Instructional Design and Development of Learning Communities: An Invitation to a Dialogue

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Our goal in this article is to encourage discussion among members of the instructional design community and members of research groups who are attempting to transform typical classrooms into "learning communities." A strength of the instructional design community is its efforts to articulate, manage, and systematize the processes involved in designing effective learning environments. A strength of researchers attempting to create "learning communities" is their emphasis on new sets of principles that have important implications for the nature of teaching, learning, and assessment. By discussing insights from these two communities, we hope to begin a conversation that strengthens the communication and collaboration between the two.

The structure of this article is as follows:

(1) an overview of frameworks for instructional design;
(2) a brief discussion of some key principles of learning communities;
(3) an exploration of relationships between the concept of learning communities and instructional design frameworks; and
(4) further issues in designing and understanding learning communities.

The Cognition and Technology Group at Vanderbilt (CTGV) is a collaborative, multidisciplinary group made up of approximately 70 individuals from a variety of disciplines. All CTGV projects are based on social and cognitive theories of learning and development, and refined through extensive testing in real-world settings. Students in CTGV projects range from kindergarten age to adults.

An Overview of Frameworks for Instructional Design

Instructional design is a discipline that is concerned with understanding and improving the process of instruction. The purpose of design activities is to prescribe optimal methods of instruction that would induce desired changes in student knowledge, skills, and affect (Dick & Reiser, 1989; Reigeluth, 1983; Reigeluth, Bunderson, & Merrill, 1978). Reigeluth (1983) describes the result of instructional design as a professional "architect's blueprint" for what the instruction should be like. This "blueprint" is then used as a prescription for instructors as to what methods of instruction should be used, given the outcomes students are to achieve and the conditions under which they are to achieve them.

On the basis of these assumptions, numerous design models have been generated (e.g., Dick & Carey's Systems Approach Model, Landa's Algo-Heuristic Design Model, Reigeluth's Elaboration Model, Merrill's Component Display Model, and Keller's Motivation-Design Model) with the intention of yielding a list of fundamental steps for the instructional design process (Reigeluth, 1983). These steps represent the most commonly identified actions recommended for conducting instructional design. Andrews and Goodson's (1980) analysis of 60 instructional design models suggests that these models share a number of common basic components, although some models contain more complex and detailed steps than others. A typical instructional design process consists of the following steps:

(1) identify objectives (e.g., what do you want students to be able to do when they have completed the instruction?);
(2) assess students' prior knowledge and skills (e.g., determine whether the target students have the prerequisites to benefit from the instruction);
(3) specify the content to be taught (e.g., what content skills should be taught to students?);
(4) identify instructional strategies (e.g., what instructional methods should be used?);
(5) develop instruction (e.g., a learner's manual, instructional materials, tests, and an instructor's guide);
(6) test, evaluate, and revise (e.g., how should students be evaluated to determine the degree to which students have meet the performance objectives?).

Using such models to plan instruction, designers have to make instructional decisions based on their judgment about what learners should learn, how they should learn, what their learning contexts should be, what learning strategies they should employ, and how they should be assessed. Instructional design is thus concerned with prescriptive theory. Most of the prescriptive theory assumes that design can be carried out separately from the situation in which the instruction is implemented (Winn, 1993).

The systematic approach is valued in the instructional design community because it helps ensure that designers follow predefined steps in a model during the design process to guarantee that what is taught is needed for students to achieve predefined learning goals and that students are evaluated in terms of how closely they achieve the objectives (see Dick & Carey, 1990; Smith & Ragan, 1993). As Winn (1990) has pointed out, instructional design conducted this way assumes that if the designers have enough knowledge of the students and what it is the students have to learn, then they can bring about predictable changes in students' knowledge and skills. The only way to determine whether designers have succeeded in their selection of strategies for the learners and creation of instructional activities is by observing student performance. Such an approach makes a complete instructional package that is relatively easy to implement and evaluate. Overall, instructional design is seen as fundamentally context-free and plan-based.

A Brief Discussion of Some Key Principles of Learning Communities

Our goal in this section is to provide a brief description of the concept of learning communities. An emphasis on this concept focuses attention on the social contexts of learning—contexts that have pervasive cognitive and motivational effects. DeCorte, Greer, and Veschafel (in press) argue that social considerations are part of the second wave of the cognitive revolution. During the first wave, the primary focus was on individual thinkers and learners, with a de-emphasis on affect, context, culture, and history (Gardner, 1985). During the second wave, theorists have attempted to relocate cognitive functioning within its social, cultural, and historical contexts (e.g., J. S. Brown, Collins, & Duguid, 1989).

We argue elsewhere that social context is to individuals as water is to fish: The effects are pervasive and hence easy to overlook (Barron, Vye, Zech, Schwartz, Bransford, Goldman, Pellegrino, Morris, Garrison, & Kantor, in press). For example, it is easy to overlook the fact that the social structures necessary to conduct most psychological experiments are very special; they are based on agreements that participants will temporarily assume the role of "subjects" who allow experimenters to rule (Bransford, 1981).

The social structure of most classrooms involves students who adopt the role of passive receivers of the wisdom that is dispensed by teachers, textbooks, and other media (A. L. Brown, 1992). The role of the teacher is to deliver information and manage learning. Usually, everyone is taught the same thing at the same time. Assessments typically measure how much each student learned about what was taught. Most computer-based laboratories involve a similar model of knowledge transmission and testing. Learning is usually individualized in the sense that students are allowed to work at their own pace and at various levels of difficulty. Ideally, however, all students are expected to learn more or less the same things.

A number of theorists argue that the structure of typical classrooms is ill-suited to the goal of encouraging the kinds of learning necessary for the twenty-first century (e.g., Barron *et al.*, in press; A. L. Brown, Ash, Rutherford, Nakagawa, Gordon, & Campione, 1993; J. S. Brown *et al.*, 1989; Hmelo, 1993). The "basics" required for success in our increasingly changing society are no longer simply reading, writing, and arithmetic, but the ability to think critically and reason about important content, plus the ability and motivation to learn independently throughout one's life (e.g., Bransford, Goldman, & Vye, 1991; A. L. Brown *et al.*, 1993; Bruer, 1993; Resnick & Klopfer, 1989). Furthermore, these new basics are necessary for everyone rather than for only a select few (Resnick, 1987).

An emphasis on the goal of helping students become independent learners has prompted many researchers to focus on the development of classroom communities that foster continuous, independent learning. Much of the interest in learning communities stems from analyses of successful informal learning environments that exist outside of school (e.g., Barron *et al.*, in press; Bransford & Heldmeyer, 1983; J. S. Brown *et al.*,1989; Lave & Wenger, 1991; Resnick 1987; Senge, 1990). For example, students who participate in successful informal learning environments typically do not spend most of their time simply memorizing what others teach them. In many settings (e.g., many apprenticeships), there is little formal teaching, yet a great deal of learning occurs (Holt, 1964; Lave & Wenger, 1991; Sternberg & Wagner, 1986).

In many learning communities, students are provided with opportunities to plan and organize their own research and problem solving, plus opportunities to work collaboratively to achieve important goals (e.g., A. L. Brown *et al.*, 1993; The Cognition & Technology Group at Vanderbilt (CTGV), 1994, in press; Collins, Hawkins, & Carver, 1991; Lamon, 1994). In addition, learning communities usually emphasize the importance of distributed expertise (e.g., Barron *et al.*, in press; A. L. Brown *et al.*, 1993; Pea, 1993). Students are allowed to specialize in particular areas so that the community can capitalize on diversity. An emphasis on distributed expertise is distinctively different from environments where all students are asked to learn the same things at the same points in time.

An Exploration of Relationships Between the Concept of Learning Community and Instructional Design Frameworks

Our goal in this section is to further explore the concept of learning communities by discussing them from the perspective of the generic instructional design framework discussed in the first section. The design framework provides a useful context for highlighting some of the key features of the concept of learning communities that differentiate them from the classroom environments typically found in schools.

Our discussion will focus primarily on our experiences with learning communities in two different projects: (1) Our SMART challenges that link together different classrooms and teachers (Barron *et al.*, in press; CTGV, 1994), and (2) our participation in the Schools for Thought Collaborative that involves collaboration with A. L. Brown & Campione (1994), Scardamalia, Bereiter, & Lamon (1994), and the St. Louis Science Center. An overview of the Schools for Thought project is available in Lamon (1994).

Identify Objectives in the Learning Communities (e.g., what do you want students to be able to do when they have completed the instruction?).

The focus on independent, lifelong learning that is characteristic of learning communities is very different from a focus on tests that assess students' mastery of specific factual and procedural objectives. For example, students can learn particular sets of skills and strategies yet fail to spontaneously use them to solve problems (e.g., Bransford, Franks, Vye, & Sherwood, 1989; Dominowski, 1990; Lin, 1993; Simon, 1980). In Whitehead's (1929) terms, their knowledge remains "inert."

Even studies that provide evidence of transfer from a set of learning experiences to a set of transfer tasks do not guarantee that students are being prepared to be lifelong, independent learners (CTGV, 1993c). Most studies of transfer are static tests; people learn something and then receive a set of transfer problems (e.g., Gick & Holyoak, 1980, 1983). Scores on such problems can be increased by "teaching to the test," which includes explicitly "teaching for transfer." However, high scores on a specific, static transfer test do not guarantee that students have learned to learn on their own.

Static transfer should be differentiated from dynamic transfer. Dynamic transfer refers to those skills that efficient learners bring to a learning opportunity that facilitate learning in a new domain, whereas static transfer refers to the transfer of facts or very specific, fixed procedures (A. L. Brown, Bransford, Ferrara, & Campione, 1983). Learning to learn can be accessed by using tests of dynamic transfer. A. L. Brown *et al.* (1983) discuss a situation in which a learner did very poorly on tests of static transfer yet was able to demonstrate a rich variety of learning to learn skills when given a dynamic test. The dynamic test provided the opportunity to access resources that could help him learn to solve problems that he needed to solve.

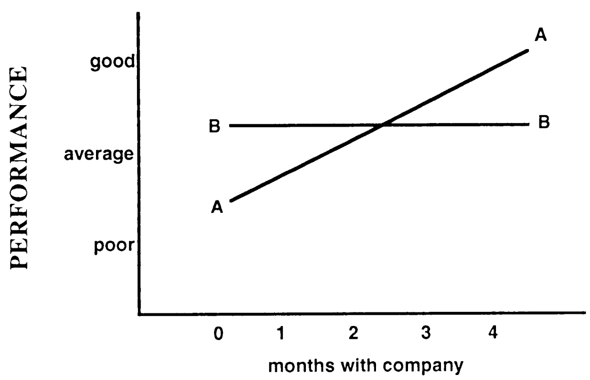

Figure 1. Effects of learning to learn. Worker A, who performed poorly on an early test, outperforms Worker B after several months with the company.

Differences between "learning to solve a particular set of problem types" and "learning to learn" are illustrated in Figure 1. Points A and B represent two different people who are being considered for a job. In both cases, there is a lot for the individuals to learn. On static tests taken during the initial interviews, Person B scores better than person A. However, when observed after several months with the company, Person A demonstrates that she is much better than B at learning on her own.

When learning to learn is one's primary objective, many approaches to instruction become questionable. As noted above, it is quite possible to provide practice at solving a fixed set of problem types in some area such as mathematics or science. These experiences can help students do well on static tests of transfer (to similar problem types). However, these experiences may be very poor for helping students learn to learn on their own.

An emphasis on learning to learn does not mean that one focuses exclusively on general skills of learning. Evidence for the importance of domain specific knowledge in directing thinking is ubiquitous (e.g., Bransford, Kinzer, Risko, Rowe, & Vye, 1989; Bransford & Stein, 1993; A. L. Brown, Campione, Reeve, Ferrara, & Palincsar, 1991; Resnick & Klopfer, 1989). As discussed later, learning to learn can be enhanced by focusing on the "big ideas" or "deep principles" that underlie specific content areas such as history, science, or math (e.g., A. L. Brown *et al.*, 1993). An emphasis on

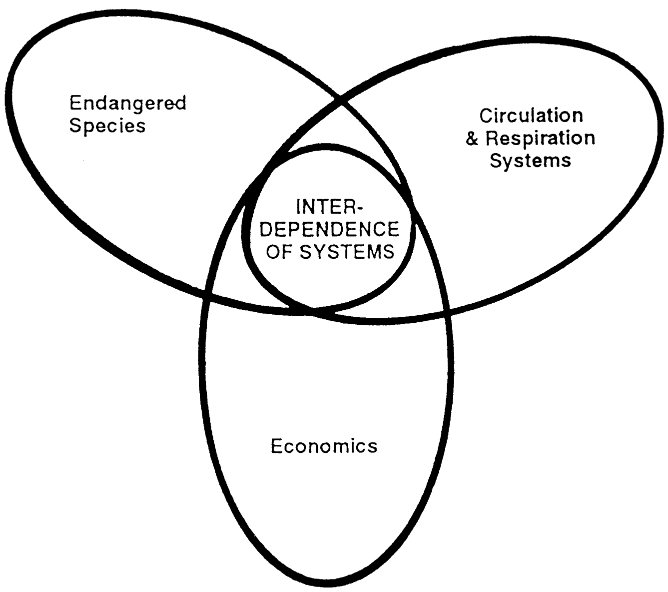

Figure 2. The deep principle "Interdependence of Systems" helps students to understand a number of different subjects.

deep principles is different from but complementary to an emphasis on general skills of learning and problem solving. General skills such as "define at least two different goals for your problem" become important when one confronts non-routine problems that require the acquisition of new concepts and strategies (Bransford & Stein, 1993). Deep principles involve concepts and theories that help one organize thinking and see analogies. For example, as illustrated in Figure 2, the principle of interdependence of systems can be applied to many different domains, such as economics, endangered species, human circulation and respiration, etc. By learning the principle in several domains, more productive learning and flexible transfer should be promoted (A. L. Brown & Campione, 1992).

Assess the Prior Knowledge and Skills of Students In Learning Communities (e.g., determine whether the target students have the prerequisites to benefit from the instruction).

The design of learning communities has important implications for assessing students' existing skills and knowledge. First, effective communities involve multiple opportunities to "make the thinking of students visible" (e.g., Collins *et al.*, 1991; Minstrell, 1989). Therefore, there are frequent opportunities to assess what students understand. The goal is always to build on students' current understanding rather than simply provide instruction designed to help them reach pre-set objectives by particular points in time. Following Bruner (1990), there is also a strong assumption that everyone can learn something relevant to the particular topic of the learning community no matter what their entry skill levels are.

A second implication of the concept of learning communities for assessing student knowledge stems from the notion of distributed expertise. The expectation in learning communities is that everyone is not ready to learn the same things at the same time. Allowing students to "major" (A. L. Brown *et al.*, 1991) in different areas provides flexibility with respect to individual student development.

In many ways, the idea of distributed expertise makes the process of assessing students skills and knowledge more difficult than in standard classrooms. However, in our experience, communities based on distributed expertise are extremely beneficial; they have powerful effects on how students think about themselves and about one another. Instead of talking about "the smart ones versus the other ones," students refer to the fact that different students know different things. And when the community is designed to capitalize on a diversity of skills and knowledge, students develop mutual respect because they realize that they need one another to accomplish important goals.

For example, in our Schools for Thought project in 1994, a significant amount of time was devoted to a "Mission to Mars" curriculum (Hickey, Petrosino, Pellegrino, Goldman, Bransford, Sherwood, & CTGV, in press). One of the components of the curriculum was a project which required actual building of model rockets. The major purpose of the project was to provide opportunities and contexts by which students would investigate such phenomena as thrust, acceleration, force, and gravity. Additionally, multiple expertise was needed in designing and implementing the project. As the activity progressed, each group took ownership over their specific area of expertise which they had been studying for the past five weeks. They deferred when it was clear that the problem was not in their domain and took leadership when the problem was within their area of focus. As the project progressed, students took on more and more of a leadership role and actually began to assist each other within and across groups. This collaboration around distributed expertise was particularly appreciated during the difficult technical activities, such as triangulating launch altitude. It was rewarding to witness individuals spontaneously supervising aspects of the shared field activity that corresponded to their expertise domain during the classroom "Mars Mission" planning.

Specify the Content to Be Taught in Learning Communities (e.g., what content skills should be taught to students?).

Effective learning communities involve sustained thinking and discussion about authentic, complex topics. Because of this, materials that attempt to provide a breadth of factual coverage need to be replaced with ones that involve opportunities for in-depth exploration. In our work on learning communities, we have tended to use problem-based and project-based activities that sustain students' interests for 4 to 16 weeks (e.g., Barron *et al.*, in press; CTGV, 1993a). We prefer to begin with problem-based anchors prior to moving to projects because the former provide models of effective thinking and problem solving that allow students to begin their subsequent projects from a more informed perspective.

The anchors that we and our colleagues use for instruction are organized around sets of "big ideas," such as sampling in the domain of statistics, measurement in the domain of geometry, and interdependence in the domain of biology (A. L. Brown & Campione, 1994; CTGV, 1991, 1993b, 1994). The use of anchors permits a great deal of flexibility; the exact content to be explored emerges as a function of community interests and interactions. Students are encouraged to identify and define their own issues that are related to the anchors and to then seek relevant resources. This is very different from always being told when, where, and what to study and read.

Identify Instructional Strategies in Learning Communities (e.g., what instructional methods should be used?).

The instructional strategies most frequently used in learning communities involve strategies for organizing the activities of students rather than strategies for delivering information. The overall goal is to help students learn to interact with one another as well as with teachers and other experts, and to interact in a way that involves a reciprocal interchange of ideas, data, and opinions.

Several organizational strategies proposed by researchers such as A. L. Brown and Campione (1994) involve activities such as reciprocal teaching (e.g., Palincsar & A. L. Brown, 1984) and jigsaw teaching (e.g., Aronson, 1978). Reciprocal teaching is a process in which student-led groups master use of strategies to comprehend difficult material. Students learn to ask teacher-type questions (and in the process find important information) as well as learning to summarize, predict, and pinpoint confusing portions of the text and ask for clarification. Comprehending difficult text is vital for students in learning communities because they use authentic materials in their research. Jigsaw groups are a structure for sharing the distributed expertise students gain in their in-depth research. After the initial large problem is presented, students break it into manageable subproblems, each researched by a small group. At certain points in the course of the unit, students regroup so that each person from a subproblem group gets together with one person from each other subgroup. Each individual is responsible for teaching what they have found out to everyone else in the jigsaw group. This structure makes each student responsible for the whole group's learning and solution of the larger problem.

Technology-based tools such as Scardamalia and Bereiter's CSILE (Computer Supported Intentional Learning Environments) also provide strategies for organization that can greatly facilitate student thinking (e.g., Bruer, 1993; Lamon, 1994; Scardamalia, Bereiter, & Lamon, 1994). In CSILE's collaborative database, students can share ideas asychronously. They can retrieve current and previous thoughts by their classmates by accessing a variety of categories, such as "topic," "author," "comments on my notes," etc. CSILE was designed to be used in the context of a community that stresses "knowledge building" rather than "knowledge telling." In knowledge building, students continually struggle to identify what they don't know and, as a group, attempt to collaboratively extend their understanding. The emphasis on knowledge building is extremely important for lifelong learning, and it is very different from typical classrooms where the emphasis is on restating the facts that have been presented by a teacher or a text.

It is important to note that effective learning communities are not simply "discovery" environments. A great deal of structure is necessary in order to make them work optimally. For example, teachers and other community experts focus on deep principles of the domains being studied (e.g., science, mathematics). They constantly work to help reframe student-generated questions from the perspective of these principles (e.g., A. L. Brown *et al.*, 1993). Nevertheless, within a domain such as science or mathematics, the exact issues defined by the students in the community may vary from year to year. This provides an advantage of ownership and distributed expertise while also ensuring that students learn the deep principles that experts in the domain use to organize their thoughts.

In our experiences with learning communities, there is also room for more traditional activities such as skill building. Students need to explicitly learn facts and skills that allow them to read, compute, and reason with fluency (e.g., Goldman & Pellegrino, 1987; Goldman, Pellegrino, & Mertz, 1988; Hasselbring, 1992). As an illustration, consider students who have to compute the dollar value of 4, 6, and 8 quarters rather than simply retrieve the answers from memory. This takes attentional resources away from thinking about other aspects of the problems to be solved (e.g., Bransford, Goin, Hasselbring, Kinzer, Sherwood, & Williams, 1988).

However, skill building is only a portion of the activities in effective learning communities. In contrast to the typical good classroom, in which the teacher is the one who identifies students' weaknesses, in a learning community students are encouraged to identify and choose the sets of skills on which they need to work. These processes of identifying areas where one needs help, and finding ways to work on them, are extremely important for lifelong learning (e.g., Bransford & Stein, 1993).

An important instructional strategy that enhances the sense of community within classrooms is to help students and teachers see themselves as part of a larger community that has similar interests and values. Technology that can help break the isolation of traditional classrooms provides a promising vehicle for creating these larger communities (Barron *et al.*, in press; CTGV, 1994; Goldman, Pellegrino, & Bransford, 1994). There are also useful strategies for community building that are designed to integrate classrooms with the larger community. For example, teachers with whom we have worked came up with the idea of having adults attempt to solve various anchor problems and letting the students act as expert guides. This strategy has worked extremely well (CTGV, 1992b, in press).

Instructional strategies typically used in learning communities are also chosen to enhance motivation. Our most basic motivational assumption is that authentic problem solving and opportunities to conduct research on self-selected topics are inherently motivating to students (e.g., Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991; Hickey, Pellegrino, Goldman, Vye, Moore, & CTGV, 1993; Pintrich, Marx, & Boyle, 1993). Initial support for this belief is provided by both classroom observations and controlled studies (e.g., Hickey *et al.*, 1993; Van Haneghan, Barron, Young, Williams, Vye, & Bransford, 1992).

Our efforts to design effective learning communities have also included the strategy of creating extrinsic challenges that students and teachers prepare for (e.g., Barron *et al.*, in press; CTGV, 1994; Goldman *et al.*, 1994; Kantor, Moore, Bransford, & CTGV, 1993). These challenges provide deadlines for meeting particular performance objectives, and this motivates teachers, students and often entire school systems to work to meet important goals.

Develop Instruction in Learning Communities (e.g., learner's manual, instructional materials, tests, instructor's guide).

Because of the need for flexibility, the instruction for learning communities cannot be designed by what Duffy (1992) calls "absentee curriculum developers." There are some general principles that guide instruction (e.g., the use of anchors that exemplify big ideas, student generated projects, reciprocal teaching and jigsaw teaching, motivating challenges, etc.), but most of the instructional details depend on content being taught and the interests and questions of the students in the class.

This emphasis on flexibility also means that the development of learning communities is not something that can or should be packaged as a finished curriculum. Instead, a curriculum framework must be developed based on deep principles of relevant content domains and pedagogy. As A. L. Brown and Campione (1994) note, effective learning communities must be re-invented from location to location rather than simply "transported" and then "implemented." These reinventions involve adaptations that take into account the particular interests and expertise of the students, teachers, and larger community involved.

A major challenge for people interested in learning communities is reinventing the idea for themselves without (a) losing the key ingredients necessary to make communities successful, and (b) simply repeating a scripted version of what worked someplace else. In our experience, there is a tradeoff between the flexibility required for successful re-invention of learning communities and the need by novices for some degree of initial structure so that they do not become overwhelmed by novelty. We are currently researching this issue and welcome any suggestions and help.

Further Issues in Designing and Understanding Learning Communities

As noted earlier, our goal in this chapter is to encourage discussion among members of the instructional design community and members of research groups who are attempting to transform typical classrooms into "learning communities." A strength of the research community is its theoretical expertise and investigation of a learner-centered approach. A strength of the instructional design community is its ability to articulate, manage, and systematize the processes involved in designing effective learning environments. Use of a generic instructional design framework has already proved useful to us in thinking through what a concept of learning communities entails.

Therefore, the design and development of learning communities can be based on a confluence of the strengths from both communities rather than shifting towards either one. There are many aspects of the design, development, and assessment of learning communities that need to be further articulated and explored jointly by both communities. The issues fall into two major categories. One set of issues focuses on approaches to designing classrooms, schools, and communities so that they function as efficient learning communities. A second set of issues involves a focus on the research and evaluation of learning communities.

Approaches to the Design and Development of Efficient Learning Communities

The nature of efficient learning communities can be summarized as providing students opportunities to : (1) plan, organize, monitor, and revise their own research and problem solving; (2) work collaboratively and take advantage of distributed expertise from the community to allow diversity, creativity, and flexibility in learning; (3) learn self-selected topics and identify their own issues that are related to the problem-based anchors and then identify relevant resources; (4) use various technologies to build their own knowledge rather than using the technologies as "knowledge tellers"; and (5) make students' thinking visible so that they can revise their own thoughts, assumptions, and arguments.

Given the nature of learning communities, we need to develop open-ended objectives and criteria for success. This needs to be done collaboratively so that teachers and students have opportunities to negotiate, revise, and construct their own goals for instruction and learning. Such objectives should be generated through extended interaction, observation, and research in the classrooms. The guidelines and procedures for actually developing such objectives, and continuing to refine and adjust them over time, are needed. This is an area in which the instructional design community can contribute a great deal of expertise.

To encourage collaborative learning, we also need to consider how we can help students plan and organize their collaborative learning activities. One approach is to develop a wide variety of anchors (e.g., videos, computer simulations, games, and hands-on activities, etc.) that can serve as common grounds for further exploration (CTGV, 1990, 1991). Especially useful are anchors that are designed to allow open-ended exploration of topics that are introduced by the teachers or experts or that are identified by the students. Within the anchored instruction model, we should also consider how much information should be embedded within the initial anchor story, how much within the auxiliary sources that accompany the anchor, and how much should be seeded by the teacher (CTGV, 1992a). The key idea is to have students contribute to the construction of knowledge and to demonstrate their learning in a variety of possible ways, such as software design or the creation of written and other products. As an illustration, Rieber (1994) helped students develop their own interactive learning environments that demonstrated their understanding of various scientific principles and blended several important attributes of different technologies (e.g., microworld, simulations, and games). His research suggests that learning and intrinsic motivation can be optimized by providing opportunities for personal discovery, exploration, ownership, and construction of knowledge.

To encourage distributed expertise in learning communities, we also need to develop user-friendly communication tools, such as the CSILE database for inter- and intra-classroom exchange of information and expertise. The research on hypertext interfaces and their effects on navigation can be of enormous value in this context. The results of the research can be used as formative evaluations to improve design and development of future effective networked learning environments. (See Hasselbring [1992] for an example of how the technological recording of the learner's interactions with the instructional materials and context can enhance design, development, and evaluation in a situated learning environment.)

Members of the instructional design community can also help design products that make students' thinking visible to themselves as well as others. Software shells, such as "Second Generation Instructional Design" (ID_2) created by Merrill and his colleagues (Merrill, Li, & Jones, 1990), would be especially exciting if they could be used to help students author their own programs, designed to help them achieve particular learning goals. In addition, students could create programs that utilize knowledge gained from their own research projects. For example, if they want to share with younger students what they learned about endangered species, they could use shells to quickly develop a program that contains the information they have gathered in the course of their research. These kinds of experiences allow students to teach as well as to learn.

Another important issue for learning communities is the management of new kinds of classrooms. Organizational and managerial expertise in the instructional design community can be very helpful as teachers coordinate with outside content experts, technologists, parents, other teachers, and principals. For example, they can help teachers create a timeline for students to complete a project. They can also help teachers create resources by introducing new technology, allocate existing resources to different segments of the students' projects, and help teachers with some aspects of collaborative team design. Presently, the learning communities model leaves a number of particular instructional activities and procedures unspecified in terms of actual implementation. Developing a structure for organization and management could be of great benefit to those attempting to implement the idea of learning communities.

Overall, the design and development of efficient learning communities requires the combined wisdom and exploration of teachers, students, cognitive researchers, developmental psychologists, content experts, instructional designers, and technologists. Communication among the members in the community is the key to success in this joint venture. As a link between the scientific knowledge of human cognition and development and educational applications, the contributions from the instructional design community are crucial for the building of learning communities. By the same token, distributed expertise implies that everyone in the community needs to understand the purpose and value of their particular expertise as well as the expertise of others.

Research and Evaluation Issues for Learning Communities

There are several areas of research and evaluation that need contributions from members of both the instructional design and cognitive communities. One involves managing a large number of human resources and bringing them together to reach consensus on their goals. Just as people who implement have to coordinate inputs from teachers, students, parents, advisory board members, etc., members of research teams who design and study learning communities face similar challenges. Members of the instructional design community have a great deal of experience in this area. These experiences could be beneficial to the larger community of individuals attempting to bring about effective change in schools.

Another area in need of further development is the area of assessment. Just as the objectives for learning communities are more open ended than is true in typical classrooms, models for assessing and evaluating the degree to which the objectives have been met also need to be expanded. Performance-based and portfolio assessment are two ideas that are compatible with the goals of learning communities. These assessments need to be formative as well as summative so that they can be used for instructional decision making. Assessments of the processes of learning should include both teacher assessment and students' self-assessment (Collins, Greeno, & Resnick, in press). The development of self-assessment skills is particularly important for the goal of achieving lifelong learning. Technology-based strategies for enhancing assessment and the construction of portfolios are very much needed. This is another area in which instructional design science can contribute valuable ideas.

Ideally, formative evaluation and revision is a daily process within effective learning communities. By designing activities that make students' thinking visible to others, and by creating performance goals that are clear and motivating, students need to have frequent opportunities to "debug" their thoughts, assumptions, and arguments. There are a number of activities that can support students' development of these self-assessment skills; one is the jigsaw group activity discussed earlier. Many of these activities require that teachers step back from their roles as knowledge providers and take on the role of facilitators or coaches. This is not to diminish the role of the teachers in any way. Teachers can provide needed models of self-monitoring and an underlying sense of direction and purpose for learning. Teachers can also guide students' knowledge construction and evaluation processes toward specific domains.

Effective learning communities also involve outside evaluations that are summative as well as formative. These activities involve real deadlines, and they let students see how well they have accomplished particular goals. For example, we noted earlier that we have experimented with several interactive, video-based "public performance challenges" that have been extremely motivating for students and teachers and have provided them with real deadlines and with important sets of feedback about their learning (Barron *et al.*, in press; CTGV, 1994). These public performance arenas make available to the teacher many of the advantages available to coaches and music and art teachers—their students actually perform and get opportunities to reflect on their performances and decide whether and how they need to improve. Ideally, students also have opportunities to revise their ideas and try again (much like playing the same team a second time).

Learning communities also need to be accountable to larger constituencies, and hence need to be subjected to summative evaluations. How to generate such evaluations is a major issue. Traditional achievement tests assess the acquisition of basic skills and knowledge, but they do not assess more sophisticated levels of thinking, reasoning, or communicating, and they do not assess learning to learn. Furthermore, traditional tests are based on the assumption that everyone has had a chance to learn the same things (an assumption that is diametrically opposed to the assumptions underlying the concept of distributed expertise). A number of research groups, including ours, are working on issues of assessment (e.g. Barron, 1994; Goldman *et al.*, 1994). Again, we welcome suggestions and help.

Summary

We see the nineties as the decade of collaboration among members from different disciplines to provide new learning experiences by building learning communities in schools. Toward that end, we have discussed the strengths of researchers attempting to create learning communities and the strengths of the instructional design community. By discussing the insights of these two communities, we hope to set the stage for further dialogue. For example, members of the cognitive community can receive a great deal of help from the expertise of the instructional design community. Similarly, members of the instructional design community can benefit from the opportunity to incorporate into their designs the latest advances in cognitive theory and educational philosophies. Such a collaboration can help members of both communities achieve their ultimate goal: To create learning environments for all students that are extraordinarily effective. □

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New Book on Educational Technology

A new basic text for both preservice and inservice teachers at all levels is due out in January, 1996 from Educational Technology Publications.

The Educational Technology Handbook: A Comprehensive Guide—Process and Products for Learning, authored by Steven Hackbarth, contains more than 300 pages, 8 1/2 x 11 inches, and is to be priced at $37.95 per copy. The text is designed to introduce the total field of educational technology, beginning with the instructional processes involved and including chapters on all major media of instruction, with emphasis on computer based learning, interactive media environments, and the emerging Information Superhighway.

Each of its 13 chapters carries extensive data on sources of hardware and software, bibliographical references, and related information, plus numerous student activities and follow-up exercises. The chapters are supplemented by a number of Appendices, a Glossary, and detailed Author and Subject Indexes.

This new volume is the first overall introduction to the field to be published by Educational Technology Publications. Professors and instructors of educational technology, instructional design, teacher education, and related areas who wish to be part of the informal network of colleagues being assembled by the text's author, Dr. Steven Hackbarth, may communicate with him now at: **hackbarths@aol.com.**

Orders for the book may be placed at this time for shipment in January of 1996: Educational Technology Publications, 700 Palisade Avenue, Englewood Cliffs, New Jersey 07632.

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The Training Research Journal: The Science and Practice of Training, first announced in the pages of this magazine early this year, has now been published in its first volume. The annual journal, priced at $60.00 worldwide, is to appear each September. The 1995/96 edition, comprised of seven major papers, more than 150 pages, is now available. See the full-page announcement and order form on the back inside cover of this magazine.

Book on Constructivism

The book on constructivist learning environments, as described in the special section in this issue, will be available shortly from Educational Technology Publications, priced at $37.95 per copy. Orders may be placed at this time for delivery immediately upon publication: Educational Technology Publications, 700 Palisade Avenue, Englewood Cliffs, New Jersey 07632.

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Contributions are welcomed from all readers to the ongoing discussions in this magazine about the field of educational technology.