2

Seven Goals for the Design of Constructivist Learning Environments

Peter C. Honebein

Introduction

Designers of constructivist learning environments live by seven pedagogical goals (Cunningham, Duffy, & Knuth, 1993; Knuth & Cunningham, 1993):

1. **Provide experience with the knowledge construction process.** Students take primary responsibility for determining the topics or subtopics in a domain they pursue, the methods of how to learn, and the strategies or methods for solving problems. The role of the teacher is to facilitate this process.
2. **Provide experience in and appreciation for multiple perspectives.** Problems in the real world rarely have one correct approach or one correct solution. There are typically multiple ways to think about and solve problems. Students must engage in activities that enable them to evaluate alternative solutions to problems as a means of testing and enriching their understanding.
3. **Embed learning in realistic and relevant contexts.** Most learning occurs in the context of school whereby educators remove the noise of real life from the learning activity. For instance, word problems in math textbooks rarely relate to the types of problems found in real life. The result is the reduced ability of the students to transfer what they learn in school to everyday life. To overcome this problem, curriculum designers must attempt to maintain the authentic context of the

learning task. Educators must ground problems within the noise and complexity that surrounds them outside the classroom. Students must learn to impose order on the complexity and noise as well as solve the core problem.

4. **Encourage ownership and voice in the learning process.** This illustrates the student-centeredness of constructivist learning. Rather than the teacher determining what students will learn, students play a strong role in identifying their issues and directions, as well as their goals and objectives. In this framework, the teacher acts as a consultant who helps students frame their learning objectives.
5. **Embed learning in social experience.** Intellectual development is significantly influenced through social interactions. Thus, learning should reflect collaboration between both teachers and students, and students and students.
6. **Encourage the use of multiple modes of representation.** Oral and written communication are the two most common forms of transmitting knowledge in educational settings. However, learning with only these forms of communication limits how students see the world. Curricula should adopt additional media, such as video, computer, photographs, and sound, to provide richer experiences.
7. **Encourage self-awareness of the knowledge construction process.** A key outcome of constructivist learning is knowing how we know. It is the students' ability to explain why or how they solved a problem in a certain way; to analyze their construction of knowledge and processes. Cunningham *et al.* (1993) call this "reflexivity," an extension of metacognitive and reflective activities.

This article discusses how to put these goals into practice by examining two constructivist learning environments, the Lab Design Project (LDP) (Honebein, Chen, & Brescia, 1992; Honebein, Duffy, & Fishman, 1993), and the SOCRATES curriculum (*S*tudent-*O*riented *C*urriculum: *R*eflection *a*nd *T*echnology as *E*ducational *S*trategies) (Honebein, 1994). In Wilson's (1996) scheme for classifying constructivist learning environments, in Chapter 1, the LDP reflects a virtual environment, while the SOCRATES curriculum reflects a classroom environment. I first describe each of the learning environments, then follow with an analysis explaining the construction of these environments in light of the pedagogical goals noted above.

Lab Design Project

The Lab Design Project (LDP) is a hypermedia system that simulates a biotechnology building. The purpose of the LDP is to provide a learning environment in which learners can:

- practice their sociological research skills;
- better understand the social, architectural, and scientific forces driving the design process for new biotechnology research centers; and
- better understand how lab design shapes scientific practice.

The LDP contains almost all the data to which a researcher has access at the actual building. These include documents from the construction of the building,

interviews with inhabitants of the building, and observations of various labs and spaces in the form of photographs. The task of the learner is to pose research questions, such as, "What is the social impact of having researchers' desks in the labs instead of outside the labs?" The learner then seeks answers to those questions by exploring the simulation and its accompanying database.

The learner starts his or her exploration of the building with a diagram showing the outside of the building (Figure 2.1). The learner clicks on the floor he or she wants to view, and a schematic of that floor appears on screen (Figure 2.2). The learner clicks on the lab he or she wants to view, and a schematic of the lab appears on screen (Figure 2.3). To view a particular area of the lab, the learner clicks on that area. Once in the lab (Figure 2.4), the learner clicks on buttons to view color photographs showing the equipment, experiments, and details of the lab. The text field at the bottom left of Figure 2.4 explains the equipment shown in the photograph.

Besides exploring the labs, the learner can review transcribed interviews with inhabitants of the building (Figure 2.5), or any one of 4000 pages of documents (Figure 2.6). These documents include memoranda between architects, builders, and administrators, building plans, letters of authorization, and sketched

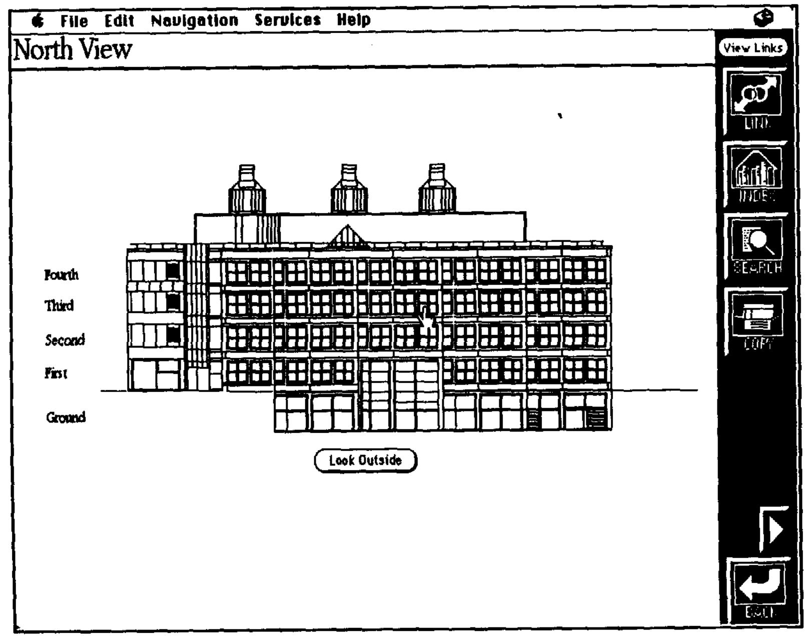

Figure 2.1. *Building View.* Here the learner can click on any floor to go to a floorplan graphic of that floor. In this example, the learner is clicking on the third floor.

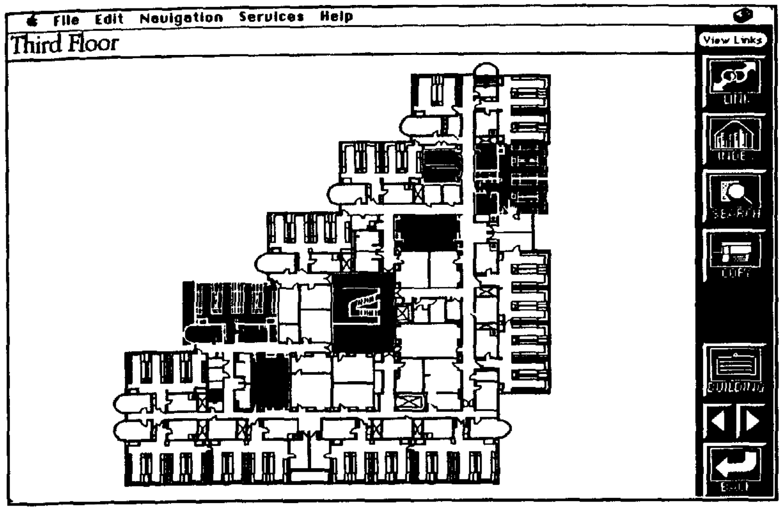

Figure 2.2. *Floor View.* This view shows a floorplan of the third floor. The rooms which are highlighted can be clicked on to zoom into a closer view of that room. In this example, the learner is clicking on Lab 321.

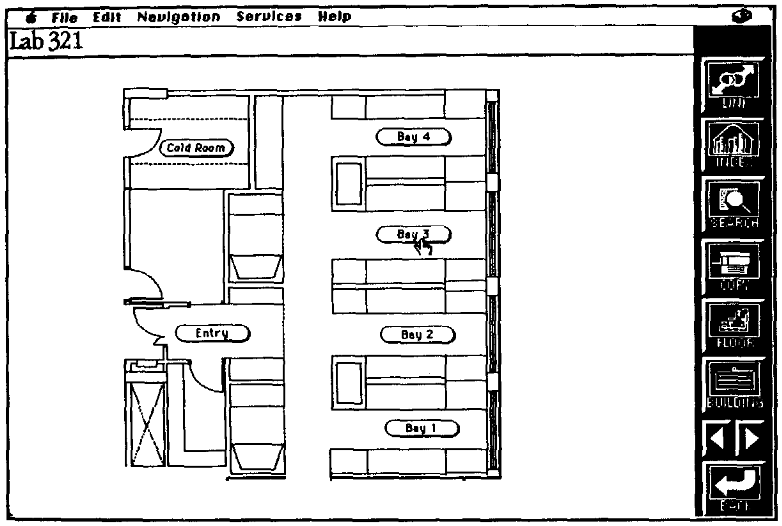

Figure 2.3. *Lab (or Room) View.* This view is a closeup of the floorplan for the laboratory. The buttons allow the learner to zoom into each one of the bays for greater detail. The learner is about to zoom into Bay 3.

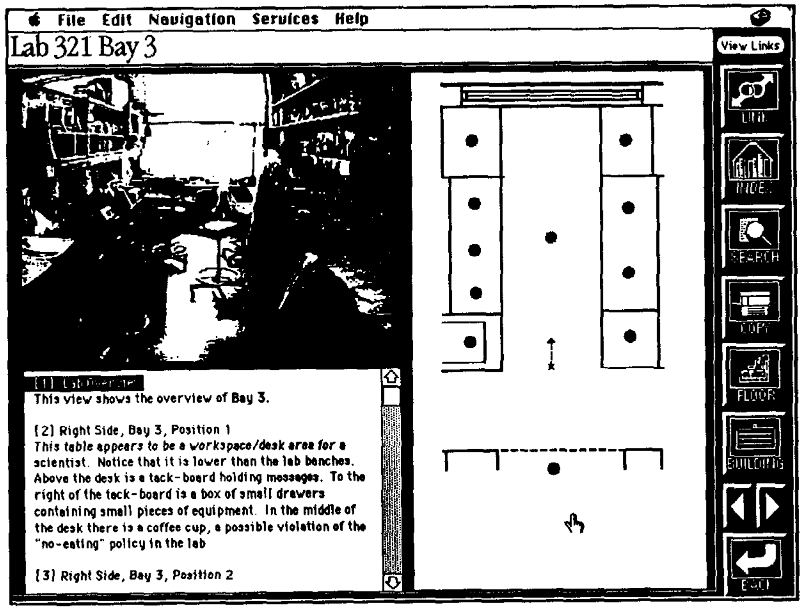

Figure 2.4. *Photograph View.* In this view, the learner is presented with a color photograph of the bay, text describing the bay, and a schematic of the bay. By clicking on the black circles in the schematic, the learner can "walk around" the bay, viewing color photographs from of a variety of perspectives. Notice the X shows the location and the arrow points the direction of the camera when the photograph was taken.

schematics. The learner accesses these interviews and documents through an index, or through a search tool that can find documents based on text and keyword queries.

Another feature of the LDP is linking. Learners complete weekly assignments by linking photographs and documents (each called nodes) that illustrate the research questions, and writing an explanation why the link is important. For example, the learner finds a photograph in a lab showing a desk at the lab bench. The learner also finds an interview with a researcher explaining that desks in the lab are a bad idea because one cannot eat food in the lab; thus, the researcher cannot eat at his desk. The learner links the photograph and the interview, and writes an annotation explaining how the two pieces of data help answer her research question. All links are public: other learners can read and follow any links created by their peers. The LDP faculty reviews each learners' links weekly, and provides comments directly to each learner through an electronic mail system built into the LDP.

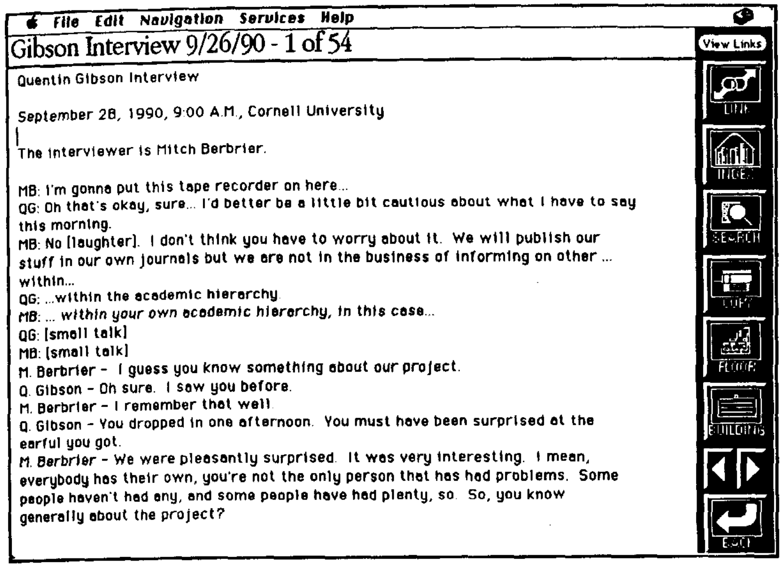

Figure 2.5. Example of an interview.

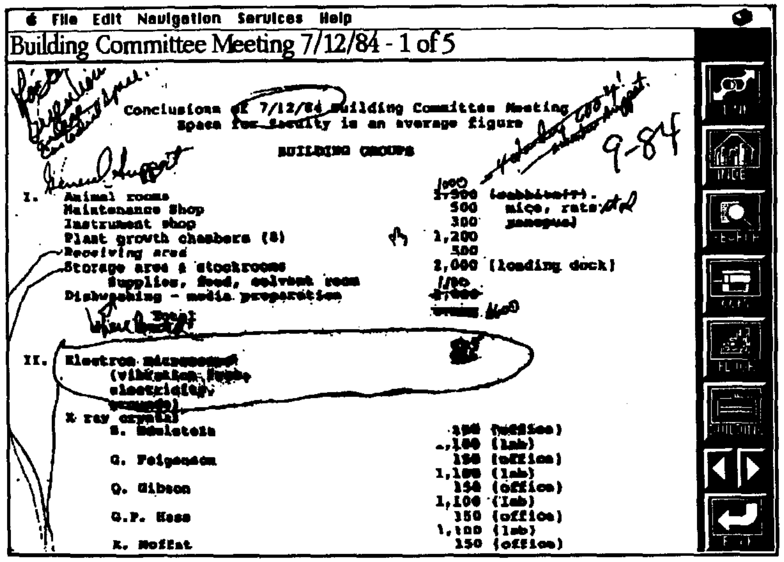

Figure 2.6. Example of a document card (containing hard-written notations).

SOCRATES Curriculum

The SOCRATES curriculum is a week-long workshop. Its purpose is to teach second-year medical students how to care for and manage patients with diabetes mellitus.

The curriculum requires approximately nine hours of class work, eight hours of work outside the class in independent or group study, and three hours of assessment. Classes are scheduled Monday, Wednesday, and Friday. Independent and group study are expected on Tuesday and Thursday. Learner assessment, consisting of a short essay examination, a clinical examination, and evaluation questionnaires, is on Saturday.

There are three primary learning activities in the workshop:

- **DiaSim**, *a computer-based simulation of diabetes patients;*
- **Patient Case Analysis and Plan**, an activity where students analyze a patient's chart and formulate a plan for an office visit; and
- **Stump the Specialist**, an activity where students create patient cases and observe how diabetes experts handle the cases.

DiaSim

The learners' task in the DiaSim activity is to manage the care of a person with diabetes. To do this, learners use a computer software program called *DiaSim* (Eli Lilly, 1988). DiaSim presents learners with a patient who has a problem with his or her blood glucose level. Learners make modifications to the patient's medication, diet, and exercise to optimize the patient's blood glucose profile. Learners see the results of their decisions by viewing a graph depicting the patient's blood glucose levels over a period of two days.

After learners complete their solutions, the preceptor leads a debriefing session. Each group presents and explains its solution. The preceptor and other learners may ask questions of the presenting group. The objective of this debriefing is to show students the different types of solutions to the problems and the rationale behind each of the solutions.

Patient Case Analysis and Plan

The learners' task in the Patient Case Analysis and Plan (PCAP) activity is to analyze a patient's chart and log book, then formulate a plan for an office visit with the patient. This activity is one that task analysts identified during clinic observations and that expert physicians described in interviews.

The preceptor assigns two patient cases in the workshop. One case is assigned on Monday and discussed in class Wednesday. The other is assigned Wednesday and discussed in class Friday. For each case, learners get a worksheet, an actual patient's chart and, if available, the patient's records of home glucose monitoring. Then, working independently and in groups, learners analyze the chart and formulate their plan. The preceptor encourages learners to use any materials or resources to help them with their analysis and plan.

In the next class session, each group presents its analysis and plan. The preceptor and the other groups have the opportunity to question the group and have the group further explain its conclusions. After each group presents its ıalysis and plan, the preceptor shows a video of an actual physician-patient (amination featuring the patient in the chart.

While watching the video, the preceptor or learners may stop the video to iscuss items of interest. The preceptor may also supplement the discussion by ıowing video interviews with the patient, the examining physician, or another xpert physician. In these interviews, the interviewees provide analysis and ritique of the examination.

›tump the Specialist

The learners' task in the Stump the Specialist (STS) activity is to use DiaSim to :reate a diabetes patient they believe is difficult to care for. During the last hour ›f the last class, an expert physician comes to class and attempts to solve the earners' cases using DiaSim.

To create a problem case, learners work in their groups to write a one-page narrative describing the patient's history. Groups then use the custom patient feature of DiaSim to define the patient's physical characteristics, type of diabetes, insulin therapy, diet, and exercise. Along with creating the patient's problems, the groups must also solve the patient's case by creating a regimen that optimizes the patient's blood glucose level.

In class, the expert selects a group's case. The expert then "thinks out loud" (Schoenfeld, 1985) during the analysis of the case and the attempted solutions. The expert enters solutions (changes to the patient's insulin, diet, or exercise) into DiaSim (which is projected so all students can see), then checks the results by showing the simulation graph. The expert repeats this process until he or she solves the case or is "stumped." A short debriefing session follows the expert's solution. During this debriefing, the expert can explain strategies in more detail, learners can ask specific questions, and the group whose case the expert used can present its solution.

Analysis of LDP and SOCRATES

The seven pedagogical goals stated at the beginning of this chapter offer a framework for the design of constructivist learning environments. Designers who use these goals as the theories behind their practice are well on their way to creating learning environments that are "constructivist." However, it is important to note that these goals provide just the framework; the designer's interpretation of the goals and subsequent translation into learning activities is the real art in the design of constructivist learning environments. In this next section, I want to share with you the thinking and rationalization that took place to put constructivist *theory into practice* for these two exemplars.

Experience with the Knowledge Construction Process

Self-directed learning is at the heart of the knowledge construction process. To achieve this goal, designers need to conceive learning activities that provide learners a level of autonomy in the learning process. The instructor should guide learners to pursue topics that interest or are relevant to *the learner* and encourage learners to experiment with various methods of solving problems.

In the LDP, the research questions serve this function. Each learner is responsible for formulating research questions. Since the questions are relevant to a learner's own interests, there is a high level of self-direction. In addition, the research questions influenced how the learner interacts with the LDP environment, from the selection of data to the construction of links.

The design strategy for the SOCRATES curriculum is similar. In the DiaSim and PCAP activities, it is each learner's responsibility to generate questions about the case, then seek answers to those questions. The questions reflect each learner's interest in the case and drive his or her search for the appropriate knowledge they need. For example, the patient's psycho-social problems interest some learners, while the patient's insulin therapy interests other learners. Regardless of the question, each learner pursues knowledge in a context that reflects what he or she feels is important about the case.

Experience in and Appreciation for Multiple Perspectives

It is helpful for the designer to adopt the premises that there are many right ways to solve problems and that there are many right answers to questions. Given these premises, the need for curricula that celebrate alternative ways of thinking and knowing becomes clear: learners experience alternative models on which they can base their own practice.

The LDP supports multiple perspectives in several ways. Through public links, learners can examine other learners' problem-solving processes. By following another learner's links and reading the link annotations, the learner sees an alternative way to conduct research. Weekly class meetings provide learners with the opportunity to discuss their research activities with their colleagues.

The nature of the SOCRATES learning activities also contributes to the learners' exploration of multiple perspectives. In the DiaSim activity, members in individual groups examine each other's perspectives on diabetes care while coming up with solutions to the patient's problem. Additionally, each group shares its solution with the other groups during the debriefing. The result is several solutions to the problem, each with a different strategy. In the Patient Case activity, group work and class debriefings facilitate the exploration of alternative perspectives, as does the patient-physician videotape and accompanying video interviews with physician, patient, and commenting physician.

Realistic and Relevant Activity

The creation of realistic and relevant activities requires a detailed understanding of the culture for which the learner is being prepared. Thus, in the cases of both the LDP and SOCRATES, the designer conducted task and cultural analyses to understand the practice of sociological researchers and the practice of physicians who care for persons with diabetes, respectively. From these analyses, the designer came to understand the nature of the problems in the culture, how problems were solved by experts, the knowledge and skill needed to be an effective practitioner, the sources of knowledge and skill (i.e., books), and the criteria for assessing successful performance.

The authentic activity in the LDP is sociological research. The task of the learner is to investigate the building as a sociologist would. Sociologists begin their research by exploring. They enter an environment and observe, looking for commonalties, oddities, and differences among elements of that environment. Their goal during this exploration is to develop a research question, such as, "Why is this the same as this?" or "Why does this occur here, but not there?" Sociologists then look for data that help them answer the questions they pose. All of these activities are possible with the LDP.

Similarly, the authentic activity for the SOCRATES curriculum is "playing doctor." In the DiaSim activity, the task of the learner is to care for a simulated patient, making "prescriptions" to the patient's insulin, diet, and exercise to bring the patient's blood glucose level under control. In the PCAP activity, learners play doctor in a richer authentic environment: learners receive an actual patient chart and must plan a visit with the patient. With the patient chart, learners must deal with such common problems as incomplete documents, illegible handwriting, and an overabundance of complex data. In this context, learners must learn to accommodate the everyday complexities of the job with the core knowledge and skill they need to solve the patient's problem.

Many people misunderstand the true nature of authentic activities. People ask, "How are simulations 'authentic' when by their very nature they are not authentic at all? They're still a simulation." The aim of an authentic activity is not just to simulate or replicate the physical environment, calling it "authentic." Rather, the aim is to design an environment in which learners use their minds and bodies as they would if they were practitioners in a domain. It is the purpose of the learning environment, whether it be simulation, actual practice, or independent study, to stimulate learners so that their thinking is related to actual practice (e.g., see Keegan, 1995). In the LDP, the simulation of the building is merely a vehicle to engage learners in the higher-level cognitive skills of observation, analysis, and synthesis—the skills of an expert sociologist. In the SOCRATES curriculum, the use of actual patient charts stimulate learners to not only develop their analytical and scientific skills, but their skills to decipher poor handwriting—all necessary for them to be proficient physicians.

How does a designer choose what parts of the learning environment are real, simulated, or fake? By examining the forces that surround the problem. For the LDP, it was too expensive to fly students to the actual building. Additionally, 20 graduate students roaming around the building would no doubt disrupt the environment and annoy the building's inhabitants. For the SOCRATES curriculum, it just didn't make sense to have second year medical students go at it with real patients.

Ownership and Voice in the Learning Process

Ownership and voice are closely tied to the goal of experience with the knowledge construction process, in that learning is student-centered rather than teacher-centered. A key indicator that a learning environment is student-centered is the role of the instructor. Typical roles for instructors in constructivist learning environments are facilitator, mentor, coach, or consultant. Designers must carefully consider the role of the instructor in their learning environment designs.

The primary role of the LDP instructor is mentor. As a mentor, the task of the instructor is to review the learners' work and provide feedback. Feedback typically consists of a critique of the quality of the work, alternative ways of thinking about the learners' research questions, and suggestions of where the learners might find additional data to support their hypotheses. In the LDP, it is the instructor's review of the learners' links and annotations that forms the mentoring relationship.

Since the activities in the SOCRATES curriculum are group-based, the instructor's primary role is that of facilitator. In this role, the instructor is responsible for encouraging groups to discuss their solutions to problems and facilitating the interaction between group members and groups themselves. The instructor draws out competing perspectives from the groups, leads the groups in analyzing those perspectives, and helps the learners synthesize the main points of the discussion.

Learning in the Social Experience

Learning in the social experience—or collaboration—is related to the previously discussed goal of experiencing multiple perspectives. Through collaborative activities, the designer lays the foundations for the sharing of multiple perspectives, as well as the social interactions learners undertake in their roles of practitioners: teamwork, leadership, negotiation, and cooperation.

There is little or no face-to-face collaboration in the LDP. Rather, the public links and annotations that learners create mediate the collaboration. Learners exploring the LDP view the links and annotations of peers. In addition, learners can bring in yet another perspective by adding comments to existing links and annotations.

Collaboration in the SOCRATES curriculum is extensive. In every learning activity, learners work with other group members to accomplish tasks. During debriefings, collaboration includes all groups and the instructor. All collaboration is face-to-face.

The LDP and SOCRATES curricula facilitate the analysis of two extremes of collaboration: independent and face-to-face. Since collaboration is computer mediated in the LDP, learners are freed from the burden of arranging group meetings and relying on others to accomplish tasks. The collaboration takes the form of colleagues helping each other. Collaboration in SOCRATES, on the other hand, requires more effort on the part of the learners. They are not individuals solving a task; rather, they are a team whose combined effort is needed for successful accomplishment. Is one type of collaboration better than the other? I do not have data the shows it is or isn't. All I have is anecdotal evidence that shows students are satisfied with both collaborative experiences, and that both types of collaboration designs appear to work in the contexts for which they were designed.

Multiple Modes of Representation

Multiple modes of representation is yet another facet of the goal of experiencing multiple perspectives. Different media represent knowledge in different ways, illustrated by the truism, "A picture is worth a thousand words." By combining several types of media in a learning environment, the designer allows learners to see the world in different lights, so that their understanding of facts, concepts, procedures, and principles is rich and multi-faceted.

The LDP delivers an environment composed of many media types. A combination of photographs, graphics, text, animation, and realia (real things) form the content domain for the environment, and contributes to various representations of knowledge. For instance, the learner might find an architectural document showing a drawing of a lab. To compare the architectural document to the actual lab, the learner can navigate to that lab to see a photograph of the lab. Yet another perspective finds the learner reviewing a text interview with the scientist who works in the lab, in which the scientist describes the layout and equipment in the lab. Each medium provides the learner with a different picture of the same thing.

Computer simulation, videos, books, patient charts, and written communication are the primary media in the SOCRATES curriculum. As in the LDP, the media provide different representations. For example, the patient charts (which are text) provide one picture of the patient, while the physician-patient video and the patient interview video provide an alternative picture of the patient. The richness of both the textual representation and the video representation provides learners with valuable insights on understanding the problems and needs associated with the patient.

The selection of the media mix should relate in some way to the authentic nature of the task. Ask yourself these questions: What media are available to practitioners as they go about doing their job? How do they use the media to accomplish tasks? The answers to these questions should provide a good list of media options. For the LDP, the media reflect what expert sociologists look at during their research.

Next, think about how to acquire the media, or substitute one medium with another if the first is unavailable. The SOCRATES curriculum, for example, substituted videotapes of physician-patient examinations for the real thing, since observing actual examinations was not possible.

Self-Awareness of the Knowledge Construction Process

In constructivist learning environments, *how* a learner knows is more valuable than *what* a learner knows. Self-awareness is very similar to many of our grade school experiences, when math teachers made us "show our work," allowing the teachers to examine how we solved problems. Thus, the designer must create learning activities that encourage or require learners to show their work, explain why their solutions are valuable, or defend their positions. Collins, Brown, and Newman (1989), in their cognitive apprenticeship model, refer to these explanations as articulation.

The annotations learners write when they create links in the LDP are the method used to examine learners' thinking processes. In the annotations, learners write their research question, then explain how the two nodes provide an answer to the question. When the instructor reviews a learner's links and annotations, the instructor gets a sense of how the learner is navigating through the database and how the learner is constructing evidence to answer the research question. The links and annotations make the learners' problem-solving process

explicit, enabling the instructor to provide the learner guidance in developing research skills.

Articulation in the SOCRATES curriculum is a very public activity that takes place during the group activities and the classroom debriefing. The instructor and the worksheets direct learners to explain their solutions. For example, why did the learner prescribe a certain regimen? How did the learner know a patient exhibited certain symptoms? In classroom debriefings, the instructor constantly asks, "Why?" in response to a learner's decision. For example, a learner might state that he or she increased the patient's lente insulin one unit at 7 AM. The instructor would ask why, and the learner would articulate the reason: The patient has a high blood glucose level from noon to 8 PM; thus, a long-acting insulin should reduce the glucose level during these hours.

Conclusion

The seven pedagogical goals of constructivism offer designers a solid framework on which to build learning environments. By designing learning activities that satisfy the goals, the designer makes an effort to put theory into practice. However, the pedagogical goals are only a framework. The designer must strive for creativity in translating these goals into actual activities.

Different types of learning environments obligate the designer to conceive of different instructional methods and strategies to bring the pedagogical goals alive. For instance, the LDP (a virtual environment) addresses the collaboration goal by building in a public system of links and annotations that are accessible by all learners. SOCRATES (a classroom environment) addresses the collaboration goal with face-to-face communication between individual group members and between groups and the instructor.

As you read the other project descriptions in this book, reflect on how the various elements of their design address the seven pedagogical goals. I am sure you will find other creative twists in how to put the theory into practice.

References

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.) *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453–494). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cunningham, D., Duffy, T. M., & Knuth, R. (1993). Textbook of the future. In C. McKnight (Ed.), *Hypertext: A psychological perspective.* London: Ellis Horwood Publishing.

Eli Lilly, Inc. (1988). *DiaSim* [computer software]. Indianapolis, IN: Eli Lilly, Inc.

Honebein, P. C. (1994). *The effects of a problem-based learning curriculum for diabetes management and care in a large medical school.* Unpublished Doctoral Dissertation.

Honebein, P. C., Chen, P., & Brescia, W. (1992). Hypermedia and sociology: A simulation for developing research skills. *Liberal Arts Computing,* Winter, 9–15.

Honebein, P. C., Duffy, T. M., & Fishman, B. J. (1993). Constructivism and the design of learning environments: Context and authentic activities for learning. In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), *Designing environments for constructivist learning* (pp. 87–108). Berlin: Springer-Verlag.

Keegan, M. (1995). *Scenario educational software: Design and development of discovery learning.* Englewood Cliffs, NJ: Educational Technology Publications.

Knuth, R. A., & Cunningham, D. J. (1993). Tools for constructivism. In T. Duffy, J. Lowyck, & D. Jonassen (Eds.), *Designing environments for constructivist learning* (pp. 163–187). Berlin: Springer-Verlag.

Schoenfeld, A. H. (1985). *Mathematical problem solving*. New York: Academic Press.

Wilson, B. (1996). Introduction to this volume.

Peter C. Honebein, Ph.D., is an instructional systems consultant based in the high desert above Reno, Nevada. You can communicate with him on the Internet: HeyHoner@aol.com.

Acknowledgments

Thanks to Tom Gieryn, principal investigator of the LDP and practicum leader, for providing the environment for innovative curriculum development. The LDP was funded by a grant from the Andrew Mellon Foundation.

Tom Duffy, David Marrero, and Stephanie Kraft were team members on the SOCRATES curriculum. The SOCRATES curriculum was supported by the Diabetes Research and Training Center at the Regenstief Institute, Indiana University School of Medicine, and a grant from the National Institutes for Health.

3

An Interpretation Construction Approach to Constructivist Desig

John B. Black
Robert O. McClintock

Study is a key concept in making design more fruitful in education. We pı that what students are doing when they construct knowledge is stu‹ Specifically, we think that the term *study* captures better what should be go during knowledge construction then does the term *learn*. Thus, in designi knowledge construction we see ourselves as designing Study Su Environments (SSEs) instead of "instructional systems" or "lea environments." Creating SSEs allows us to create "a place for study in a w‹ instruction" (McClintock, 1971). The core of study is the hermeneutic acti\ constructing interpretations. Hermeneutics as a field focused initial interpretation of texts, but has broadened to interpretation in general (Gad 1976; Palmer, 1969). From this perspective, the basis for cognition (and *b‹* general) is interpretation based on background knowledge and t (Heidegger, 1962; Winograd & Flores, 1986). Consistent with these philoso arguments for the centrality of interpretation in cognition are the many re results from cognitive psychology showing that understanding involves m a large number of inferences (Black, 1984, 1985). Thus, the key considerat designing a SSE is fostering the construction of interpretations bas‹ observations and background contextual information.

Teachers College, Columbia University has been collaborating with the I School (a K–12 independent school in New York City) on the Dalton Techn Plan. The general aim of this plan is to develop a digital knowledge-bas information infrastructure for all aspects of the K–12 educational experienc to implement educational strategies designed to make use of this infrastru enhancing significantly an already excellent educational experience. Iı