Instructional-Design Theories and Models Volume III

Building a Common Knowledge Base

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Instructional Theory for Education in the Information Age

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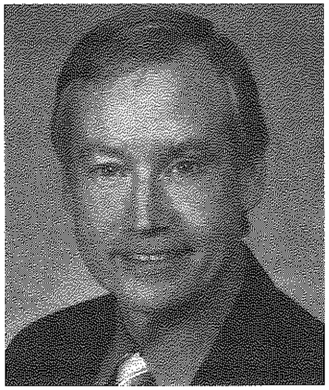

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EDITORS' FOREWORD

Vision

- *To portray the relationship between instructional theory and the information-age paradigm of education*

Educational systems and their suprasystems' needs

- *Information-age educational needs are substantially different from industrial-age educational needs.*
- *Our educational systems must transform to a customized, learning-focused paradigm of education (from a standardized, sorting-focused paradigm).*

Instructional systems and their suprasystems' needs

- *Information-age educational needs are substantially different from industrial-age educational needs.*
- *Learning experiences must be designed to meet those new educational needs.*
- *Instructional theory must be designed to foster those learning experiences.*

Vision of an information-age educational system

Foundational principles

- *Customization and diversity*
- *Initiative and self-direction*
- *Collaboration and emotional development*
- *Holism and integration*

Main features

- *Attainment-based progress*
- *Personal record of attainments*
- *Criterion-based assessment*
- *Customized, flexible progress*
- *Customized, flexible goals*
- *Customized, flexible methods*
- *Personal learning plan*
- *New teacher roles (e.g., caring mentor, designer of student work, facilitator of the learning process)*
- *New student roles (e.g., worker, self-directed learner, teacher)*
- *Parents as partners in learning*
- *Community-based learning*
- *New roles for technology*

Main roles for technology

- *Record keeping for student learning (standards inventory, personal attainments inventory, personal characteristics inventory)*
- *Planning for student learning (develop a contract that specifies goals, projects, teams, parent and teacher roles, and the deadline for each project)*

- *Instruction for student learning (e.g., simulations, tutorials, drill and practice, research tools, communication tools, and learning objects). Instructional-event theory plays the largest role here.*
- *Assessment for (and of) student learning (integrated with instruction, use authentic tasks, provide immediate formative feedback, certify student attainments—summative assessment)*
- *These four major roles are seamlessly integrated, and such a comprehensive learning management system (LMS) serves other roles, as well.*

How instructional theory can help

- *We need sound guidance for the conduct of all teacher roles: mentor, designer, and facilitator.*
- *We need sound guidance for the design of technology's instructional roles.*
- *This common knowledge base must address systems of methods based on both means (approaches) and ends (outcomes) of instruction.*
- *We need sound guidance for the design of the other three major functions for technology —record-keeping, planning, and assessment systems—all seamlessly integrated with instructional systems.*

—CMR & ACC

INSTRUCTIONAL THEORY FOR EDUCATION IN THE INFORMATION AGE

The primary theme of this book is the need to build a common knowledge base for instruction. Toward that end, it has presented a framework and set of instructional theories and offered some terms for a common language, to initiate a dialogue about that common knowledge base. However, an important principle of systems theory is that a system must meet the needs of its suprasystem.[1] This chapter explores the relationship between this common knowledge base about instructional systems and the larger systems of education that they serve.

Educational Systems and their Suprasystems' Needs

Systems theorists have long shown that social systems must meet the needs of their suprasystem in order for that larger system to sustain them (Banathy, 1996; Checkland & Scholes, 1990). For example, a business must meet a need in its community (however small or large that community may be) in order for the community to be willing to give it resources (money). Similarly, a school system must meet the needs of its community in order for that community to continue to provide the school system with sufficient tax money and students.

The challenge today is that our society and the communities that comprise it have changed in significant, large-scale ways, as we have evolved from the

1. A suprasystem is a larger system in which a system is a part (a subsystem).

industrial age to the information age (see Reigeluth, 1999, chapter 1; chapter 1 in this volume). Knowledge work has replaced manual labor as the predominant form of work. There is a much greater need now for lifelong, self-directed learning. There is much greater complexity in our societal systems and technological tools, creating a much stronger need for such types of learning as higher-order thinking skills, problem-solving skills, systems-thinking skills, collaboration skills, emotional development, and character development.

Our educational system was designed for a different era—the industrial age—in which standardization and compliance were needed above all else. The dramatic change in the educational needs of our society is reminiscent of the transformative change in transportation needs that occurred as we evolved from the agrarian age to the industrial age. It became necessary to ship large quantities of raw materials and finished goods to and from factories. To try to improve the horse-and-wagon transportation system to meet these new needs could only provide a slight improvement in meeting those new needs. Turning to a different paradigm, the railroad provided a quantum improvement (an order of magnitude) in meeting the new needs. In a similar way, trying to improve the industrial-age educational system, with its one-size-fits-all, sorting-focused structure (see chapter 1), can at best only provide a slight improvement in meeting the new educational needs of the information age. Transforming it to a customized, learning-focused educational system can provide a quantum improvement in meeting the new educational needs. This has important implications for instructional theory, which I will address shortly.

Instructional Systems and their Suprasystems' Needs

Instructional systems are embedded within educational (or training) systems and therefore must also meet the needs of their suprasystem. Banathy (1991) identified four subsystems that can be viewed as levels of any educational system, and each of those subsystems has a primary process to be performed by a primary agent. The *learning experience system* resides primarily in the student and is focused on the process that a student goes through while learning. The *instructional system* resides primarily in the teaching agent (such as a teacher, textbook, or computer), whose primary process is providing instruction to facilitate the learning experience. The *administrative system* resides primarily in the administrators (such as the principal and the central office personnel), whose primary process is managing the instructional system, among other subsystems (financial, transportation, etc.). And the *governance system* resides primarily in the school board and other policymakers (on the national, state, and district levels), whose primary process is formulating policies to direct the administrative and instructional systems. Banathy proposes that the desired learning experiences should drive the design of the instructional system, which in turn should drive the design of the administrative system, and all of those systems should drive the design of the governance system.

The learning experiences must be designed in such a way as to meet the needs of the larger educational system, which in turn must be designed in such a way as to meet the needs of the information-age society in general and each community and student in particular. Otherwise, there will be continual dissatisfaction with, and turmoil in, our educational systems. And instructional theory must be designed to foster those learning experiences. Next, this chapter proposes a vision of an information-age paradigm of education in the form of (1) some principles that are based on the educational needs of an information-age society and (2) some features that the information-age paradigm of education might possess in order to implement those principles. Finally, it addresses how instructional theory can be most helpful in supporting this customized, information-age paradigm of education.

A Vision of an Information-Age Educational System

Based on the emerging educational needs of the information age, I propose that the new paradigm of education must be grounded in the following "Foundational Principles":

- **Customization and diversity.** First, different students learn at different rates. It is a waste of human potential to make some students wait for the rest of the class after they have learned what was being studied, just as it is a waste to make some students move on before they have learned it. Second, given the far greater complexity of our information-age society, we need citizens who have a much broader range of expertise than during the industrial age. Therefore, we must teach students different attainments from each other, capitalizing on their particular talents and strengths (in addition to a common core of "essential" attainments). Third, different students learn best in different ways. Therefore, we need to offer different instructional methods to different students—methods as different as those presented in unit 2 on different approaches to instruction. In sum, we need our students to be diverse (to learn different things, customized to their talents and interests), and we need our instruction to be diverse (to help students learn in different ways and at different rates, customized to their diverse profiles of strengths and intelligences).
- **Initiative and self-direction.** Given that students today can expect to have over 10 jobs in their lifetimes (http://www.bls.gov/news.release/pdf/nlsoy.pdf), and given the rapid rate at which technology and information change in many knowledge-work jobs, our society needs people who are lifelong learners. This means we need to cultivate in our students both a love of learning and the skills for learning. We need to help students become self-directed learners and develop a mindset of taking initiative in both problem solving and their own learning. This principle has been incorporated into many of the instructional theories in this volume.

- **Collaboration and emotional development.** Given that employers in the information age are increasingly organizing their knowledge workers into teams, and given that research has shown that emotional intelligence is more important than cognitive intelligence to one's success in life (see chapter 12), students need to develop their inter- and intrapersonal skills and knowledge. Just as the values and habits of compliance and conformity were taught in the "hidden curriculum" of the industrial-age paradigm, the values and habits of getting along well with others and understanding one's own emotions, strengths, and weaknesses must be taught in the hidden curriculum of the new paradigm. Learning experiences—and instructional theories—must be conceived in ways that foster the development of these qualities.
- **Holism and integration.** Given the increasing complexity of our systems in the information age, it is ever more important that we develop an understanding of systems thinking—the causal dynamics that underlie the behavior of our systems, such as biological, social, ecological, organizational, physical, and technological systems. All the various school subjects are inextricably interrelated, and it is a serious disservice to students to teach them in isolation from one another. It is also a serious disservice to just address the cognitive development of students, for social, emotional, psychological, physical, and all other aspects of human development are important and are interrelated with each other. Obesity, drug use, bullying, violence, teen pregnancy are but a few of the consequences of not addressing all aspects of human development. Also, research has shown the importance of emotion to successful cognitive learning (Greenspan, 1997). In the information-age paradigm of education, we must treat both the student and the content holistically. Certainly, methods for integrated learning (chapter 13) offer important guidance for implementing this principle.

Main Features for an Information-Age Educational System

Given these foundational principles, what should the instruction be like in the information-age paradigm of education? This is a central concern for instructional theory. The following are some of the main features that I propose, in the spirit of opening an active dialogue.

Attainment-Based Progress Perhaps the most important feature, to change the system from a sorting focus to a learning focus, is to change the student's progress from being time-based to being attainment-based. Rather than moving on to a new topic because it is Monday, students only move to a new topic when they master the current one.

Personal Record of Attainments To have attainment-based progress, it is clearly important to keep track of what each student has learned. In this record of attainments, each attainment is checked off as it is reached (creating an inventory of what the student has learned), and many attainments are accompanied by evidence, such as artifacts of various kinds (creating an electronic portfolio). The personal record of attainments provides an important basis for decisions about what is within reach to learn next (within Vygotsky's "zone of proximal development," 1978).

Criterion-Based Assessment The personal record of attainments also requires a change from norm-based assessment, in which students are compared with each other, to criterion-based assessment—a different paradigm of assessment in which student learning is compared to a standard or set of criteria. This requires setting a standard (and sometimes a progression of standards) for each attainment (see chapter 15), as well as assessment criteria.

Customized, Flexible Progress In attainment-based progress, a student is not forced to move on to a new topic *before* she has mastered it, and she is also allowed to move on to a new topic *as soon as* she has mastered it. In this way, every child succeeds, even those who are severely learning disabled. Some take longer than others and learn less in a year, but each learns to her maximum ability. The major concern that is voiced about this feature is that it is unmanageable or too expensive. I later address how technology makes it possible to manage all students' progress efficiently.

Customized, Flexible Goals As mentioned earlier, there is (1) a societal need for people who have very different kinds of expertise, and (2) a personal need for people to cultivate their individual talents and interests. While there is certainly a core of common knowledge that all students (citizens) should have, the information-age educational system also allows a considerable amount of learning time to be devoted to goals that each student and his parents think are important.

Customized, Flexible Methods Because students learn best in different ways, teachers provide different kinds of learning opportunities (different kinds of instructional methods). Those methods cater to the strengths of each student (see, e.g., Levine, 2002), but some methods are also chosen to cultivate students' strengths in different learning styles and formats, with guidance to support cultivating those new strengths. This is where instructional-event theory (see chapter 1) needs to play the biggest role, and teachers desperately need good guidance about which methods to use when.

Personal Learning Plan To manage customized attainment-based progress, customized goals, and customized methods, each student needs a personal learning plan, somewhat similar to the individualized education plans (IEPs) currently used in special education. This plan takes the form of a contract that is developed every so often (perhaps about two months) by the student, his parents, and a mentor-teacher. They jointly set the goals, but also plan the means and the deadlines, complete with milestones. This helps the student develop expertise in project planning, meeting deadlines, and self-directed learning.

New Teacher Roles To provide this kind of customized instruction, the teacher's role has to change from the "sage on the stage" to the "guide on the side." However, there are several roles involved in being a guide. First, the teacher is a *caring mentor*, a person who is concerned with the full, well-rounded development of the child. A mentor-teacher is responsible for perhaps 25 children of different ages for the span of a developmental stage in the child's life (typically about three or four years). Second, the teacher is a *designer of student work* (Schlechty, 2002). The student work may include project-based learning, experiential learning, discussion-based learning, skill-based tutorials, and all the other "galaxies" of methods described in units 2 and 3 of this book. Third, the teacher is a *facilitator of the learning process*. This includes helping to develop a personal learning plan, coaching or scaffolding the student's learning when appropriate, facilitating discussion and reflection, and arranging availability of various human and material resources. These are only three of the most important new roles that teachers serve, but not all teachers perform all the roles. Different kinds of teachers with different kinds and levels of training and expertise are involved (including students as teachers; see the next section).

New Student Roles First, learning is an active process. The student must exert the effort. The teacher cannot do it for the student. This is why Schlechty (2002) characterizes the new paradigm as one in which *the student is the worker*, not the teacher, and that the teacher is the designer of the student's work. Second, to prepare the student for lifelong learning, the teacher helps each student to become a *self-directed and self-motivated learner*. Students are self-motivated to learn when they first go to school. The industrial-age paradigm systematically destroys that self-motivation by removing all self-direction and giving students boring work that is not relevant to their lives. In contrast, the information-age system is designed to nurture that self-motivation through self-direction and active learning. Student motivation is the key to educational productivity and helping students to realize their potential. It also greatly reduces discipline problems, drug use, and much more. Third, it is often said that the best way to learn something is to teach it. Students are perhaps the most underutilized resource in our school systems. Furthermore, someone who has just learned something is often better at helping someone else learn it than is someone who learned it long ago. In addition to older students teaching slightly younger ones, peers can learn from each other in collaborative projects, and they can also serve as peer tutors. Therefore, new student roles include student as worker, self-directed learner, and teacher.

Parents as Partners in Learning Parents can do much to help their children learn. In some homes they already do; but in all too many they do not, and this creates a handicap for their children that the industrial-age educational system is unable to address. In an information-age educational system, parents are required to meet with the teacher and student to create each new personal learning plan, or contract. The role of the parents in supporting the child's learning is specified in that contract. In some cases, the plan and the work are designed for parents to learn with their child to advance their own education. Since the mentor-teacher is concerned with the whole, well-rounded development of the child, the teacher also supports the parents in their parenting skills. Anyone who has seen the "nanny" shows on TV knows how useful and appreciated this can be for the parents. This certainly requires some special training, and for extreme cases, like those shown on TV, a local social service agency partners with the teachers.

Community-Based Learning The community is involved in many ways. Some projects are designed to address community problems. Some community organizations and individuals serve as volunteers for offering service-learning projects. Some serve as mentors for students in a partnership with the teacher-mentor. Special relationships are developed with such community organizations as museums, zoos, libraries, hospitals, boys and girls clubs, town and county governments, correctional facilities, police and fire departments, and much more.

New Roles for Technology Just as customized learning requires new roles for teachers, students, parents, and the community, it also requires new roles for technology. In fact, the kind of customization described in this vision would be next to impossible for a teacher to carry out without technology. This is such an important feature for the Information-Age paradigm of education that the following section is devoted to describing it.

The Main Roles of Technology in an Information-Age Educational System

I currently see at least four main roles or functions for technology to make the kind of customization and learning focus described above feasible and cost-effective. Each of these is described next.

Record Keeping For Student Learning The personal record of attainments for each student, described earlier, could be a nightmare for teachers to maintain. Here is a role that technology is ideally suited to play, and it saves teachers huge amounts of time. It replaces the current report card, and it has three parts. First, it has a *Standards Inventory* that contains both required educational standards (national, state, and local) and optional educational standards for access by the teacher, student, and parents. Domain theory (see chapter 15) is highly instrumental for designing this technological tool. It presents a list of things that should or can be learned, along with levels or standards or criteria at which they can be learned. Second, it has a *Personal Attainments Inventory* that contains a record of what each student knows. In essence, it maps each student's progress on the attainments listed in the Standards Inventory (and perhaps some that are not yet listed there). It shows when each attainment was reached, which ones are required, what the next required attainments are in each area, and links to evidence of each attainment (in the form of summary data and/or original artifacts). Third, it has a *Personal Characteristics Inventory* that keeps track of each student's characteristics that influence learning, such as learning styles, profile of multiple intelligences, student interests, and major life events.

Planning for Student Learning The personal learning plan, or contract, could also be very difficult for teachers to develop for all of their students. Here, again, is a role that technology is ideally suited to play. It helps the student, parents, and teacher to (1) decide on *long-term goals*; (2) identify the full range of attainments that are presently *within reach* for the student; (3) select from those options the ones that they want to pursue now (*short-term goals*), based on requirements, long-term goals, interests, opportunities, etc.; (4) identify *projects* (or other means) for attaining the short-term goals; (5) identify *other students* who are interested in doing the same projects (if desired); (6) specify the roles that the teacher, parent, and any others might play in supporting the student in learning from the project; and (7) develop a contract that specifies goals, projects, teams, parent and teacher roles, and the deadline for each project.

Instruction for Student Learning Trying to "instruct" 25 students who are all learning different things at any point in time could be very difficult for teachers if they had to be the instructional agent all the time, as is typical in the industrial-age paradigm. However, technology can introduce the project to a student (or small team), provide instructional tools (such as simulations, tutorials, drill & practice, research tools, communication tools, and learning objects) to support learning during the project, provide tools for monitoring and supporting student progress on the project, and even provide tools to help teachers and others develop new projects and instructional tools. Instructional-event theory (see chapter 1) is direly needed here, as are instructional-planning theory and instructional-building theory.

Assessment for (and of) Student Learning Once more, conducting formative and summative assessments of students could be a nightmare for teachers, since students are not all taking a given test at the same time. And once again, technology can offer great relief. First, assessment is *integrated with instruction*. The plentiful performance opportunities that are used to cultivate skills and

understandings are used for both formative and summative assessments. Second, the assessments present *authentic tasks* on which the students demonstrate their knowledge, understanding, and skill. Third, whether in a simulation or a tutorial or drill and practice, the technology is designed to evaluate whether or not the criterion was met on each performance and to provide *formative feedback* immediately to the student for the greatest impact. When the criteria for successful performance have been met on x out of the last y performances, the *summative assessment* is complete and the corresponding attainment is automatically checked off in the student's personal inventory of attainments. In the few cases where the technology cannot assess the performance, an observer has a handheld device with a rubric for assessment and personally provides the immediate feedback on student performances. The information from the handheld device is uploaded into the computer system, where it is placed in the student's personal inventory. Finally, technology provides tools to help teachers develop assessments and link them to the standards. Instructional-evaluation theory is critical for technology to reach its potential contribution to this role.

Note that these four roles or functions are seamlessly integrated. The record keeping tool provides information automatically for the planning tool. The planning tool identifies instructional tools that are available. The assessment tool is integrated into the instructional tool. And the assessment tool feeds information automatically into the record keeping tool. The label that comes the closest to describing this kind of comprehensive, integrated tool is *learning management systems* (LMS; Reigeluth et al., 2008; Watson, Lee, & Reigeluth, 2007). Also, please note that there are many other roles or functions for such a learning management system. These secondary functions include communications (e-mail, blogs, Web sites, discussion boards, wikis, whiteboards, instant messaging, podcasts, videocasts, etc.); LMS administration (offering access to information and authority to input information based on role and information type); general student data (student's address, parent/guardian information, mentor-teacher and school, student's location/attendance, health information); school personnel information (address, certifications and awards, location, assigned students, tools authored, student evaluations that they have performed, teacher professional development plan and records, repository of teaching tools, awards their students have received); and more.

It should be apparent that technology will play a crucial role in the success of the information-age paradigm of education. It will enable a quantum improvement in student learning, and likely at a lower cost per student per year than in the current industrial-age paradigm. Just as the electronic spreadsheet made the accountant's job quicker, easier, and less expensive, the kind of LMS described here will make the teacher's job quicker, easier, and less expensive. But instructional theory is sorely needed for technology to realize its potential contribution.

How Instructional Theory Can Help

This is but one speculative vision of the information-age paradigm of education. It is by no means certain that this is what the new paradigm will be like. One thing that is certain, however, is that paradigm change to customized instruction *will* happen in education. It is as inevitable as was the change from the agrarian-age paradigm (the one-room schoolhouse) to the current paradigm at the dawn of the industrial age. Think about how different and more complex our current paradigm is than the one-room schoolhouse. The new paradigm will be even more different, and the difference in complexity will be even greater. It is also likely that there will be far more diversity within this new paradigm than there is in our current paradigm.

While the vision described here is by no means certain, it is grounded firmly in an assessment of the educational needs of the information-age society—educational needs that are vastly different from those of the industrial age. Those needs are represented in the foundational principles described earlier. And the features described herein respond directly to those principles. Of course, other features may also respond to those principles and will likely represent much of the diversity of the new paradigm. I encourage readers to explore other features that might respond better to those principles.

My main reason for asking you to think about a vision for the information-age paradigm of education is that we need instructional theorists to contribute to a common knowledge base for the new paradigm, not for the paradigm of a bygone era. We need sound guidance for the conduct of all teacher roles: mentor, designer, and facilitator. We also need sound guidance for the design of technology's instructional roles. Both of these forms of guidance need to address all of the means and ends of instruction: means like the direct approach (chapter 5), discussion approach (chapter 6), experiential approach (chapter 7), problem-based approach (chapter 8), and simulation approach (chapter 9); and ends like memorization outcomes, skill outcomes (chapter 10), understanding outcomes (chapter 11), affective outcomes (chapter 12), and integrated learning outcomes (chapter 13). We need to move beyond isolated instructional theories to developing a common knowledge base for instruction that will meet the needs of the information-age paradigm.

We also need sound guidance for the design of the other three major functions for technology—record-keeping systems, planning systems, and assessment systems—all seamlessly integrated with instructional systems.

In this third and final volume in the trilogy of *Instructional-Design Theories and Models*, we have offered an understanding of the nature of instructional theory (chapter 1), the nature of instruction (chapter 2), the universal "first principles" of instruction (chapter 3), the situational nature of instruction (chapter 4), the architecture of instructional theory with its layers of design (chapter 14), domain theory for mapping attainments (chapter 15), learning objects (chapter 16), and approaches to theory building (chapter 17). Ali Carr-Chellman and I share the

hope that these will help those of you who want to contribute to meeting these pressing needs to make the information-age paradigm of education a reality.

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