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Educational Systems Development and Its Relationship to ISD

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Banathy (1987) has identified four subsystems in any educational enterprise:

1. the **learning experience** subsystem, in which the learner processes information from the environment to produce new or modified cognitive structures,

2. the **instructional** subsystem, in which instructional designers and teachers use information about learning needs (gained through analysis activities), as well as administrative and governance input, to produce environments or opportunities for learners to learn,

3. the **administrative** subsystem, in which administrators use information about instructional needs, as well as governance input, to make decisions about resource allocation, including use of leadership, and

4. the **governance** subsystem, in which "owners" use their goals and values to produce policies and in other ways provide direction and resources for the educational enterprise in order to meet their needs (which usually include those of their learners, teachers, and administrators).

These four subsystems exist in all educational enterprises, regardless of context (e.g., public education, corporate training, health education, military training, higher education).

Instructional Systems Development (ISD) is the knowledge base about the instructional subsystem, whereas Educational Systems Development (ESD) is the knowledge base about the complete educational enterprise. Given that most of this book deals with ISD, this chapter first focuses on describing what ESD is and why it is needed, and then addresses the interdependencies between ISD and ESD.

WHAT IS ESD?

ESD is like ISD in several ways. First, both encompass knowledge bases for "process" and "product" (means and ends). (See table 6.1.) Regarding the *products* knowledge base, ISD instructional theory (see, e.g., Reigeluth, 1983; 1987) offers guidance as to what the instruction (the product of an ISD effort) should be like to be most effective, efficient, and appealing, for different situations (e.g., kinds of learning, learners, and learning contexts). In a similar way, ESD offers guidance as to what a new educational system (the product of an ESD effort) should be like for different kinds of needs and conditions in its suprasystem (e.g., in a community, for a K-12 educational system; or in a corporation, for a corporate training operation). This design is often referred to as a *vision* of a different paradigm of education, and includes a description of the features the new system should have to meet specific needs under given conditions (see, e.g., Reigeluth, 1994). Regarding the *processes* knowledge base, in ISD the numerous ISD models (see Gustafson, 1991, for a review; and see Dick & Carey, 1990, for an example) offer guidance as to what process an instructional development team should engage in to create a product of high quality. In a similar way, ESD offers guidance as to what process a systemic restructuring team should engage in for creating a new educational system of high quality.

Table 6.1.
The Knowledge Bases of ISD and ESD

	Process	Product
ISD	ISD Models	Instructional Theories
ESD	ESD Models	Visions (features)

A second similarity between ESD and ISD is their links to systems theory (Ackoff, 1981; Checkland, 1981) and design theory (Cross, 1984; Nadler, 1981). Both use *systems thinking* to understand and take into account the mutually interdependent relationships (1) between the new system (instructional or educational) and its suprasystem, (2) between the new system and its peer systems (other systems that are parts of the same suprasystem), and (3) among the many functions and components that compose the new system. Both ESD and ISD use *design theory* to inform the process. The fundamental elements of analysis, synthesis, and evaluation and the basic activities of design, development, and implementation are but the tip of the iceberg of design theory that is relevant to both endeavors. Furthermore, in the melding of systems theory and design theory, we understand that the ISD process is not linear—that there is much need for simultaneity and recursion during the process. The same is true for ESD.

Aside from these similarities between ESD and ISD, what really is ESD and why is it needed? ESD is concerned with creating a *new paradigm* of education, as opposed to making changes within the existing paradigm. It entails fundamental change and recognizes that a fundamental change in one aspect of a system requires fundamental changes in other aspects for it to be successful. In public education, it must pervade all levels of the system: classroom, building, district, community, state government, and federal government. Similarly, in corporate training, it must pervade all levels of the corporation. In this way, it can encompass not only the nature of the learning experiences and the instructional system, but also the administrative and governance systems. Such an approach to change is indeed radical, not to mention difficult and risky. So it is important to ask if we really need such a radical change.

WHY IS A NEW PARADIGM NEEDED IN EDUCATION?

Daniel Bell (1973), Alvin Toffler (1980), Robert Reich (1991), and others have identified several massive changes that our society has undergone: from the agrarian age to the industrial age, and now entering into what some call the information age.

The dawn of the industrial age brought with it massive changes in *all* of society's systems, including the family, business, and education. In fact, that is the only time in the history of the United States that education has undergone a paradigm change—from the one-room schoolhouse to the industrial, assembly-line model we have today. The current system is substantially the same as it was when we became an industrial society. The reforms that have been made since then have all been piecemeal changes.

Now that we are entering the information age, we find that paradigm shifts are occurring or will likely soon occur in *all* of our societal systems, from communications and transportation to the family and the workplace. It is little wonder that we again find the need for a paradigm shift in education. Society is changing in sweeping ways that make our current educational system obsolete, in all contexts—K-12, higher education, corporate education, health education, and so forth.

Changes in Society

Let's begin with a look at the family. The extended family in the agrarian age entailed the parents and children living together with grandparents and even aunts, uncles, and cousins. This form gave way to the nuclear family in the industrial age. In turn, the information age has given rise to a diversity of forms, including the single-parent family and the dual-income family. This societal change has important implications for the kinds of changes needed in education.

As a second case in point, businesses in the agrarian age were organized around the family: the family farm or the family trade (e.g., bakery, carpentry). The family represented the organizational structure and determined the lines of authority. This structure gave way to the bureaucratic form of organization in the industrial age. Today, corporations are restructuring to create horizontal "enterprise webs" in place of vertical layers of middle managers (Reich, 1991). Transformations based on team approaches, total quality management, process orientation, and technological imperatives are rapidly changing the structure of businesses worldwide.

Of all our societal systems, business is the most user-driven (client-driven), so it has naturally been among the first to systemically transform itself (Ackoff, 1981). However, *all* our other societal systems, including education, health, legal, and political, are also becoming increasingly dysfunctional as we evolve deeper into the information age; systemic transformation will be needed—and is inevitable—in all these areas, including education.

Educational systems are like transportation systems in some important ways. Like the one-room schoolhouse, the horse was ideally suited to the agrarian age. It was highly flexible and individualized. But as we evolved into the industrial age, the transportation needs of society began to change. It became necessary to transport large quantities of raw materials and finished goods to and from factories. Rather than (or in addition to) trying to improve the prevailing system, an alternative paradigm was developed—the railroad. Like our current educational system, it offered a quantum improvement in meeting the new needs of the industrial age, but everyone had to leave from the same place at the same time and travel at the same rate to the same destination (or be dropped off somewhere along the way).

Since the dawn of the information age in the 1950s, America's transportation needs have again been changing in dramatic ways. Again we have turned to a new paradigm, a combination of the automobile and the airplane. Similarly, society has been changing in such dramatic ways (see table 6.2) that we need a new educational system that is as different from our current system as the automobile and airplane are from the railroad. Like the new transportation system, the

new educational system may develop in parallel with the current system, be separate from but coexist with it, and slowly grow while the current system slowly declines. New roles will require new skills, and new resources and facilities will also be required, so it is simply not logistically possible to change the current system everywhere at once.

Table 6.2.
Major Paradigm Shifts in Society

Society:	Agrarian	Industrial	Information
Transportation:	Horse	Train	Plane & car
Family:	Extended family	Nuclear family	Single-parent family
Business:	Family	Bureaucracy	Team
Education:	One-room schoolhouse	Current system	?

Clearly, paradigm shifts in society cause (or require) paradigm shifts in *all* societal systems. This explains why educational performance has generally declined in the United States since the 1960s while educational costs have dramatically increased. Furthermore, it indicates that the situation will continue to get worse no matter what piecemeal changes we make and no matter how much money we pour into the current system—unless we change the paradigm.

Relationships Between Society and Education

The need for a new paradigm of education is based on massive changes in both the conditions and educational needs of an information society. Therefore, we must look at those changes in order to figure out what features the new system should have. Table 6.3, page 88, shows some of the major differences between the industrial age and the emerging information age. These differences have important implications for the features of the new educational system: how it should be structured, what should be taught, and how it should be taught.

Although we can see it beginning to change, our current system has been characterized by adversarial relationships not only between teachers and administrators, but also between teachers and students and often between teachers and parents. Consolidated districts have been highly bureaucratic, centrally controlled autocracies in which students get no preparation for participating in a democratic society. Leadership has been vested in individuals according to a hierarchical management structure, and all those lower in the hierarchy have been expected to obey the leader. Learning has been highly compartmentalized into subject areas. Students have typically been treated as if they are all the same and have all been expected to do the same things at the same time. They have also been forced to be passive learners and passive members of their school community. These features of our current system must all change (and have indeed begun to change), for they are counterproductive—harmful to our citizens and our society—in the information age.

Table 6.3.
Major Differences Between the Industrial Age and the
Information Age That Affect Education

Industrial Age	Information Age
Adversarial relationships	Cooperative relationships
Bureaucratic organization	Team organization
Autocratic leadership	Shared leadership
Centralized control	Autonomy with accountability
Autocracy	Democracy
Conformity	Diversity
Compliance	Initiative
One-way communications	Networking
Compartmentalization (Division of labor)	Holism (Integration of tasks)

In the industrial age we needed minimally educated people who would be willing and able to put up with the tedium of work on the assembly lines. However, those assembly-line jobs are rapidly becoming an endangered species. Just as the percentage of the work force in agriculture dropped dramatically in the early stages of the industrial age, so the percentage in manufacturing has been declining dramatically over the past few decades. As Reich (1991) points out, even in manufacturing companies, a majority of the jobs today entail manipulating information rather than materials. Just as the industrial age represented a focus on, and extension of, our physical capabilities (mechanical technology), so the information age represents a focus on, and extension of, our mental capabilities (intellectual technology). This makes effective learning paramount. Surprisingly, our current system is not designed for learning!

Systems Thinking Applied to Learning

Two things educators know for certain are that different people learn at different rates and different people have different learning needs, even from their first day at school. Yet our industrial-age educational systems present a fixed amount of content to a group of learners in a fixed amount of time, so it is like a race to see who receives the A's and who flunks out. Our current systems are typically *not* designed for learning; they are designed for selection. Again, this is true in corporate and other contexts, not just K-12 education.

To emphasize learning, the new system must no longer hold time constant and allow achievement to vary. It must hold achievement constant at a competency level and allow learners as much time as they need to attain competence. There is no other way to accommodate the facts that different people learn at different rates and have different learning needs. However, to have an *attainment-based* rather than time-based system, we must in turn have *person-based progress* rather than group-based progress. That in turn requires changing the role of the teacher to that of a *coach* or facilitator/manager, rather than that of dispenser of knowledge to groups of learners who pass by at the ring of a bell like so many little widgets on an assembly line.

If the teacher is to be a facilitator and educational manager, learning must occur primarily from sources other than the teacher or trainer. Hence, the system must be *resource-based*, utilizing powerful new tools offered by advanced technology, rather than teacher-based. In addition, it requires much more collaboration and teamwork among students, including *cooperative*

learning and cross-age tutoring, rather than our industrial-age view that collaboration among students equates with cheating.

Interestingly, the industrial age not only made a new system of transportation—the railroad—necessary (to ship large quantities of raw materials and finished goods to and from factories), but it also made the railroad possible (with its manufacturing technology). In a similar way, the information age has not only made a new educational system necessary, but has also made a new system possible (with its information technologies). We now have powerful tools to facilitate learning that we did not have a few years ago. And the power of those tools continues to increase, while their cost continues to decline dramatically.

Hence, based on changes in the workplace, the emerging picture of the new educational system includes the changes shown in table 6.4.

Table 6.4.
Emerging Picture of Features for an Information-Age
Educational System Based on Changes in the Workplace

Industrial Age	Information Age
Grade levels	Continuous progress
Covering the content	Attainment-based learning
Norm-referenced testing	Individualized testing
Nonauthentic assessment	Performance-based assessment
Group-based content delivery	Personal learning plans
Adversarial learning	Cooperative learning
Classrooms	Learning centers
Teacher as dispenser of knowledge	Teacher as coach or facilitator of learning
Memorization of meaningless facts	Thinking, problem-solving skills, and meaning making
Isolated reading, writing skills	Communication skills
Books as tools	Advanced technologies as tools

Education and Systemic Changes in the Family

The information-age family also has important implications for the new K-12 educational system. Given the predominance of single-parent families and dual-income two-parent families in advanced countries, parenting is not occurring today as it did in the industrial age. Latch-key children are just the "tip of the iceberg" regarding the shortage of communication, caring, and structure that students receive in the home. Add to that the increasing incidence of mental and physical child abuse and the alarming increase in the number of "crack babies" and children born with other chemical-abuse problems, and we can see that our society will face very severe social problems 20 years from now if our educational system does not team up with other social service agencies to become a system of learning and human development—a system that is concerned with the development of the whole child, not just the child's mental development.

In the new K-12 educational system, the "school" needs to become a caring environment, just as the information-age workplace is becoming a caring environment. Our current K-12

system seems to have been designed to be just the opposite. Not only do we require students to change teachers every year, but we require them to change every 45 minutes! And teachers only see students in large groups, as if to minimize personal interaction. Schools are often so large that an atmosphere of impersonality, bureaucratic control, and helplessness results in feelings of anonymity and behavioral problems. We need to create smaller "schools within the school" that operate independently of one another, and each child needs a mentor who will stay with her for a number of years, perhaps a developmental stage of her life. The mentor should be concerned with the development of the whole child, including all of Gardner's (1987) "seven intelligences" and more: mental, physical, emotional, creative, social, psychological, and ethical (see table 6.5).

Table 6.5.
Emerging Picture of Features for an Information-Age
Educational System Based on Changes in the Family

- A "teacher" is responsible for a child for a period of about 4 years.

- That teacher is responsible for educating the *whole* child.

- Each school has no more than 10 teachers, to create a smaller, caring environment (the notion of schools-within-a-school).

- Each student develops a quarterly contract with the teacher and parents.

INTERDEPENDENCIES BETWEEN ISD AND ESD

ESD and ISD are interdependent in that each relies on the other to some degree for its success.

ESD Needs ISD

There are at least two major ways in which ESD is dependent on ISD. First, because ESD is a new knowledge domain and ISD is more fully developed, ESD can benefit from *building on what we know* about ISD. The ISD process can contribute many insights as to what a successful ESD process might be like, including knowledge about analysis, design, development, implementation, and evaluation. In addition, ISD professionals have design skills and a systems perspective that are both much needed in ESD. Therefore, ESD should actively recruit ISD professionals and build on what they have learned about the systems design process.

Second, the new paradigm of education requires *well-designed resources*. Without high-quality resources, the new system will not come anywhere near reaching its potential to improve education. ISD is needed (both the ISD process and instructional theory) to create such quality resources.

ISD Needs ESD

There are at least three major ways in which ISD is dependent on ESD. First, ISD professionals understand that they can better meet learners' needs by personalizing their instructional systems. However, doing so usually *requires significant changes in the larger organization* (administrative and governance systems) for their success. All too often ISD professionals have had to settle for second-rate instructional designs because of organizational constraints. ESD can provide insights and assistance to ISDers to bring about the necessary organizational changes that make higher-quality instructional systems workable.

Second, ESD will open a whole *new clientele* to ISDers. K-12 schools currently have little incentive for using ISD to improve the quality of instruction. However, in the new paradigm, the greater emphasis on well-designed resources will create a higher demand for ISD expertise. Most public schools that are restructuring are placing greater emphasis on teacher-made materials to replace textbooks, and school districts are increasingly establishing the position of curriculum specialist (also referred to as educational technologist or instructional consultant) to support such teacher efforts (see, e.g., Kemp, in press).

Third, ESD helps ISD to see the need for *new directions in instructional theory*. More constructivist approaches, such as problem-based learning (Albanese & Mitchell, 1993; Barrows & Tamblyn, 1980; West, 1992), offer great potential to help learners acquire such qualities demanded by the information age as initiative, responsibility, problem-solving competence, team-building and group-process skills, and communication skills. Instructional theory must be developed to help ISDers create instructional systems that support such learning experiences. In particular, instructional theory is needed to provide guidance on creating an engaging problem space/scenario, on designing personalized, interactive skill-builders, and on creating powerful tools to help learners build causal models (e.g., through multimedia simulations).

SUMMARY

When we look at the ways society is changing as we evolve deeper into the information age, we can see definite paradigm shifts in the workplace and the family, and a growing need for paradigm shifts in virtually all other societal systems. From those changes, we can see that a new paradigm of education is essential to meet the new educational needs of both learners and the suprasystems that sponsor the educational systems. Furthermore, we can identify some general features that an information-age educational system should have to meet the new needs: continuous progress, attainment-based learning, individualized testing, performance-based assessment, personal learning plans, cooperative learning, learning centers, teacher as coach or facilitator of learning, thinking and problem-solving skills and meaning making, communication skills, and advanced technologies as tools.

To foster the advent of this new paradigm of education, an ESD knowledge base is under development and is similar in many ways to the ISD knowledge base: It has process and product components, and it is based on systems theory and design theory. Furthermore, there are strong interdependencies between ESD and ISD. ESD needs ISD to build on what it has learned about the systems design process and to recruit people who have expertise in systems thinking and the design process. ISD needs ESD because it often requires significant changes in the larger organization, it opens up a whole new clientele, and it offers insights into new directions for instructional theory.

Educators must begin to use ESD's needs-based, systems-design approach to improving education in all contexts. Without such an approach, we will almost certainly be condemned to a system that no longer meets our educational needs.

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