort, testing a systems approach ID procedure by applying the procedure to actual course development efforts during 1966 and 1967. The other collaborating institutions were Syracuse University, University of Colorado, and San Francisco State College. The collaborating researchers carefully documented time expenditures and costs associated with a systems approach to course development, reporting their findings in a final report (Barson, 1967). The heuristic guidelines and procedural model tested in this project (Figure 3.1) were widely disseminated and played a seminal role for later ISD model builders.

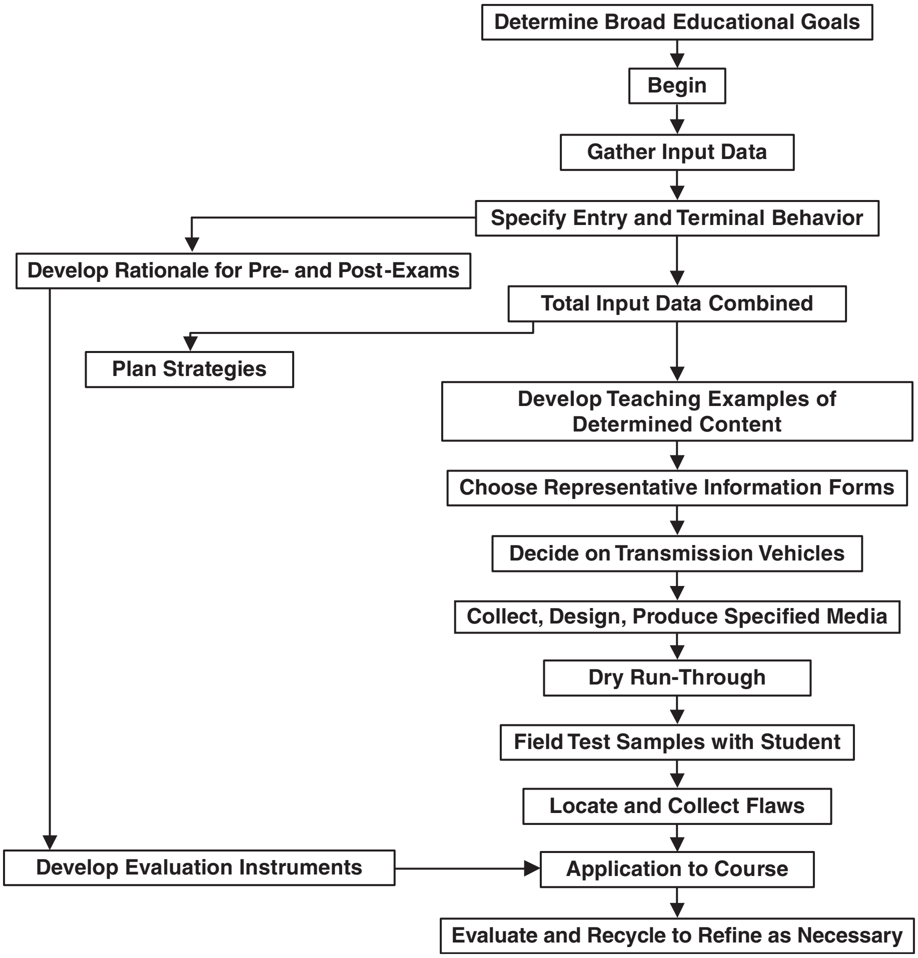

Figure 3.1 Facsimile of Barson Model.

Syracuse University. At Syracuse University, one of the Barson project's participating institutions, Donald P. Ely served as the head of both the academic program and the university audiovisual center from 1959 until the service center split off in 1971, becoming the Center for Instructional Development. This center was led for the next quarter century by Robert M. Diamond, who became a nationally visible champion for ISD and its application to the improvement of college instruction (see Diamond, 1975, 1980, 1985).

The academic program area (there were no departments in the School of Education), dubbed *instructional communications* in 1963, was one of the national flagship programs and its faculty sought to keep the program on the cutting edge. This included sponsorship of a conference in April 1964, ''To

Develop New Dimensions for Research in Educational Media Implied by the Systems Approach to Instruction.'' Led by Eugene Oxhandler, the conference proposed a new paradigm to guide inquiry about educational media (Oxhandler, 1965). Although the naturalistic research methodology envisioned in this conference did not become a standard approach in the near term, the spotlight on the systems approach added to the momentum that was gathering in the field behind the systems concept.

Indiana University. Indiana University's Audio-Visual Center was headed from 1942 to 1972 by the visionary L.C. ''Ole'' Larson, who supported explorations in applying the systems approach to college teaching. Larson was early to see the value of building an organization that cohered around a holistic theory. He bought into the systems view and forged an organization that had clearly designated functional units: research and analysis, development, production, evaluation, and implementation (note the congruence with the phases of the ISD process). It was no accident that the academic program took the name Instructional *Systems* Technology in 1969, at the recommendation of a committee chaired by Bob Heinich.

As director of research of the Audio-Visual Center, Henry Bern (1961) was among the first to advocate for the systems approach as a pedagogical methodology. A little later he was predicting a bright future for ''educational engineers'' (1967), echoing a concept proposed a quarter-century earlier by W.W. Charters (1945).

Working with faculty on course development projects in the Audio-Visual Center, Gene Faris and Richard Stowe generated an early ISD model that was tested during 1966 and 1967; this model would later be published by Faris (1968) as one of the first full-fledged ISD models.

Florida State University. As part of an effort to enhance research capabilities in the Florida State University (FSU) College of Education, Professor Russ Kropp established a center for research and development on computer-assisted instruction (CAI) and in 1966 brought in Duncan Hansen and Walter Dick as assistants. The center's contract with IBM included the training of CAI specialists, and Hansen and Dick established a series of courses to support this program. One course, designed and taught by Dick in 1967, focused on a systems approach to the development of CAI materials (W. Dick, personal e-mail communication, December 23, 2008). Dick also developed a visual-verbal model of the systematic design process, which was used at FSU in 1968 and later incorporated in modified form in the Dick and Carey textbook (1978), discussed below.

Over the next several years Robert Morgan, Robert Gagne, Leslie Briggs, Robert Branson, and Roger Kaufman joined the nascent Instructional Systems program (W. Dick, personal e-mail communication, December 23, 2008), constituting one of the most prestigious academic programs in the nascent field.

The Systems Approach at Regional R&D Laboratories

The Elementary and Secondary Education Act of 1965 established a nation-wide network of twenty regional educational research and development laboratories. The Southwest Regional Laboratory for Educational Research and Development (later Southwest Educational Development Lab) in Austin, Texas, began by carrying out a number of curricular materials development projects, led by Richard Schutz and Robert L. Baker (coming from Arizona State University). Their experiences fed into a set of handbooks on instructional product research and development, one of which, by Baker and Schutz (1971), became used as an ISD textbook. Similar work was also being done at other regional labs, which were encouraged to use systems-approach procedures to produce high-quality instructional materials for use in schools. The Far West Laboratory in San Francisco was especially active in ISD. A project directed by Bela Banathy there produced a twenty-three-volume library of paperback programmed modules for each step in the ISD process, under the title *Training Resources*, published in 1975.

Although the federal support, virtually eliminated during the Reagan Administration, was not sustained for a long enough period to significantly impact school practice, the knowledge gained in these enterprises enriched the literature of ISD and demonstrated the feasibility of ISD as a replicable process.

CONCEPTUAL UNDERPINNINGS OF ISD: COGNITIVE LEARNING THEORY

Although it can be fairly claimed that the outlines of the ISD process derive predominantly from the systems approach and from behaviorist theory, it is equally true that the *instructional strategies* drawn upon by instructional designers derive heavily from cognitive learning theory. Hannum (2005), in telling the story of the IPISD project at Florida State University in the early 1970s, emphasizes that the developers were strongly influenced by the theories of Robert Gagne, who was then at Florida State (p. 11). Gagne's work had reached the educational technology field as early as 1962 with his seminal book, *Psychological Principles in System Development*. It continued with *Conditions of Learning* (1965), in which he introduced his Events of Instruction framework. Subsequent editions of this book showed a deft eclectic touch, harmonizing the findings from behaviorist and cognitivist research into a coherent whole.

During the period of the late 1960s, Jerome Bruner was the most visible representative of the cognitive orientation. His *Toward a Theory of Instruction* (1966) directly challenged the behaviorist paradigm, arguing instead that human learning is driven by active minds that are continuously seeking to make sensible meaning out of their everyday experiences. He led the development of one of the most influential curriculum development projects of those times, a humanities course, *Man: A Course of Study*, which was used widely in school in the United States and UK in the 1970s. It incorporated the discovery method, instantiated in pre-packaged sets of materials. The movement led by Bruner had a decisive impact on curriculum development in American schools, and likewise on instructional designers who served the school market. In an early survey of instructional designers, Hoban (1974) found that 59 percent of respondents used concepts from Bruner's theories in their work, second only to the 71 percent who used Skinner's theories (p. 463).

Of course, one limitation of the cognitivist perspective is that offers solutions primarily for learning tasks in the cognitive domain—intellectual tasks. It offers little guidance to the achievement of objectives lying the interpersonal, attitudinal, or motor skill areas.

CONCEPTUAL UNDERPINNINGS OF ISD: COMPUTER PROGRAMMING

The systems approach itself evolved out of analytical methods associated with the original general-purpose computers, so it should not be surprising that logic diagrams, process flow charts, and mathematical expressions were prominently visible tools in the early days of ISD. For example, the first ISD-type model to appear in the journal *Educational Technology* (Childs, 1968), consists of an elaborate flow chart, complete with activity blocks, decision blocks, and feedback loops to guide activities referred to as *programming*.

Not only were the analytical methods of computer programming influential in early ISD thinking, but computers themselves were envisioned as a delivery system for instruction virtually from the beginning. Although computer hardware in the 1960s was limited to centralized mainframe units, some educators and some computer specialists were convinced that computer-assisted instruction (CAI) could offer a cost-effective alternative to labor-intensive face-to-face instruction. By 1968 a number of experimental CAI programs were under way: ULTRA at New York Institute of Technology, TRAC at the Oregon College of Education, PLATO at the University of Illinois, and TICCIT in Reston, Virginia. Almost invariably, the initial instructional strategies used in these programs resembled those of PI, blending two of the major conceptual threads of ISD. However, the costs involved in delivering instruction via mainframe computers proved to be prohibitive, so programs such as these languished with little impact until the era of the microcomputer changed the cost equation.

THE EMERGENCE OF ISD AS A FULL-FLEDGED CONSTRUCT

Sparks in the Stubble

Glimmers of what would become a vision of a generic, systemic, and systematic process of creating instructional materials and environments can be glimpsed in the educational technology literature throughout the 1960s. Early versions of the systems approach appeared even in the popular education literature; for example, articles by Mauch (1962) and Bern (1967) in *Phi Delta Kappan*, advocated the utility of viewing teaching-learning situations as systems, and thus amenable to deconstruction (system analysis) and restructuring (system synthesis) into new, more productive forms.

The systems approach gained visibility in the audiovisual instruction world when the third general session of the 1966 DAVI convention in San Diego was devoted to a pair of presentations by John Barson and Bob Heinich. Barson's presentation, ''The Systems Approach in Higher Education,'' summarized the work of his Instructional Systems Development project, described earlier. Heinich's, ''The Systems Approach in Elementary and Secondary Education,'' recapitulated his dissertation findings, alluded to earlier. This event was important for raising awareness in a key sector—a large organization whose membership was still primarily focused on producing and delivering audiovisual materials to teachers and professors. The following year the DAVI convention devoted a half-day and a half-dozen sessions to ''The Systematic Design of Instructional Materials,'' indicating a growing interest in this topic.

Reaching Critical Mass

By 1967 and 1968 the earlier conceptual sparks had been nourished by the fuel of federal support and big-business investment and were beginning to glow brightly enough to be noticed in educational technology and related fields. The various conceptual elements—PI as an application of behavioral psychology, system engineering, and computer programming—were converging into a new compound, under the label of *instructional development* (sometimes *instructional design*). Several authors now were ready to propose systematic procedural models that laid out specific steps of lesson-development fully and in some detail, published in a venue that reached a wide swath of educational technology scholars.

The Barson project final report (1967) contained such a model, but was not published in a widely disseminated venue until later (See Figure 3.1).

Eraut's (1967) article was ''an attempt to summarize and to advocate a methodology for course development'' (p. 92), but his box-and-arrow charts described the overall strategy without giving a succinct procedural guide.

Bela Banathy (1968) provided a book-length treatment of the application of systems thinking to education and included a flowchart for ''The Design of

Instructional Systems.'' It is very close to the mark, but the elements in the flowchart are left at a rather general level and in the terminology of systems engineering rather than that of lesson planning; it does not explicitly take into account the psychological processes entailed in a learning episode.

Five publications from 1968 appear to meet the criteria for earliest full-blown ISD model, including being widely promulgated and using the label *instructional design* or *instructional development*. John Childs (1968) provides a complex box-and-arrow flow chart, which he summarizes at the end as ''the procedural steps . . . in the process of instructional design'' (p. 14); and his twelve steps overlap well with conventional ISD models.

Gene Faris (1968) advocates for the job title of *instructional developer* and epitomizes the job by showing the course development model used at Indiana University—a box-and-arrow chart that contain the basic elements of ISD models. As it happened, this model was not developed further nor emulated to any extent, so could not be cited as particularly influential.

Haney, Lange, and Barson (1968) presented the Barson 1967 model, but now in a peer-reviewed, widely circulated research journal. It is a full-fledged ISD model and, further, the authors advocate a *heuristic* approach to its use—a perspective that was elaborated quite fully and effectively later by Romiszowski (1981).

The fourth of the five publications is a spinoff of the Barson model, developed by a team at Teaching Research in Oregon led by Dale Hamreus (Hamreus, 1968). The Oregon model is more detailed than Barson's—a box-and-arrow flow chart with twenty-two steps. It suffers a bit because of its complexity; the elements of the model were later reconfigured into a much more mnemonic arrangement in the form of the IDI model, discussed later. The Oregon model was quite widely known, although published only as a local report, then made available through the ERIC microfiche system. According to Gustafson and Branch (1997), it was used primarily ''by teams developing large-scale curriculum projects, a common activity of the period'' (p. 73).

The fifth candidate for earliest complete and widely promulgated ISD model is the article by Roger Kaufman (1968) in the same issue of *AV Communication Review* as that of Haney, Lange, and Barson. His box-and-arrow charts depict a full systemic problem-solving process, and one of the charts is a credible procedural model for lesson development (Figure 4, p. 422). But it suffers a bit by comparison because it does not adopt the *instructional design* label, instead being captioned as ''A Possible Mission Profile for Preparing Instructional Materials Using a Systems Approach.''

These ''first'' ISD models helped disseminate ideas about ISD but had little practical impact outside the academic realm. The soon-to-be-developed IDI model, discussed in the next section, eventually was taught to teams of educators at hundreds of school districts around the United States and, in the process, disseminated widely in academia. The later IPISD model, implemented throughout the Department of Defense, would have a tremendous impact on later models developed in the business sector and in academia.

Instructional Development Institute (IDI). The earlier path-setting activities at USC, Syracuse, and Michigan State provided the foundation for a consortium formed around 1970 under the leadership of James D. Finn, composed of those three institutions plus U.S. International University. (Indiana University joined in the mid-1970s; Florida State, Arizona State, and Georgia became members later, after the era of the IDI project.) This consortium, initially known as National Special Media Institute (NSMI) and later as University Consortium for Instructional Design and Technology (UCIDT), worked together to develop, test, and disseminate a packaged training program on instructional design, funded under Title XIII of NDEA. The IDI was a fully programmed five-day workshop on ISD intended for teachers at the K-12 level. Between 1971 and 1974 it was offered to 300 to 400 groups of educators in the United States and later in several other countries. In 1976 it was expanded to seven days, adding units on evaluation and diffusion strategies developed at Indiana University.

IDI workshops were usually conducted by faculty and graduate students from participating universities, who later used the IDI materials in their own college courses. Thus the IDI became an influential vehicle for disseminating the IDI model (see Figure 3.2) and other workshop materials and methods

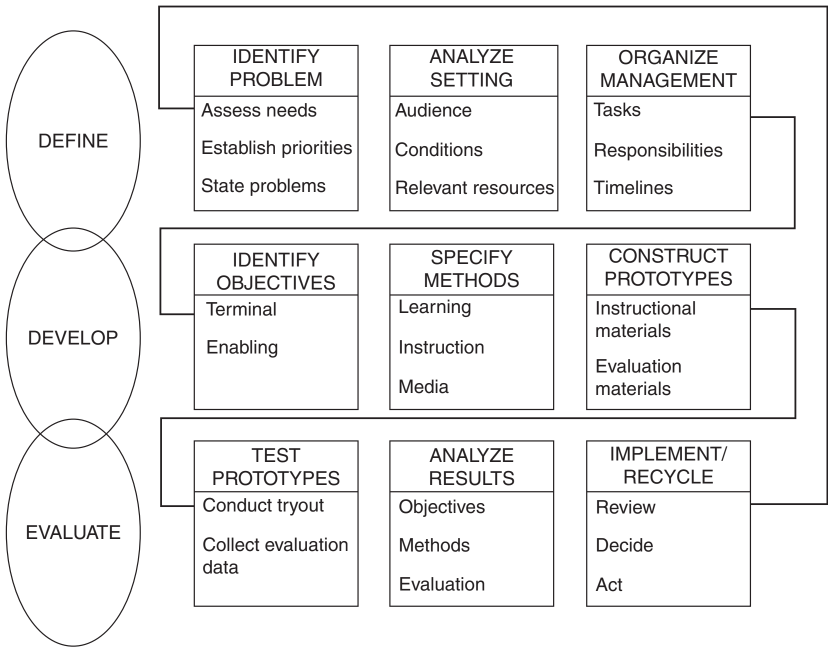

Figure 3.2 The IDI Model.

among educational technology faculty and students across the United States (Schuller, (1986).

THE INFLUENCE OF SCHOLARLY INSTITUTIONS

New theories and scientific constructs tend to be taken seriously to the extent that they are recognized by credible authorities and institutions. ISD, which emerged partly out of research and development within academia, was embraced quite quickly and fully by educational technology academics. Progressively oriented professors and staff members at leading audiovisual centers saw the potential of ISD as a new paradigm. For theorists, it offered a scientific foundation for thinking about the improvement of instruction, which was long the concern of audiovisualists and instructional psychologists. For practitioners, it provided an accessible, succinct methodology to guide the entire process of creating instructional materials or whole learning environments; it could be used as a road map for an instructional video production and also for the redesign of a whole curriculum. So there was a latent followership, ready to participate when leaders stepped forward to found institutional infrastructure for ISD.

AECT and Its Division of Instructional Development

The primary scholarly organization for what would become the educational technology field was until 1970 known as the Division of Audio-Visual Instruction (DAVI) of the National Education Association (NEA). At that time the NEA decided to restructure, requiring DAVI to reorganize as a free-standing professional association, the Association for Educational Communications and Technology (AECT).

ISD was not yet prominent enough to merit serious consideration as the name of the field, but it had a following that grew at an accelerating rate in the late 1960s. As soon as the new AECT organizational structure allowed the formation of special-interest groups, the first group to petition for ''division'' status was the Division of Instructional Development (DID), in 1971. Richard Stowe, a member of the staff of the Audio-Visual Center at Indiana University, became the first president, and two other Indiana University faculty members led a symposium at the 1971 AECT convention to explore ''a definition of instructional development'' (Davies & Schwen, 1971). In the subsequent three decades the DID continued to prosper, with a series of recognized leaders in the field serving as directors of the division.

The DID was from the beginning one of the largest divisions of AECT—*the* largest during many years. As such, it garnered a good share of the platform space at AECT conventions, sponsoring dozens of symposia, research reports, and other papers every year. This sort of institutional base is critical to attract scholars to invest time and energy in research and theory development. Without an outlet to report their efforts, interest would have surely waned.

Having a critical mass of dues-paying members also enabled the establishment of outlets for professional writing, another necessary component of academic sustainability. The most important of these outlets was the *Journal of Instructional Development*.

Journal of Instructional Development

Scholarly communication in the area of instructional design and development expanded greatly after 1977, thanks to the launching of a specialty journal, the *Journal of Instructional Development* (JID), in that year. The notion of a special-interest journal devoted to instructional design and development topics was championed by Kenneth Silber, then a professor at Governors State University, who had been deeply involved in formulating AECT's new definition of educational technology (AECT, 1977). He argued that the association's own definition of *a profession* required a high level of scholarly communication, a criterion that was not being met by the association's current lineup of journals (K. Silber, personal e-mail communication, September 17, 2008). His proposal for a new journal was accepted by AECT and by the end of 1977 volume 1, numbers 1 and 2 of JID were published, with Silber as editor and John B. Johnson, also of Governors State University, as managing editor.

The journal attracted submissions from many of the leading scholars in the nascent ISD field and provided an outlet for others who were interested in doing research in this area but had been unsure whether there would be a place to publish their findings. Its referees included leading scholars in the field, and it maintained high standards for acceptance, typically accepting only about one-quarter of the manuscripts submitted (K. Silber, personal e-mail communication, September 17, 2008).

JID continued to be published quarterly through volume 11 in 1988. Unfortunately, the period of 1986 to 1988 found AECT struggling with unsustainable deficits, leading to the hiring of a new association manager, who undertook major cost-cutting measures. In 1988 the board of directors decided to merge JID with the other leading research journal under a new name and structure. The new *Educational Technology Research and Development* (ETR&D) would have two sections, each with its own editor, with Norman Higgins of Arizona State University as the first editor of the Development section.

During its heyday JID served as an important forum for new ideas in instructional design and development, although its subscriber base did not extend much beyond the membership of the ID interest group in AECT. Nevertheless, key JID articles were widely cited in the educational technology literature, proof of its wider readership and scholarly impact.

Other Influential Associations and Journals

As discussed earlier, the National Society for Programmed Instruction had become the National Society for *Performance* and Instruction in 1973 in recognition that its members' interests now extended beyond programmed instruction to encompass a growing palette of strategies, formats, and processes to achieve results-oriented improvements in human performance. Its monthly periodical, *Performance and Instruction*, carried success stories, particularly from the corporate realm, along with new-and-improved ISD models. During this period it took the lead in exploring the ''front end'' of the design process—analytical methods to determine the source of performance deficiencies, be they susceptible to training solutions or not.

The American Society for Training and Development (ASTD) represented a larger and more general population than AECT or NSPI—corporate trainers, designers, and training managers. Its monthly journal, *Training & Development,* spoke mainly to training managers but did document the emergence and spread of the ISD approach to training design. Its annual survey of ''the state of the industry,'' along with the annual survey conducted by *Training* magazine, provide the best documentation of the adoption of new instructional media and methods over the years.

Although not published by a professional association, the monthly magazine *Educational Technology* exhibited consistent thought leadership in educational technology, not to mention admirable resiliency. Founded by Larry Lipsitz in the early 1960s to promote the study and dissemination of programmed instruction, it evolved into the most widely circulated and widely read periodical in the field of educational technology, still going strong into the 21st century. Lipsitz viewed the magazine as a platform for debate about emerging ideas regarding media and methods, especially instructional design, and it garnered more than its share of ground-breaking papers by major authors.

Codification of ISD in Textbooks

By the early 1970s the elements of a generic ISD process had jelled and were being codified in a form that could be communicated to many potential users through textbooks and handbooks. The 1970s saw the birth of a spate of textbooks that would help disseminate the ISD approach. The first in the market were Kemp (1971), Baker and Schutz (1971), and Gerlach and Ely (1971), although the latter was primarily devoted to instructional media—putting media utilization into the context of a systems approach.

These textbooks were preceded by a number of monographs and paperback workbooks that presented many of the ISD elements, but in a bit more rudimentary or less widely marketed form—for example, Leslie J. Briggs' monograph, *Handbook for the design of instruction* (1970), developed at Florida State

University in 1968–1970 for an ISD course he was teaching there; it built upon Briggs' earlier work at American Institutes for Research (Briggs, Campeau, Gagne, & May, 1967). Another precursor to the fully developed ISD textbook was the series of programmed workbooks by W. James Popham and Eva Baker: *Establishing instructional goals* (1970a), *Planning an instructional sequence* (1970b), and *Systematic instruction* (1970c).

The second round of textbooks arrived in the mid-1970s; examples include Gagne and Briggs (1974), Davis, Alexander, and Yelon (1974), Diamond (1975), Briggs (1977), and Dick and Carey (1978). In the following decades, new editions, particularly of the Dick and Carey textbook (Dick & Carey, 1985, 1990, 1996; Dick, Carey, & Carey, 2001, 2005) and Jerrold Kemp's—who was later joined by Gary Morrison and Steve Ross (Kemp, 1971, 1977, 1985; Kemp, Morrison, & Ross, 1994, 1998; Morrison, Ross & Kemp, 2001, 2003, 2007)—continued to offer updated ISD procedures to new generations of students of educational technology.

Codification of ISD Through Certification Standards

Although there is no national program of professional certification for instructional designers, since the 1970s the major professional associations have supported efforts in this direction. In 1977 AECT and NSPI formed a joint task force on certification. This task force evolved into a separate organization in 1983, the International Board of Standards for Training, Performance, and Instruction (IBSTPI), which issued a list of competency-based standards for instructional design in 1986 (*Instructional design competencies: The standards*). The competencies described in the IBSTPI standards are very closely aligned with the generic ISD models of the time. Thus the publication and dissemination of these standards, which were accepted and promoted by two major professional associations, lent legitimacy to the ISD approach.

WIDENING DISSEMINATION OF ISD

ISD Models

By the late 1970s, the standard way of expressing prescriptions about the components of the ISD process and their sequencing was through an ISD model. Authors by the dozens proposed different variations on the basic systems approach model (Andrews & Goodson, 1980). These models tended to agree on the most fundamental components and their sequencing: analysis of the problem, followed by making design decisions, leading to the development of prototype solutions, which could be implemented on a pilot basis, then be evaluated before full implementation. This common core procedure of *a*nalysis, *d*esign, *d*evelopment, *i*mplementation, and *e*valuation gradually came to be referred to colloquially as the *ADDIE* process. This term was not used as a formal title and was not the name of any specific model or other procedural guide (Molenda, 2003); it was just a shorthand nickname used mainly in oral discussion. From the late 1980s onward it became the most commonly used label to refer colloquially to the ISD family of models.

By the beginning of the 1980s there were enough ISD models on the market to justify scholarly analysis. The ERIC Clearinghouse on Information Resources commissioned a study by Professor Kent Gustafson at University of Georgia. The resulting ''information analysis document'' (Gustafson, 1981) yielded a taxonomy of four categories: classroom ID models, product development models, systems development models, and organization development models, with multiple examples of each category. This sort of official recognition, like the textbooks and standards discussed earlier, gave further legitimacy to the notion of ISD models.

Differing Rates of Adoption of ISD

During this period of expansion, advocates for ISD attempted to promote its use in K-12 and higher education. These efforts were largely unsuccessful, possibly for reasons related to the social and economic dynamics of these institutions (see Martin & Clemente, 1990), exploration of which would go beyond the scope of this chapter. Within the educational technology academic community, by the end of the 1980s, skill in instructional design was viewed as *the* core competency of the professional working in higher education or being educated in one of the growing number of academic programs.

Meanwhile, ISD flourished in corporate and military training as a way to standardize design practices for more efficient and effective training. Large corporations, such as AT&T, IBM, NCR, and Motorola, adopted ISD as their corporate training doctrine, creating their own ISD models to guide training designers' work. The ISD concept was also disseminated by giant consulting firms such as Ernst & Young and Arthur Andersen & Co. (later Andersen Consulting, then Accenture in 2000) that offered training services to its clients. Client companies learned about consulting firms' ISD procedures and often decided to adopt similar practices within their own training programs. By the late 1980s, ISD had become the ''gold standard'' for corporate training design.

Arrival as the Reigning Paradigm

When a new definition of instructional technology was devised by AECT in 1994 (Seels & Richey, 1994) it was obvious that ISD had come to occupy the center of the stage. The core terms of the new definition were taken right from ISD: ''Instructional technology is the theory and practice of *design, development, utilization, management, and evaluation* [emphasis added] of processes and resources for learning'' (p. 1). It would be difficult to dispute that by 1994 the ISD construct had become the reigning paradigm in instructional technology.

QUESTIONING THE ISD PARADIGM

Research on ISD Process

Although instructional design was a popular topic for research during the period of growing popularity of ISD in the 1970s and 1980s, only a small fraction of instructional design research was devoted to the ISD process itself (Molenda, 1987). Most studies dealt with the variables associated the ''design'' stage of the process—particularly, the efficacy of various instructional strategies and tactics. Few studies tackled the larger questions such as ''Does ISD work?'' or ''Who uses ISD?'' or ''What is needed for successful implementation of ISD?''

Two research syntheses published in 1986 (Ellson, 1986; McCombs, 1986) can serve to summarize the findings of those studies that did examine the whole ISD process. Ellson, looking for instructional treatments associated with major improvement in learning productivity, identified ''performance-based instructional design'' as one of the few educational methods that achieved a level of productivity that was at least double that of conventional instruction (p. 119). On the other hand, McCombs, in her synthesis of the early research on the ISD process, most of it done in the military services, emphasized the faults rather than the successes of the method. She found that what was done in the name of ISD often yielded unsatisfactory results, and she identified factors that were crucial to successful implementation of ISD. For instance, users noted that ISD models tended to be deficient in providing specific guidance on how to do each step. McCombs thus inferred that organizations intending to use ISD must ensure that their designers have the requisite skills to fill the gaps in the methodology (p. 72).

Corporate Pressures

By the late 1990s, however, an accumulation of pressures in the business world—including rapidly evolving digital technologies (see Liu, Gibby, Quiros, & Demps, 2002), intense cost competition with the accompanying need to reduce human resources costs, and the increasing pace of organizational change—led to a period of critical questioning of ISD orthodoxy. This dissatisfaction culminated in a lead article in *Training* magazine entitled ''The Attack on ISD'' (Gordon & Zemke, 2000). Experts quoted in the article charged that the ISD approach was too slow and clumsy for the fast-changing digital environment, failed to focus on what is most important, and tended to produce uninspired solutions.

Other critics in the corporate sphere argued that ISD should be viewed as a subordinate process within the larger process of performance improvement, on the grounds that training alone was never a sufficient solution to any training problem within an organization (Molenda & Pershing, 2004). It is this viewpoint that inspired this very handbook.

A Challenge to Underlying Instructional Theory

At the same time as business pressures were mounting, theoreticians and researchers were debating the merits of bold new (or recently rediscovered) claims regarding the fundamental nature of human learning . . . and how different methods of instruction did or did not fit with these new understandings. The debate took off when several influential scholars proposed a new paradigm for the design of instruction, which they called ''constructivism.'' The most frequently cited beginning of this movement is Bednar, Cunningham, Duffy, and Perry's ''Theory into practice: How do we link?,'' initially an occasional paper, later published in an anthology in 1991. These authors plus David Jonassen combined to write a number of manifestoes promoting this new paradigm (for example, Duffy & Cunningham, 1996; Duffy & Jonassen, 1992; Jonassen, 1991). They made strong claims about the invalidity of the psychological and philosophical bases of prior theories. These claims were difficult to evaluate because, first, the concept of ''constructivism'' was not clearly defined and, second, the proponents' examples of ''constructivist'' instructional prescriptions—situated cognition, anchored instruction, cognitive flexibility, problem based learning, cognitive apprenticeship, and everyday cognition—had previously been proposed by psychologists guided by cognitivist theories of learning, not constructivist philosophy. These definitional and labeling issues are discussed in depth by Robinson, Molenda, and Rezabek (2008).

Dave Merrill considered the shift of focus from a behaviorist to a cognitivist view of the learner to constitute a paradigm shift to what he termed ''second generation instructional design'' or ID_2 (Merrill, Li, & Jones, 1990). Other contributors to the debate took a less revolutionary posture, and simply proposed that the findings of cognitive psychology research could provide a great deal of guidance to instructional designers when it came to the *design* stage in the ISD process, the stage at which instructional strategies and tactics were being selected (Dick, 1997).

In many of the latter cases, scholars have actually been proposing new *frameworks* around which to organize lessons or instructional units—not new models of the total instructional development process (Molenda & Russell, 2006). Such frameworks specify the sequence of learning activities that should be incorporated into effective lessons. A familiar example is the Events of Instruction framework (Gagne & Medsker, 1996). Another even more detailed set of prescriptions is offered by Foshay, Silber, and Stelnicki (2003) as ''a cognitive training model'' (p. 23). The authors offer seventeen specific tactics organized around the various psychological stages of a lesson: gaining attention, linking to prior knowledge, structuring the content, presenting the new knowledge, and strengthening the new knowledge through practice and feedback. Many other prescriptive guides are discussed in detail in Reigeluth's comprehensive three-volume series on instructional-design theories (Reigeluth, 1983, 1999; Reigeluth & Carr-Chellman, in press). The guidelines offered in these volumes revolve around which teaching-learning tactics to use, when to use them, and how to sequence them within the lesson.

Selection and sequencing guides and templates such as these should not be mistaken for procedural guides for conducting the entire planning process. Authors contribute to the semantic confusion when they label selection-and-sequencing guides or lesson frameworks as *models*. This label usually is and ought to be reserved for guides to the overall planning process.

In any event, in response to this challenge theorists and practitioners have been busy exploring ways to design learning environments that place learners in realistic settings, that engage them in problem-solving, and that give them greater ownership of the whole learning process. The ''constructivist'' movement coincided with the flowering of digital media that made it more feasible to create the sorts of interactive, exploratory, immersive environments recommended by this theory.

A Changing Digital Environment

In the late 1980s, as computing power multiplied geometrically and became more ubiquitous through networking, and as computer systems became more capable of offering multimedia presentations, they began to be seen as a new delivery platform: ''digital media.'' Just as the shift from audiovisual material production to television production entailed changes in the design process in the 1950s, so did the shift from traditional media to digital interactive media in the 1980s and 1990s (Jonassen & Mandl, 1990). For example, the increased complexity of interactive materials fostered concerns that such materials might be difficult for learners to use, to understand, or to accept; thus user-centered design and usability methods (Corry, Frick, & Hansen, 1997; Frick & Boling, 2002), borrowed from software design, became subjects of debate and study.

The rapid growth of the Internet and the World Wide Web in the 1990s presented instructional designers with another fundamentally different media environment in which to work. Web-based instruction, by its very nature, requires more learner-controlled activities, such as reading, writing, discussion, and reflection, as opposed to the teacher-controlled activities of the face-to-face classroom—lectures, demonstrations, and question-answer exchanges between teachers and learners. Thus instructional designers had to think afresh about the sorts of instructional solutions to be created.

As the proportion of instruction delivered over the web increased, designers, particularly those in military and business environments, considered borrowing another concept from software engineering, the *object*. Proponents suggested that the use of reusable *learning objects*—''small (relative to the size of an entire course) instructional components that can be reused a number of times in different learning contexts'' (Wiley, 2002, p. 4)—was the key to gaining greater efficiency in churning out the thousands of hours of course material needed in the hundreds of web-based distance learning programs. It is not yet clear whether this particular approach will fulfill the dreams of its proponents, but the search continues for ways to automate the ISD process to the extent possible.

TO WHAT HAS ISD EVOLVED?

After the challenges of several paradigm battles and of adaptation to emerging media platforms, ISD continues to be a robust construct. After launching ''the attack on ISD'' (Gordon & Zemke, 2000), Ron Zemke later teamed with Allison Rossett to reconsider the criticisms raised in the original article. Their analysis (Zemke & Rossett, 2002) concluded that the flaws attributed to ISD lay more in how the process was executed, rather than flaws in ISD as a theory.

That is, what is implemented in the name of ISD is not always in conformance with the canonical definition of ISD (and it could be argued that there is not a canonical definition). An example of this gap is the widespread failure to actually conduct formative evaluation, as specified in ISD theory. For years, ASTD has carried out an annual review of trends in corporate training, often asking survey respondents if they conduct formative or summative evaluation of learning gains from newly created instructional products. The response typically shows that about 40 percent of organizations do so (see, for example, Sugrue, 2003, p. 19). Thus, one of the key components of the ISD approach appears to be omitted much of the time. Other research studies document similar shortcomings in execution. These findings are consistent with those of McCombs back in 1986: that to be implemented successfully ISD needs to be carried out rigorously, and that it needs to be conducted by people who are able to bring skill and creativity to the process.

There are others who feel that ISD, even if implemented adequately, still has blind spots that limit its suitability as the reigning paradigm. They suggest that design traditions in other disciplines—such as art, architectures, and software engineering—offer alternatives worthy of consideration (Bichelmeyer, Boling, & Gibbons, 2006; Molenda & Boling, 2008, pp. 119–122). Of particular current concern is the extent to which clients or users are involved in the design process. Carr-Chellman and Savoy (2004) discuss a range of design approaches from user-based, to user-centered, to truly user-controlled or emancipatory design, which they claim can be transformational for learners and the institutions in which they operate.

The psychological underpinnings of ISD have evolved over time as well. After two decades of debate about which is the ''one correct'' theory to inspire instructional design, there seems to be a new consensus, voiced well by Willis (1998), that an eclectic posture is warranted. As he points out, ''strategies developed within one paradigm are used by those who support another'' (p. 15), indicating that practitioners continue to adapt on a pragmatic basis. By observing how designers work, it appears that they intuitively adapt the process to the environment in which they work and the audience of learners they serve. For example, those who work with adult learners would more readily find value in a user-centered or participatory design approach.

CONCLUSION

The concept of ISD was created over forty years ago and has been evolving ever since. It is probably safe to say that ISD in practice will continue to evolve in response to changing social and economic forces, advances in understanding how humans learn, and new telecommunications technologies. Wallace Hannum's career retrospective (2005) summarizes aptly the confidence of ISD's proponents: ''Still the processes and procedures specified in the ISD model seem our best bet for developing and delivering high-quality training, regardless of how it is delivered'' (p. 19).

References

1. Andrews, D. H., & Goodson, L. A. (1980). A comparative analysis of models of instructional design. *Journal of Instructional Development*, *3*(4) 2–16.
2. Association for Educational Communications and Technology (AECT). (1977). *The definition of educational technology*. Washington, DC: Author.
3. Baker, R. L., & Schutz, R. E. (Eds.). (1971). *Instructional product development*. New York: Van Nostrand Reinhold.
4. Banathy, B. (1968). *Instructional systems*. Palo Alto, CA: Fearon.
5. Barson, J. (1967). *Instructional systems development. A. demonstration and evaluation project: Final report*. U.S. Office of Education, Title II-B project OE 3-16-025. East Lansing, MI: Michigan State University. 125 p. (EDRS: ED 020 673).
6. Bednar, A. K., Cunningham, D., Duffy, T. M., & Perry, J. D. (1991). Theory into practice: How do we link? In G. Anglin (Ed.), *Instructional technology: Past, present and future*. Denver, CO: Libraries Unlimited.
7. Bern, H.A. (1961, July/August). Audiovisual ''engineers''? *Audio-Visual Communication Review*, *9*(4), 186–194.
8. Bern, H. A. (1967, January). Wanted: Educational engineers, *Phi Delta Kappan 48*, 230–236.
9. Bichelmeyer, B., Boling, E., & Gibbons, A. S. (2006). Instructional design and technology models: Their impact on research and teaching in instructional design

and technology. In M. Orey, V. J. McClendon, & R. M. Branch (Eds.), *Educational media and technology yearbook 2006* (pp. 33–49). Westport, CT: Libraries Unlimited.

10. Branson, R.K. (1978, March). The interservice procedures for instructional systems development. *Educational Technology 18*(3), 11–14.
11. Branson, R. K., Rayner, G. T., Cox, J. L., Furman, J. P., King, F. J., & Hannum, W. H. (1975). *Interservice procedures for instructional systems development* (five volumes). Fort Benning, GA: U.S. Army Combat Arms Training Board. (NTIS Nos. ADA 019 486, ADA 019 487, ADA 019 488, ADA 019 489, ADA 019 490).
12. Briggs, L. J. (1970). *Handbook of procedures for the design of instruction*. Pittsburgh: American Institutes for Research.
13. Briggs, L. J. (Ed.). (1977). *Instructional design: principles and applications*. Englewood Cliffs, NJ: Educational Technology Publications.
14. Briggs, L. J. (1980). Thirty years of instructional design: One man's experience. *Educational Technology*, *20*(2), 45–50.
15. Briggs, L. J., Campeau, P. L., Gagne, R. M., & May, M. A. (1967). *Instructional media: A procedure for the design of multi-media instruction, a critical review of research, and suggestions for future research*. Pittsburgh: American Institutes for Research.
16. Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Belknap Press.
17. Bumstead, R. A. (1968, May). AT&T systems approach for love and money. *Training in Business and Industry*, *5*(5), 43–46, 62, 64.
18. Carr-Chellman, A., & Savoy, M. (2004). User-design research. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (2nd ed.) (pp. 710–716). Mahwah, NJ: Lawrence Erlbaum Associates.
19. Charters, W.W. (1945, February). Is there a field of educational engineering? *Educational Research Bulletin*, *24*(2), 29–37, 56.
20. Childs, J. W. (1968, August 30). A set of procedures for the planning of instruction. *Educational Technology*, *8*(16), 7–14.
21. Corrigan, R.E. (1964). Programmed instruction as a systems approach to education. In G.D. Ofiesh & W. C. Meierhenry (Eds.), *Trends in programmed instruction: Papers from the first annual convention of the National Society for Programmed Instruction* (pp. 36–45). Washington DC: Department of Audiovisual Instruction, National Education Association.
22. Corrigan, R. E., & Kaufman, R. (1966). *Why system engineering*. Palo Alto, CA: Fearon Publishers.
23. Corry, M. D., Frick, T. W., & Hansen, L. (1997). User-centered design and usability testing of a web site: An illustrative case study. *Educational Technology Research and Development*, *45*(4), 65–76.
24. Crowder, N. A. (1962). Intrinsic and extrinsic programming. In J. E. Coulson (Ed.), *Programmed learning and computer-based instruction* (pp. 58–66). Hoboken, NJ: John Wiley & Sons.

25. Curl, D. H. (1967, March). Essentials of a training system. *Training in Business and Industry*, *4*(3), 37–41.
26. Davis, R. H., Alexander, L. T., & Yelon, S. L. (1974). *Learning system design: An approach to the improvement of instruction*. New YorkMcGraw-Hill.
27. Davies, I. K., & Schwen, T. M. (Eds.). (1971). *Toward a definition of instructional development*. Papers presented at the annual convention of the Association for Educational Communications and Technology, Philadelphia.
28. Diamond, R. M. (1975). *Instructional development for individualized learning in higher education*. Englewood Cliffs, NJ: Educational Technology Publications.
29. Diamond, R. M. (1980). Instructional development: One biased view (problems, issues, and the future). *Educational Technology*, *20*(2), 51–54.
30. Diamond, R. M. (1985). Instructional design: Systems approach. In T. Husén & T. N. Postlethwaite (Eds.), *International encyclopedia of education* (pp. 2558–2563). Oxford, UK: Pergamon.
31. Dick, W. (1987). A history of instructional design and its impact on educational psychology. In J. A. Glover & R. R. Ronning (Eds.), *Historical foundations of educational psychology* (pp. 183–202). New York: Plenum Press.
32. Dick, W. (1997). Better instructional design theory: Process improvement or reengineering? *Educational Technology*, *37*(5), 4–7, 50.
33. Dick, W., & Carey, L. (1978). *The systematic design of instruction*. Glenview, IL: Scott, Foresman.
34. Dick, W., & Carey, L. (1985). *The systematic design of instruction* (2nd ed.). Glenview, IL: Scott, Foresman.
35. Dick, W., & Carey, L. (1990). *The systematic design of instruction* (3rd ed.) Glenview, IL: Scott, Foresman.
36. Dick, W., & Carey, L. (1996). *The systematic design of instruction* (4th ed.). New York: HarperCollins.
37. Dick, W., Carey, L., & Carey, J. O. (2001). *The systematic design of instruction* (5th ed.). New York: Longman.
38. Dick, W., Carey, L., & Carey, J. O. (2005). *The systematic design of instruction* (6th ed.). Boston: Pearson/Allyn and Bacon.
39. Dills, C. R., & Romiszowski, A. J. (Eds.). (1997). *Instructional development paradigms*. Englewood Cliffs, NJ: Educational Technology Publications.
40. Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 170–198). New York: Macmillan Library Reference USA
41. Duffy, T. M., & Jonassen, D. H. (Eds.). (1992). *Constructivism and the technology of instruction: A conversation*. Hillsdale, NJ: Lawrence Erlbaum Associates.
42. Dyer, R. H. (1969, March). AT&T Long Lines training centers are heavy on audiovisual and programmed instruction. *Training in Business and Industry*, *6*(3), 33–37.

43. Ellson, D. G. (1986). Improving productivity in teaching. *Phi Delta Kappan 68*(2), 111–124.

44. Eraut, M. R. (1967). An instructional systems approach to course development. *Audio-Visual Communication Review*, *15*(1), 92–101.

45. Faris, G. (1968, November). Would you believe . . . an instructional developer? *Audiovisual Instruction*, *13*(9), 971–973.

46. Finn, J. D. (1956). AV development and the concept of systems. *Teaching Tools*, *3* (4), 163–164.

47. Finn, J. D. (1957a). Automation and education: I. General aspects. *Audio-Visual Communication Review*, *5*(1), 343–360.

48. Finn, J. D. (1957b). Automation and education: II. Automatizing the classroom—background of the effort. *Audio-Visual Communication Review*, *5*(2), 451–467.

49. Finn, J. D. (1960). Automation and education: III. Technology and the instructional process. *Audio-Visual Communication Review*, *8*(1), 5–20.

50. Finn, J. D., Perrin, D., & Campion, L. E. (1963). *Studies in the growth of instructional technology, 1: Audiovisual instrumentation for instruction in the public schools, 1930–1960*. Occasional Paper No. 6.

51. Ford, G. A. (1970, July). Four steps are no longer enough: A systems approach adaptation of JIT for the 1970s. *Training and Development Journal*, *24*(7), 29–34.

52. Foshay, W. R., Silber, K. H., & Stelnicki, M. B. (2003). *Writing training materials that work: How to train anyone to do anything: A practical guide for trainers based on current cognitive psychology and ID theory and research*. San Francisco: Pfeiffer.

53. Frick, T., & Boling, E. (2002). Effective web instruction: Handbook for an inquiry-based process. Unpublished manuscript. Bloomington, IN: Indiana University.

54. Fund for the Advancement of Education. (1955). *Teachers for tomorrow*. New York: Author.

55. Gagne, R. M. (1962). Introduction. In R.M. Gagne (Ed.), *Psychological principles in system development*. New York: Holt, Rinehart & Winston.

56. Gagne, R. M. (1965). *The conditions of learning*. New York: Holt, Rinehart and Winston.

57. Gagne, R. M., & Briggs, L. J. (1974). *Principles of instructional design*. New York: Holt, Rinehart and Winston.

58. Gagne, R. M., & Medsker, K. L. (1996). *The conditions of learning: Training applications*. Fort Worth, TX: Harcourt Brace.

59. Galbraith, J. K. (1967). *The new industrial state*. Boston: Houghton Mifflin.

60. Gerlach, V. S., & Ely, D. P. (1971). *Teaching and media; a systematic approach*. Englewood Cliffs, NJ: Prentice-Hall.

61. Gilpin, J. (1962, March/April). Design and evaluation of instructional systems. *Audio-Visual Communication Review*, *10*(2), 75–84.

62. Glaser, R. (1962). Psychology and instructional technology. In R. Glaser (Ed.) *Training research and education*. Pittsburgh: University of Pittsburgh Press.

63. Glaser, R. (1965a). Toward a behavioral science base for instructional design. In R. Glaser (Ed.), *Teaching machines and programmed learning II: Data and directions*. Washington, DC: Department of Audiovisual Instruction, National Education Association.

64. Glaser, R. (Ed.). (1965b). *Teaching machines and programmed learning II: Data and directions*. Washington, DC: Department of Audiovisual Instruction, National Education Association.

65. Glaser, R. (1968). Educational technology as instructional design. *Educational Technology* *8*(1), 5–6.

66. Gordon, J., & Zemke, R. (2000, April). The attack on ISD. *Training*, *37*, 43–53.

67. Gustafson, K. L. (1981). *Survey of instructional development models*. Syracuse, NY: ERIC Clearinghouse on Information Resources.

68. Gustafson, K. L. (1994). Instructional design models. In T. Husen & T. N. Postlethwaite (Eds.), *The international encyclopedia of education* (2nd ed.). (Vol. *2*, pp. 2856–2862). Oxford, UK: Pergamon.

69. Gustafson, K. L., & Branch, R. M. (1997). Revisioning models of instructional development. *Educational Technology Research and Development*, *45*(3), 73–89.

70. Hamreus, D. (1968). The systems approach to instructional development. In *The contribution of behavioral science to instructional technology*. Monmouth, OR: Oregon State System of Higher Education, Teaching Research Division. (EDRS: ED 041 448. Microfiche only.).

71. Haney, J. B., Lange, P. C., & Barson, J. (1968, Winter). The heuristic dimension of instructional development. *Audio-Visual Communication Review 16*(4), 358–371.

72. Hannum, W. (2005) Instructional systems development: A 30-year retrospective. *Educational Technology*, *45*(4), 5–21.

73. Harris, R.F. (1964). Programmed instruction at Chanute AFB, Illinois. In G. D. Ofiesh & W. C. Meierhenry (Eds.), *Trends in programmed instruction*. Washington DC: Department of Audiovisual Instruction, National Education Association.

74. Heinich, R. (1965). *The systems engineering of education II: Application of systems thinking to instruction*. Los Angeles: School of Education, University of Southern California.

75. Heinich, R. (1970). *Technology and the management of instruction*. Monograph 4. Washington, DC: National Education Association.

76. Heinich, R., Molenda, M., & Russell, J. D. (1989). *Instructional media and the new technologies of instruction* (3rd ed.) New York: Macmillan.

77. Hoban, D. (1974). The instructional developer, *Audio-Visual Communication Review*, *22*(4), 453–466.

78. *Instructional design competencies: The standards*. (1986). Batavia, IL: International Board of Standards for Training, Performance and Instruction (IBSTPI).

79. Jonassen, D. H. (1991). Objectivism versus constructivism: do we need a new philosophical paradigm? *Educational Technology Research and Development*, *39* (3), 5–14.

80. Jonassen, D. H., & Mandl, H. (Eds.). (1990). *Designing hypermedia for learning*. Berlin: Springer-Verlag.

81. Kaufman, R. A. (1964). The systems approach to programming. In G. D. Ofiesh & W. C. Meierhenry (Eds.), *Trends in programmed instruction: Papers from the first annual convention of the National Society for Programmed Instruction* (pp. 33–35. Washington DC: Department of Audiovisual Instruction, National Education Association.

82. Kaufman, R. A. (1968, Winter). A system approach to education: Derivation and definition. *Audio-Visual Communication Review*, *16*(4), 415–425.

83. Kemp, J. E. (1971). *Instructional design: a plan for unit and course development*. Belmont, CA: Fearon.

84. Kemp, J. E. (1977). *Instructional design: a plan for unit and course development* (2nd ed.). Belmont CA: Fearon-Pitman.

85. Kemp, J. E. (1985). *The instructional design process*. New York: Harper & Row.

86. Kemp, J. E., Morrison, G. R., & Ross, S. M. (1994). *Designing effective instruction*. New York: Merrill.

87. Kemp, J., Morrison, G. R., & Ross, S. M. (1998). *Designing effective instruction* (2nd ed.). Upper Saddle River, NJ: Merrill.

88. Lange, P. C. (1967). Introduction to section II, program development. In P. C. Lange (Ed.), *Programmed instruction: The sixty-sixth yearbook of the National Society for the Study of Education. Part II* (pp. 57–60). Chicago: University of Chicago Press.

89. Liu, M., Gibby, S., Quiros, O., & Demps, E. (2002). Challenges of being an instructional designer for new media development: A view from the practitioners. *Journal of Educational Multimedia and Hypermedia*, *11*(3), 195–219.

90. Lumsdaine, A. A., & Glaser, R. (Eds.). (1960). *Teaching machines and programmed learning: A source book*. Washington DC: Department of Audio-Visual Instruction, National Education Association.

91. Mauch, J. (1962). A systems analysis approach to education. *Phi Delta Kappan*, *43*, 158–161.

92. Mager, R. F. (1961). *Preparing objectives for programmed instruction*. San Francisco, CA: Fearon.

93. Mager, R. F. (1962). *Preparing instructional objectives*. Belmont, CA: Fearon.

94. Mager, R. F. (1984a). *Analyzing performance problems, or, You really oughta wanna* (2nd ed.). Belmont, CA: David S. Lake Publishing.

95. Mager, R. F. (1984b). *Developing attitude toward learning, or, SMATS ''n'' SMUTS* (2nd ed.). Belmont, CA: David S. Lake Publishing.

96. Mager, R. F. (1984c). *Goal analysis* (2nd ed.). Belmont, CA: David S. Lake Publishing.

97. Mager, R. F. (1984d). *Measuring instructional results, or, Got a match?* (2nd ed.). Belmont, CA: David S. Lake Publishing.

98. Mager, R. F. (1984e). *Preparing instructional objective* (rev. 2nd ed. Belmont, CA: David S. Lake Publishing.

99. Markle, S. M. (1967). Empirical testing of programs. In P. C. Lange (Ed.), *Programmed instruction: The sixty-sixth yearbook of the National Society for the Study of Education* (pp. 104–140). Chicago: University of Chicago Press.

100. Markle, S. M., & Tiemann, P. W. (1967). *Programming is a process*. Sound filmstrip. Chicago: University of Illinois at Chicago.

101. Martin, B. L., & Clemente, R. (1990) Instructional systems design and public schools. *Educational Technology Research and Development*, *38*(2), 61–75.

102. McCombs, B. L. (1986). The instructional systems development (ISD) model: A review of those factors critical to its successful implementation. *Educational Communications and Technology Journal*, *34*(2), 67–81.

103. Merrill, M. D., Li, Z., & Jones, M. K. (1990). Second generation instructional design (ID2). *Educational Technology*, *30*(1), 7–14.

104. Molenda, M. (1987, March 1). *An agenda for research on instructional development*. Presented at annual convention of Association for Educational Communications and Technology, Atlanta. Available online at http://www.indiana.edu/~molpage/Agenda%20Res%20on%20ID.pdf. Retrieved November 15, 2008.

105. Molenda, M. (1997). Historical and philosophical foundations of instructional design: A North American view. In R. D. Tennyson, F. Schott, N. M. Seel, & S. Dijkstra (Eds.), *Instructional design: International perspectives, vol. I: Theory, research, and models*. Mahwah, NJ: Lawrence Erlbaum Associates.

106. Molenda, M. (2003). In search of the elusive ADDIE model. *Performance Improvement*, *42*(4), 34–36.

107. Molenda, M., & Boling, E. (2008). Creating. In A. Januszewski & M. Molenda (Eds.), *Educational technology: A definition with commentary*. Mahwah, NJ: Lawrence Erlbaum Associates.

108. Molenda, M., & Pershing, J. A. (2004). The strategic impact model: An integrative approach to performance improvement and instructional systems design. *TechTrends*, *48*(2), 26–32.

109. Molenda, M., & Russell, J. D. (2006). Instruction as an intervention. In J. A. Pershing (Ed.), *Handbook of human performance technology* (3rd ed.) San Francisco: Pfeiffer.

110. Mood, A. (1964, April). *Some problems inherent in the development of a systems approach to instruction*. Paper presented at Conference on New Dimensions for Research in Educational Media Implied by the Systems Approach to Education, Syracuse University, Syracuse, New York.

111. Morrison, G. R., Ross, S. M., & Kemp, J. E. (2001). *Designing effective instruction* (3rd ed.) Hoboken, NJ: John Wiley & Sons.

112. Morrison, G. R., Ross, S. M., & Kemp, J. E. (2003). *Designing effective instruction* (4th ed.). Hoboken, NJ: John Wiley & Sons.

113. Morrison, G. R., Ross, S. M., & Kemp, J. E. (2007). *Designing effective instruction* (5th ed.). Hoboken, NJ: John Wiley & Sons.

114. Nicely, C. S., Nelson, M. J., & Kaufman, R. A. (1970, May). A system for learning systems. *Training in Business and Industry*, *7*(5), 40–45.

115. Oxhandler, E. K. (1965, May). Afterthoughts on a systems conference. *Audiovisual Instruction*, *10*(5), 395–397.

116. Phillips, M. G. (1966). Learning materials and their implementation. *Review of Educational Research*, *36*(3), 373–379.

117. Popham, W. J. (1980). Two decades of educational technology: Personal observations, *Educational Technology*, *20*(1), 19–21.

118. Popham, W. J., & Baker, E. (1970a). *Establishing instructional goals*. Englewood Cliffs, NJ: Prentice-Hall.

119. Popham, W. J., & Baker, E. (1970b). *Planning an instructional sequence*. Englewood Cliffs, NJ: Prentice-Hall.

120. Popham, W. J., & Baker, E. (1970c). *Systematic instruction*. Englewood Cliffs NJ: Prentice-Hall.

121. Postlethwait, S. N. (1968). Audio-tutorial system. *Journal of Animal Science*, *27*, 938–940.

122. Postlethwait, S. N., Novak, J., & Murray, H. (1972). *The audio-tutorial approach to learning*. Minneapolis, MN: Burgess.

123. Quinn, A. K. (1970, February). In training, the system's the thing. *Training and Development Journal*, *24*(2), 25–29.

124. Reigeluth, C. M. (Ed) (1983). *Instructional-design theories and models*. Hillsdale, NJ: Lawrence Erlbaum Associates.

125. Reigeluth, C. M. (Ed) (1999). *Instructional-design theories and models, Volume II: A new paradigm of instructional theory*. Mahwah, NJ: Lawrence Erlbaum Associates.

126. Reigeluth, C. M., & Carr-Chellman, A. (Eds.). (in press) *Instructional-design theories and models, Volume III: Building a common knowledge base*. New York: Routledge.

127. Reiser, R. A. (1987). Instructional technology: A history. In R. M. Gagne (Ed.), *Instructional technology: Foundations*. Hillsdale, NJ: Lawrence Erlbaum Associates.

128. Reiser, R. A. (2001). A history of instructional design and technology: Part II: A history of instructional design. *Educational Technology Research and Development*, *49*(2), 57–67.

129. Reiser, R. A. (2007). A history of instructional design and technology. Chapter 3 in R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (2nd ed.). Upper Saddle River, NJ: Pearson Prentice Hall.

130. Robinson, R., Molenda, M., & Rezabek, L. (2008). Facilitating learning. In A. Januszewski & M. Molenda (Eds.), *Educational technology: A definition with commentary*. Mahwah, NJ: Lawrence Erlbaum Associates.

131. Romiszowski, A. J. (1981). *Designing instructional systems: Decision making in course planning and curriculum design*. London: Kogan Page.

132. Saettler, P. (1990). *The evolution of American educational technology*. Englewood, CO: Libraries Unlimited.

133. Scott, D. T. (1960). Teaching high school physics through the use of films. *Audio-Visual Communication Review*, *8*(4), 220–221.

134. Schuller, C. F. (1986). Some historical perspectives on the instructional technology field. *Journal of Instructional Development*, *8*(3), 3–6.

135. Scriven, M. (1967). The methodology of evaluation. In R. Tyler, R. M. Gagne, & M. Scriven (Eds.), *AERA monograph series No. 1, Perspectives of curriculum evaluation* (pp. 38–83). Chicago: Rand McNally.

136. Seels, B., & Richey, R. (1994). *Instructional technology: The definition and domains of the field*. Washington DC: Association for Educational Communications and Technology.

137. Shrock, S. A. (1991). A brief history of instructional development. In G. J. Anglin (Ed.), *Instructional technology: Past, present, and future*. Englewood, CO: Libraries Unlimited.

138. Silvern, L. C. (1963). *Systems engineering in the educational environment*. Hawthorne, CA: Northrop Norair Division of the Northrop Corp.

139. Silvern, L. C. (1965). *Basic analysis*. Los Angeles: Education and Training Consultants.

140. Skinner, B. F. (1954). The science of learning and the art of teaching. *Harvard Educational Review*, *24*, 86–97.

141. Skinner, B. F. (1965). The technology of teaching. *Proceedings of the Royal Society*, Series B, 1965: 162, 427–443.

142. Skinner, B. F. (1968). *The technology of teaching*. New York: Appleton-Century-Crofts.

143. Sugrue, B. (2003). *State of the industry*. Alexandria, VA: American Society for Training and Development.

144. A system to create training systems. (1971, September). *Training in Business and Industry*, *8*(9), 40–41.

145. Tracey, W. R., Flynn, E. B., Jr., Legere, C.L.J. (1967). Systems approach gets results. *Training in Business and Industry*, *4*(6), 17–21, 32–38.

146. Washington County Board of Education. (1963). *Washington County closed-circuit television report*. Hagerstown, MD: Author.

147. Wiley, D. A., II. (2002). Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy. In D. A. WileyII (Ed.), *The instructional use of learning objects*. Bloomington IN: Agency for Instructional Technology and Association for Educational Communications and Technology.

148. Willis, J. (1998). Alternative instructional design paradigms: What's worth discussing and what isn't. *Educational Technology*, *38*(3), 5–16.

149. Zemke, R., & Rossett, A. (2002, February). A hard look at ISD. *Training*, *39*, 27–34.