History and Development of Instructional Design and Technology

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Abstract

The origins and evolution of instructional technology and instructional design are treated in this chapter as separate concepts, although having intertwined histories. As with other technologies, their origins can be traced to the scientific discoveries on which they are based. Early in the twentieth century, new discoveries in optics and electricity stimulated educators to the adoption of technological innovations such as projected still pictures, motion pictures, and audio recording. Individuals and, later, groups of affiliated professionals promoted enriching learning by adding visual and, later, audiovisual resources where verbal presentations previously dominated. As radio broadcasting grew in the 1930s and then television in the 1950s, these mass media were perceived as ways to reach audiences, in and out of school, with educative audiovisual programs. In the 1960s, the wave of interest in teaching machines incorporating behaviorist psychological technology

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engendered a shift in identity from audiovisual technologies to all technologies, including psychological ones. As computers became ubiquitous in the 1990s, they became the dominant delivery system, due to their interactive capabilities. With the global spread of the World Wide Web after 1995, networked computers took on communication functions as well as storage and processing functions, giving new momentum to distance education. Meanwhile, research during and after World War II prompted a technology of planning – systems analysis. In the 1960s, educators adapted the systems approach to instructional planning, starting the development of instructional systems design (ISD). Since the 1980s, ISD has been the reigning paradigm for instructional design, while instructional design has become the central activity of instructional technology professionals.

Keywords

Instructional technology · Instructional design · Visual instruction · Audiovisual instruction · Radio · Television · Programmed instruction · Systems approach

Introduction

This brief history strives to tell the story of the evolution of instructional design and technology in the field of education. The terms used in the title, *instructional technology* and *instructional design*, are two separate constructs having separate – but intertwined – histories. Here, *instructional technology*, being the overarching construct, will be treated first, with *instructional design* being treated as a later development.

The Origins and Evolution of Instructional Technology

By definition, the role of technology is to put new scientific discoveries into practical application. Thus, one of the themes running through the history of the field is that new technologies tend to crop up in the wake of new scientific advancements. For example, the invention of the steam-driven rotary press around the turn of the nineteenth century, coupled with the invention of lithography, enabled the mass production of large-format color prints. As they were expensive to produce, a school or university might possess only a few copies of a given artwork or biological illustration; curating and promoting the use of such pictures became part of the job of visual education specialists. Later, the invention of photography added to the stock of images available for use by educators. By the turn of the twentieth century, the invention of the incandescent light bulb made projection of photographic images practical in educational institutions. Edison's invention of the film camera and projector added movies to the inventory of visual education specialists.

By the 1920s, in the USA the National Education Association had created a professional home for visual education specialists, the Department of Visual

Instruction (DVI). After World War II, when magnetic tape audio recording equipment became widely used, the name was broadened to Department of Audio-Visual Instruction (DAVI). As the focus of the field shifted from supporting the use of audiovisual hardware and software to creating and implementing instructional systems, the organization adopted a new name, Association for Educational Communications and Technology (AECT), in 1970 and has continued under that name to the present time.

In response to the continuous parade of innovations in media and advances in learning theory, the leading professional associations have periodically established committees to reflect on the current definition of the field. The first (Ely, 1963) signaled a shift from a product identity to a process identity, although the central axis remained "audiovisual." By 1977 (AECT Task Force on Definition and Terminology, 1977), the overall self-concept had shifted to "instructional technology" (although the Task Force delineated a distinction between *educational technology* and *instructional technology* and chose the former as the overarching construct). A more recent definition embraces the *educational technology* label and ignores the educational/instructional distinction (Januszewski & Molenda, 2008).

Unfortunately, these carefully crafted definitions have had limited impact on discourse among practitioners. This can be accounted for – in part – by the fact that each new wave of technological innovation attracts advocates for that particular technology. "Educational radio" broadcasters came from the ranks of radio, not education. "Educational television" producers came from the ranks of television. Programmed instruction enthusiasts typically identified with experimental psychology. Computer-assisted instruction (CAI) devotees generally came from the field of computer science/technology. Distance education practitioners were rooted in the traditions of university extension services. As Martin Weller summarizes the situation, "Edtech is also an area to which people come from other disciplines, so there is no shared set of concepts or history" (Weller, 2018, p. 34). The smaller core group of educators who identify as instructional technology professionals generally has had little power or control over developments as massive waves of technological fads and fashions have washed over institutions of education and training. This is the story as observed by those witnesses.

Hard and Soft Technologies

As civilization advanced, it demanded more and more specialized skills, eventually including reading and writing. To pass along those skills to the next generation required more expertise than could be found in the home or cottage industry, hence the establishment of schools and apprenticeships. Education and training became more organized over the centuries as educators developed new techniques and tools to make their efforts more efficient and effective. Some of these methods could be considered technological in the sense proposed by John Kenneth Galbraith (1967, p. 12), that is, applying scientific or other organized knowledge to the attainment of practical ends. Such developments may take the form of *hard* technologies,

including materials and physical inventions, or *soft* technologies, including special work processes such as instructional design. Throughout the eighteenth and nineteenth centuries, media innovations gradually enhanced the schooling experience. Maps, globes, and scientific apparatus were standard equipment in the better European and American schools and colleges in the eighteenth century, but it was not until early in the nineteenth century that a new general-purpose display format – the blackboard – came into widespread use (Anderson, 1962).

Visualizing the Curriculum: The Paradigm of a Concreteness Continuum

Slide projection evolved from the seventeenth-century hand-painted slides illuminated by oil lamps. This "magic lantern" provided entertainment for theatrical audiences throughout the nineteenth century (Petroski, 2006). Edison's invention of incandescent lighting by electricity in the 1890s made slide projection affordable, and by the end of the nineteenth century, lantern slides were in common use in education. Edison's later perfection of the motion picture camera and projector led to the production of nontheatrical short films, beginning around 1910. British and French short-subject films showed amazing sights such as microscopic creatures, insects in flight, and underwater seascapes. Films of news events and travel adventures played to rapt theater audiences.

Silent films began to be used in schools as early as 1910 (Saettler, 1990, pp. 98–99). By the 1920s, educators could find theatrical films edited for special purposes, industrial films, government films, and a smaller number of films produced specifically for the classroom. Despite the marginal value of many of the available films, interest and usage continued to grow, and by the end of the 1920s, many education agencies had units devoted to film or visual education, and thick catalogs documented the thousands of films available to educators.

The field's initial identity was that of *visual instruction*, a movement within education to surmount the limitations of "verbalism," that is, reliance on the spoken and written word – lectures and books (Hoban, Hoban, Jr., & Zisman, 1937). The visual instruction movement posited that what really counted was meaningfulness, not just rote memory. Meaningful learning came from rich and varied experiences, as direct and concrete as possible. Where firsthand experience was not feasible, visual images could provide a measure of realism. One could say that the underlying paradigm was that of *concreteness*: provide as concrete a learning experience as possible. Edgar Dale, through his influential textbook (1946), expanded the notion of audiovisual instruction by proposing in his Cone of Experience that learning experiences – including direct personal experiences, field trips, and dramatizations, as well as audio and visual media – could be arrayed in a continuum from concrete to abstract, and each type has a role to play.

From Visual to Audiovisual Instruction: The Paradigm of Communication Improvement

As early as 1910, various types of phonograph recordings, used mostly for music, were available to the public. Although magnetic tape displaced the phonograph for recording purposes in the 1950s, vinyl records remain in use into the twenty-first century. Records, and later cassette tapes, made it possible to add a soundtrack to filmstrips and slide sets. Thus, the identity of the field became *audiovisual instruction*. By the 1930s, schools maintained equipment pools that contained (in order of frequency) lantern slide projectors, radio receivers, 16 mm silent film projectors, 35 mm silent film projectors, filmstrip projectors, opaque projectors, micro-slide projectors, 16 mm sound film projectors, and 35 mm sound film projectors (Saettler, 1990, p. 234).

Educational Radio

As broadcast radio stations began to reach mass audiences in the 1920s, governments stepped in to regulate the process. In most countries (other than the USA), broadcasting facilities were directly managed by the government. However, with the founding of the British Broadcasting Corporation (BBC) in 1927, several major countries, including Canada and Japan, followed its model of a quasi-autonomous public corporation. Providing cultural and educational programming was assumed to be a primary responsibility of these organizations; such programs were often among the first to be broadcast. The first school programs began in England in 1926. By the mid-1930s, there were school broadcasting services in virtually every European country as well as in Australia, Japan, South Africa, and India.

In the early 1920s, many American colleges and universities obtained licenses to operate radio stations. A large proportion of these succumbed to competition with commercial stations, but some put down roots. The operations that prospered were the ones in which radio played an integral part in the university's mission – bringing educational opportunities to audiences beyond the campus (Wood & Wylie, 1977). Later federal legislation reserved a portion of the FM radio band for noncommercial stations, giving school systems, universities, and public non-profit groups the chance to reach mass audiences.

From the beginning, educational broadcasts covered the whole range of subjects, including foreign languages, health, social studies, home economics, science, music, and many others, including art. By the mid-1930s, several American radio stations operated by local and state school boards had developed sophisticated educational programming, often incorporating innovative pedagogical techniques. In the UK, BBC programmers worked closely with advisory boards of teachers in every subject area to find niches into which audio material might add value (Bailey, 1957). In 1936, in England and Wales some 4600 schools were registered users (Parker, 1939). However, in the Americas and many European countries, programming tended to be, in the words of Levenson and Stasheff, "informally educative" (1952) rather than directly instructional. This pattern of consigning programming to a supplementary

role was to be repeated with television, programmed instruction, and computer-assisted instruction.

Instructional Film

World War II brought films to the forefront of military training. The British and American armed forces made extensive use of 16 mm films for training and motivational purposes. Between 1941 and 1945, the Division of Visual Aids for Military Training produced over 400 sound films and over 400 silent filmstrips, enabling a military mobilization far broader and faster than the Axis strategists had expected (Saettler, 1990). During the war, as films were being produced and used in training, the US Army commissioned a series of psychological studies (Hovland, Lumsdaine, & Sheffield, 1949) that studied various filmic techniques and their instructional effectiveness. Because of the concentration of time, money, effort, and research expended on these productions, a genre of *instructional film* came into its own.

After the war, instructional film research continued under US Navy sponsorship at Pennsylvania State University (Hoban Jr. & Van Ormer, 1951). Some of the experiments dealt with utilization techniques but most explored presentation variables, such as camera angles, pacing, narration, music, and color (Saettler, 1990). Most of the basic research on visual and auditory perception has been done outside the field of instructional technology. However, a flood of applied research followed the enactment of the National Defense Education Act of 1958 in the USA. Generalizations gathered from the basic and applied research were compiled by Fleming and Levie (1978) in the form of message design principles, principles that have continued to be validated by research in multimedia learning (Mayer, 2014).

The Audiovisual Instruction Era

The period between World War II and the advent of personal computers in 1982 could be characterized as the audiovisual instruction era. Instructional films, 35 mm slide/filmstrip projectors, opaque projectors, radio receivers, and record players were owned by American schools at the rate of at least 1 per 100 teachers by the late 1940s. Television receivers reached this status in 1958 and overhead projectors in 1960 (Finn, Perrin, & Campion, 1962). Magnetic tape recording, invented in Germany in 1935, was introduced to the USA by servicemen who brought back recorders after the war. By 1956, reel-to-reel tape recorders had joined the ranks of media devices found in mass use in schools (Finn et al., 1962). Cassette audio recorders were introduced by Phillips in the Netherlands in 1962 and became the standard audio format in schools around the world by the early 1970s.

The rate of use of audiovisual media by K-12 teachers during this era was strongly affected by accessibility; instructors were likely to use materials that were stored in their own classrooms, somewhat less likely to use those housed in a center in their building, and even less likely to use items, such as 16 mm films, that had to be delivered from outside the building on a scheduled basis. Evidence from various

sources indicates that the average teacher used about one film per month (Cuban, 1986, pp. 14–18). The reasons given by teachers for the low rate of use of film and similar media, in addition to accessibility, were lack of training with the technology, unreliability of projection equipment, limited school budgets (for rental of films and purchase of projectors), and difficulty of integrating the material into the curriculum. Not coincidentally, surveys in the 1990s and 2000s identified the identical barriers to teachers' use of computers (National Center for Education Statistics, 2000).

During the postwar period, communication theory became a dominant paradigm both in the physical and social sciences. Flowing from Shannon and Weaver's (1949) information theory, through Wiener's (1950) cybernetics and Berlo's (1960) process of communication model, thinkers in instructional technology began to view teaching-learning problems as communication problems. Improvement of communication depended on detecting where the weak points in the process were and ameliorating them – choosing a more visual medium, building more redundancy into the message, matching the receiver's language capability better, providing the sender with better feedback about the receiver's response, and the like. This perspective is reflected in the name adopted in 1970 by the Association for Educational *Communications* and Technology (AECT).

Television: Educational and Instructional

Television broadcasting began on a small scale before World War II but did not blossom until after the war. In countries such as Japan, the UK, and other European nations, it was already assumed that the purpose of broadcasting was to provide cultural enrichment as well as entertainment, so news, public affairs, science, and the arts were part of the program schedule right from the beginning. In the USA, the template established with radio – a program schedule heavily dominated by commercially sponsored entertainment – was carried over to television. To compensate for this gap, in 1952 the Federal Communications Commission (FCC) reserved 242 channels for noncommercial licenses. By 1958, 35 "educational television" (ETV) stations were on the air; by 2020, there were 330 stations in all 50 states that were members of the Public Broadcasting System (PBS), a partially government-supported agency formed in 1970. Although many of these stations are affiliated with colleges and universities, their programming is dominated by news, public affairs, science, history, and the arts – programs of general cultural "uplift," but not intended to fulfill an instructional function.

In the UK, the BBC began school television broadcasts in 1957; by the mid-1970s, over 80 percent of all schools were making regular use of BBC programs (Mohanty, 1984), a pattern that carried on into the twenty-first century. Guided by a school broadcasting council that included strong representation of teachers, programs were carefully designed to be integrated into the national curriculum. In other European countries, the general pattern has been for the state television corporation to devote a small percentage of its broadcast hours to programming aimed at in-school audiences and adult education. Like the UK, Canada also operates a national television network, the CBC, which began to provide school TV broadcasts in 1952. They continued to offer a limited schedule of in-school programs

throughout the 1960s and 1970s, as the various provinces gradually undertook their own program production. Like the USA, Canada's K-12 education system is controlled by provincial authorities rather than the national government. By the mid-1960s, most of the provinces were producing instructional television (ITV) programs tailored to their specific curricular needs.

In the late 1950s and through the 1960s, there were directly instructional programs distributed on a regional basis in the USA, such as the Eastern Educational Network (EEN) and the Midwest Program of Airborne Television Instruction (MPATI), and a few on a national basis, such as *Continental Classroom*. For reasons too numerous to cover here, the concept of replacing many teachers with a single master teacher proved unsuccessful. Instead, schools and colleges, with subsidies from the Ford Foundation and the federal government, established their own local ITV operations, using closed-circuit transmission within one campus or microwave transmissions to link multiple campuses. After the popularization of videotape recording, which became video cassette recording in the 1970s, ITV programming was increasingly created and used as off-the-shelf packaged units rather than being received through broadcasting (Thornton & Brown, 1968).

As with educational films, ETV and ITV programs tended to emulate the familiar genres: lecture, demonstration, voice-over visualization, interview, panel discussion, dramatization, field trip, or documentary (Wood & Wylie, 1977, p. 259). American productions, particularly those beamed to college audiences, tended to be more verbal – the so-called talking heads – than European productions (Tanner & Woerdehoff, 1964). European programs, particularly those of the BBC, were notable for their emphasis on visualization. The BBC collection became a major international archive of exemplary programming that was drawn upon by producers from around the globe. A break from this expository presentation pattern began in the 1960s, influenced by the so-called cognitive revolution, which suggested that television should be participative rather than passive (McBride, 1966). This movement eventually led to the production of several series, especially in science and social studies, that portrayed problematic situations and invited learners to discuss them. The Jasper Woodbury Problem Solving Series, incorporated in videodiscs, represented the culmination of this movement (Cognition and Technology Group at Vanderbilt, 1992).

Behaviorism and Programmed Instruction: The Paradigm of a Technology of Teaching

The term *behaviorism* refers to several related theories in psychology. One of them, radical behaviorism, has had the greatest practical impact on instructional technology due to the application of its primary technique, operant conditioning, to teaching-learning problems (Burton, Moore, & Magliaro, 2004). B.F. Skinner's analysis of the problems of group-based traditional instruction (Skinner, 1954) led him to the invention of a mechanical device for applying operant conditioning to cognitive learning. Referred to by others as a "teaching machine," the device

controlled the arrangement of stimuli, responses, and reinforcers according to reinforcement principles. Within a few years, inventive publishers devised ways to arrange these conditions in the form of a book rather than a machine, and programmed instruction lessons in book format were published in great profusion in the 1960s. However, the teaching machine did not disappear; it continued to be developed and profited from the increasing availability of computer processing, re-emerging in the 1980s as computer-assisted instruction.

Among programmed instruction advocates, attention gradually shifted to the process of designing self-instructional materials. B.F. Skinner came to refer to his development methods as a *technology of teaching* (1965, 1968). Thereafter, *technology* increasingly took on the dual meanings of "application of scientific thinking" – or soft technology – and the various communications media and devices or hard technology.

The first attempts to use computers to present and control programmed instruction began in the early 1960s with mainframe computers. The early experiments in CAI began just at the time that programmed instruction was at its peak, so many of the early CAI programs followed a drill-and-practice or tutorial format, similar to programmed instruction. For example, beginning in the mid-1960s, the CAI research and development program at Stanford University created successful drill-and-practice materials in mathematics and reading, later adding foreign languages (Saettler, 1990).

CAI programs more adaptable to individual differences were developed in the Time-shared Interactive Computer-controlled Information Television (TICCIT) project at Brigham Young University in the 1970s after the invention of the microprocessor led to the proliferation of "mini-computers." Although they produced successful programs in mathematics and English composition, both the Stanford and TICCIT programs failed to gain major adoption in their intended sectors, K-12 and community college education (Saettler, 1990).

The Programmed Logic for Automatic Teaching Operations (PLATO) project at the University of Illinois began in 1961, aiming to produce cost-efficient instruction using networked inexpensive terminals and a simplified programming language for instruction, TUTOR. Most of the early programs were basically drill-and-practice with some degree of branching, but a wide variety of subject matter was developed at the college level. Over time, terminals at outlying universities were connected to the central mainframe in a time-sharing system, growing to hundreds of sites and thousands of hours of material available across the college curriculum. The PLATO system pioneered many applications that later became standard Internet formats – a graphical Web browser, online forums and message boards, email, chat rooms, instant messaging, remote screen sharing, and multiplayer games – leading to the emergence of what was perhaps the world's first online community (Woolley, 1994). PLATO continued to grow and evolve right through the early 2000s, finding a niche in military and vocational education.

"Intelligent tutoring" systems continue to be developed, incorporating artificial intelligence to allow more adaptation based on users' backgrounds, past

performance, and current mastery – for example, AutoTutor (Graesser, 2016) and TutorIT (Scandura, 2015) – although such programs remain expensive and limited in scope.

The role of computers in education began to change dramatically with the development of "microcomputers" in the 1960s and 1970s. Computers designed for personal use became increasingly commercially successful after the introduction of new models in 1977 by Apple and RadioShack and in 1981 by IBM, and as more people grew accustomed to using a personal computer, they became more and more popular in schools. Previously, students encountered mainframe or mini-computers in labs, where they served as tutors, typically controlling drill-and-practice exercises. Now both students and teachers could have access to user-friendly desktop computers in the classroom and at home to use as productivity tools – word processing programs for writing, spreadsheets for organizing quantitative data, and presentation software to create graphs and slide shows.

Throughout the 1980s, school adoption of computers increased at a steady rate. By 1990 several countries in Europe and North America had reached the plateau of having approximately one computer per classroom. However, as had been discovered earlier in the audiovisual era, access to the hardware does not equate to use (Plomp & Pelgrum, 1991; Pelgrum & Plomp, 1993). In these early years, student usage was primarily to learn *about* computers rather than to learn *with* computers. Building on the earlier Plomp and Pelgrum research, an international survey involving 22 countries (not including the USA or the UK) in 2006 found that virtually 100% of students in those countries had access to computers (Law, Pelgrum, & Plomp, 2008). However, teacher adoption varied greatly from place to place, from 20% to 80%, and increased access to computers did not correlate with students using them to master vital curricular skills. As seen in earlier audiovisual research, teachers' pedagogical orientation, as well as practical hurdles, determined how seriously they embraced the new technology to pursue curricular learning goals.

As profoundly as personal computers changed the information environment in the 1980s, the advent of the Internet in the 1990s changed it even more. The rapid increase in connections to the Internet in the early 1990s vastly expanded the potential for sharing information at a distance. As the World Wide Web became the most popular Internet protocol by around 1993, it became the de facto standard platform for sharing resources.

The Origins and Evolution of Instructional Design

The construct that is nowadays known as *instructional design* originally was referred to as *instructional systems design* (ISD). This construct represents a synthesis of developments that arose from different fields of study – especially industrial training protocols, military systems analysis, behavioral psychology, and pedagogical research. Each of these tributaries viewed ISD through a different lens, but their insights converged around a process that has similar features. Leslie Briggs's (1977) definition describes this synthesis:

> Instructional systems design—a systematic approach to the planning and development of a means to meet instructional needs and goals; all components of the system (objectives, instructional materials, tests, etc.) are considered in relation to each other in an orderly but flexible sequence of processes; the resulting delivery system is tried out and improved before widespread use is encouraged. (p. xxi)

Each of the tributaries is described below, followed by the story of how these influences flowed together to create the contemporary construct of *instructional design*.

Tributaries to Instructional Design

Industrial Training During Wartime, 1918–1945

When the USA entered World War I, the number of men who enlisted in the military created a critical skill shortage in the shipyards and other defense industries. The US Shipping Board engaged Charles R. Allen, a vocational educator, to devise a training system to fill the void (Griffiths, n.d.). Allen's four-step system, characterized as "Show, Tell, Do, Check," and his method for analyzing job tasks (Allen, 1919) were highly detailed and were used in a highly standardized fashion at hundreds of defense plants. A similar situation arose when the USA entered World War II in 1941. The Training Within Industry (TWI) Service built on Allen's work to create a standard training methodology that was implemented in over 16,000 defense plants in the USA, UK, and Canada (Griffiths, n.d.). After the war, the program was disbanded, but TWI was exported to Japan and Europe to help rebuild their industrial capability. Ironically, the methodology returned to North America when Toyota and other manufacturers established plants in the USA, bringing back TWI as part of the *kaizen* (continuous improvement) system (Dinero, 2005), and was still being applied into the 2020s.

TWI was not a direct contributor to the concept of instructional design, but the TWI system gives industrial training a standardized template for the design and delivery of training, establishing a widespread corporate mentality attuned to a standardized approach to training design, such as the systems approach.

Military Research and Development, 1941 Through the Early 1950s

The systems approach traces its origins to military research during World War II. 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 analyzing, creating, and managing man-machine operations, now referred to as *systems analysis*, was applied to the development of training materials and programs.

During the postwar period, each of the US 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 (McCombs, 1986). In the 1950s, the military services issued regulations specifying that newly developed

weapons must be treated as "man-machine *systems*," with operator training integrated into the total package provided by contractors (Dick, 1987). As the notion of *systems approach to instruction* evolved, it came to mean an approach that is both systemic and systematic: viewing a teaching-learning situation holistically and paying attention to the interplay of forces among the parts while devising solutions to problems in a step-by-step manner.

Programmed Instruction and the Development Process, the Late 1950s

Programmed instruction (PI), discussed above as a psychological technique that evolved into a technology, specified a process for developing PI software. 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. This demanded a commitment to evaluation and revision – "developmental testing" – 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* – more than the PI *format* itself – that made PI successful, epitomized by Markle and Tiemann (1967) in the phrase "programming is a process."

From Military Research to Pedagogical Principles, the 1960s

By the mid-1960s, prominent educational psychologists Robert Gagné (1965) and Robert Glaser (1962) were aggregating findings from research on learning in the military and industrial realms, as well as in schools. 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 did not attempt to lay out specific detailed procedures or models for ISD, but they did provide the pedagogical rationale for an approach such as ISD.

Societal Pressures Forge a Synthesis

By the 1960s, socioeconomic conditions in the USA became more receptive to technological solutions to problems in education and training. First, the "baby boom" of the immediate postwar period meant a rapidly growing population of school-age children, threatening to overwhelm conventional educational facilities, encouraging a search for technological tools to make teaching less labor-intensive. Second, the Cold War meant an adversarial posture between the Western European and American allies and the Soviet Union, which had demonstrated its technological superiority with the launching of Sputnik in 1957. The American response included the National Defense Education Act of 1958, which prioritized education in science and technology. Third, the 1960s was an era of social upheaval in North America and Europe, leading to new government programs to ameliorate poverty, including the Great Society social programs of President Lyndon Johnson.

The Job Corps, created in 1964, provided general and vocational education, technical training, and work experience at residential centers for young people from poverty backgrounds. Overnight a huge market was created for self-instructional materials for the tens of thousands of Job Corps learners. Thus 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. Several future contributors to the ISD movement, including Robert Morgan, Robert Branson, and Donald Tosti, among others, gained firsthand experience working in the learning industry on Job Corps projects (D. Tosti, personal e-mail communication, July 24, 2008).

Federal R&D funds from the Elementary and Secondary Education Act and the Higher Education Act of 1965 supported a large number of academic projects aimed at developing and testing systems approach models. Barson's Instructional Systems Development project, conducted at Michigan State University and three other universities, produced an influential model and a set of heuristic guidelines for developers (Barson, 1967). During this same period, Leonard Silvern at the University of Southern California began offering the first course in applying the systems approach to instruction, "Designing Instructional Systems," which was based on his military and aerospace experience. He also produced a detailed procedural model that influenced later model builders (Silvern, 1965).

In the early 1970s, Florida State University was selected by the US Department of Defense to develop procedures to substantially improve Army training. The 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) (Branson et al., 1975; Branson, 1978). The IPISD model eventually had enormous influence in military and industrial training because its use was mandated not only in all the US armed services but also among defense contractors. The many and varied ISD models that followed differed in details but typically adhered to a common conceptual framework: analyze, design, develop, implement, and evaluate. This conceptual framework came to be called by its acronym, ADDIE (Molenda, 2003).

Critiques and the ISD Concept Today

In the 1970s and 1980s, advocates for the systems approach attempted to promote its use in K-12 and higher education. These efforts struggled to gain traction, for reasons related to the social and economic dynamics of these institutions. However, ISD was welcomed in corporate and military training, where it became the reigning paradigm as a way to standardize design practices and make training more efficient and effective. By the early 1980s, more than 40 different ISD models sharing congruent "ADDIE" features were being used (Andrews & Goodson, 1981). By the end of the 1980s, skill in instructional design was viewed as the core competency of the instructional technology professional. By contrast, the development and

production of audiovisual materials – the previous mainstay of the profession – became a niche specialization, one that was often outsourced.

In the 1990s, advocates of constructivism raised questions about many instructional practices, including those associated with ISD. Constructivism may be viewed as a challenge to ISD either at the level of selecting instructional methods or at the broad philosophical level (Dick, 1997). At the instructional methods level, constructivism is a label for a learner-centered pedagogy based on widely accepted principles from cognitive psychology. The ISD process does not mandate any specific instructional methods. In fact, one of the classic works in ISD (Reigeluth, 1999) provides a compendium of instructional strategies and tactics available for use at the "design" stage of ISD, the majority coming from the cognitive perspective. Indeed, the psychological underpinnings of ISD have evolved over time, expanding upon its original behaviorist bias. After two decades of debate over the one "correct" theory to inspire instructional design, there seems to be a new consensus, represented 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.

A more recent alternative paradigm is the Successive Approximation Model (SAM) (Allen & Sites, 2012), which specifies an iterative process, beginning with a rough prototype modified through cycles of evaluation and revision. However, the notion of iterative progression toward a more finished product is central to ISD, as is evident in the earliest ISD textbooks and also the more recent. For example, in Handshaw's model, "prototype" appears at the center of the model (Handshaw, 2014). Another popular contemporary ISD textbook advocates a model in which evaluation and revision encompass every step in the process (Morrison, Ross, Morrison, & Kalman, 2019).

One of the most publicized critiques from the corporate domain (Gordon & Zemke, 2000) laid out a broad array of criticisms of an anecdotal nature. After a vigorous debate about the supposed deficiencies presented in the original article, Zemke and Rossett (2002) concluded that the flaws attributed to ISD lay more in how the process was executed rather than flaws in ISD as a conceptual framework.

Other critics feel that ISD, even if implemented adequately, still has deficiencies that limit its comprehensiveness. They suggest that design traditions in other disciplines – such as art, architecture, and software engineering – offer alternatives worthy of consideration (Molenda & Boling, 2008, pp. 119–122; Gibbons, 2014). Others are concerned about 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.

In the twenty-first century, ISD continued to enjoy widespread support, not only from practitioners but also from thought leaders. Prominent consultants, such as Darryl L. Sink & Associates (Sink, n.d.) and Handshaw Inc. (Handshaw, 2014); leading textbook authors, such as Gary Morrison and co-authors (2019) and Walter Dick and co-authors (Carey, Carey, & Dick, 2022); and the major performance standards organization, the International Board of Standards for Training,

Performance and Instruction (IBSTPI) (Koszalka, Russ-Eft, & Reiser, 2013), all continue to champion the systems approach as the standard for instructional design.

Conclusion

The field and profession of instructional technology has been evolving for over a century, beginning with the visual instruction movement, which promoted the use of slides and silent films for schools, colleges, and adult education. Technological innovations created new opportunities to expand the scope and refine the techniques of audiovisual instruction. US government investment in science and technology in the 1950s and 1960s built up the technological capacity of schools and colleges in the USA and drove research and development on a wide range of technological innovations, including psychological technologies. The process of instructional systems design grew out of military research melded with academic research on the instructional process. In the half century since its inception, ISD became and remains the dominant paradigm in the field of instructional design, and instructional design – intertwined with distance education – has become the central focus of the instructional technology profession.

The phenomenon that became known as *distance education* began outside the realm of instructional technology. Offering university credit for nonresidential study first gained serious traction in the mid-nineteenth century when an "external programme" was chartered at the University of London. This model was emulated at the University of Chicago and, later, Columbia University and the University of Wisconsin in the USA late in the nineteenth century as *correspondence study* (Molenda & Subramony, 2021, p. 12). When radios became widely available in homes, "schools of the air" emerged, often as part of the outreach efforts of universities. The correspondence-study model went through a paradigm shift in the 1970s, led by Britain's Open University, which employed broadcast radio and television supplemented by print and audio materials to present new material to learners. Students interacted with tutors, either at local learning centers or via telephone, to work through the material and complete assignments, with credit granted based on performance on coursework and examinations (Molenda & Subramony, 2021, p. 13). The label of *distance education* began to predominate, and its high-technology delivery system brought it into overlap with the world of instructional technology. This overlap only grew larger as distance education programs moved more and more toward online delivery.

As the delivery systems for technology-based instruction shifted from inside the classroom, to transmission through broadcast media, to incorporation in networked computers, to sharing via World Wide Web, instructional technology evolved from a field based largely in North America and Western Europe to one that is thoroughly global in practice and in perspective.

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