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ABSTRACT

The introductory technology course for preservice teachers provides a forum for them to develop technological competency as they reflect on their own learning processes, develop a deeper understanding of learning theory, examine the relationship between theory and practice, critique the nature of school-based learning experiences, and analyze assumptions underlying instructional methods. To accomplish these goals, two instructional activities were designed to provide preservice teachers with a common learning experience that exemplified contrasting approaches to instruction. One activity was a highly structured, teacher-directed lesson based on a didactic instructional model. This activity involved developing a home page using HyperText Markup Language (HTML). Students completed the activity by working individually at a computer with little peer interaction. The second activity required students to assume primary responsibility for planning and implementing the project as they worked cooperatively to support each other as a community of learners. This activity involved creating a home page through a more active constructivist approach; students were encouraged to be creative and to share their work and expertise with their classmates. Most students reported increased motivation and a better understanding of material learned through constructivist methods, although some failed to see the relevance of connecting theory to practice.(AEF)

Learning About Learning in an Introductory Educational Computing Course

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Current trends in education reflect a shift from traditional didactic pedagogy toward student-centered constructivist instructional practices. These trends are evident in increased attention to constructivist learning theory and teaching methods in preservice teacher education courses (Howey, 1996), and in recent curricular reform reports (National Association for Secondary School Principals, 1995; National Council of Teachers of Mathematics, 1991; National Research Council, 1995; National Science Teachers Association, 1990). Although preservice teachers have been exposed to constructivist theory in their coursework, teachers rarely draw on the learning theories they have studied to guide their practice (Pinegar & Carter, 1990).

Teachers tend to base their pedagogy on their experiences as learners in didactic K-12 classrooms (Knowles & Holt-Reynolds, 1991, Lortie, 1975), rather than relying on formal theories of learning. They often interpret constructivist reforms in light of their previous school experiences and implement constructivist practices in idiosyncratic ways. For example, a constructivist use of manipulatives might entail allowing students to use hands-on materials to develop a concrete representation of an abstract mathematical concept. This process helps students construct more complex understandings and their own problem solutions. However, some teachers integrate manipulatives with their didactic practice by demonstrating the correct way for students to use the materials to solve a problem. Thus, teachers can transform constructivist uses of manipulatives to fit with their existing practice.

Helping teachers change their pedagogy to reflect a more constructivist orientation is a difficult and challenging process. Educational psychology-based courses on learning often present models of learning as complex and abstract theories that are divorced from preservice teachers' personal learning experiences. On the other hand, methods courses typically focus on constructivist instructional strategies (i.e. cooperative learning, reciprocal teaching, discovery learning), helping preservice teachers understand *how* to teach in constructivist ways, but without providing explicit links to the theory-based assumptions that underlie constructivist practice. Preservice teachers need to experience constructivist learning activities from a student perspective if they are to be effective constructivist teachers (Stofflett & Stoddart, 1994). Helping preservice teachers reflect on their experiences as a constructivist learner can help them make important connections between learning theory and related instructional practices.

Most stand-alone technology courses focus on helping preservice teachers learn to use various hardware and software applications (i.e. Downs, 1992; McKenzie, 1994; Niess, 1991; Raiford & Braulick, 1995), and current standards focus on ensuring preservice teachers develop specific technology competencies (Wiebe & Taylor, 1997). Although developing technology related skills is an important goal for teacher education programs, the preservice technology course can also provide a unique context for future teachers to explore their own learning. Unlike methods courses, in which preservice teachers often know the content and focus on learning to teach it, preservice teachers expect to learn new concepts and skills in the technology course. Many preservice teachers enter the class with word processing experience, but little exposure to other productivity applications (Sheffield, 1996). They often have minimal experience with e-mail or Internet browsers and it is rare to find a preservice teacher who has considered instructional uses of technology beyond drill-and-practice activities. Thus, most preservice teachers bring limited skills and understandings needed to integrate technology with their instruction. The technology course provides a forum for them to develop technological competency as they reflect on their own learning processes, develop a deeper understanding of learning theory, examine the relationship between theory and practice, critique the nature of school-based learning experiences, and analyze assumptions underlying instructional methods.

To accomplish these goals, two instructional activities were designed to provide preservice teachers with a common learning experience that exemplified contrasting

approaches to instruction. One activity was a highly structured, teacher directed lesson based on a didactic instructional model. The second activity required preservice teachers to assume primary responsibility for planning and implementing the project as they worked cooperatively to support each other as a community of learners. This activity was based on a constructivist instructional model. Preservice teachers completed these activities during the first quarter of the class and used them as a referent for understanding the discussions and activities that followed.

Didactic Activity

The initial computer activity involved developing a home page using HyperText Markup Language (HTML). Preservice teachers completed the activity by working individually at a computer with little peer interaction. The activity was highly structured as preservice teachers were given a handout that included all of the information they would need to complete the project. The handout provided precise directions that stated exactly what needed to be typed into the text editor (in boldface type), and a detailed explanation of what each line of the program did. Many preservice teachers quickly realized that they could simply type in the boldface lines without reading the detailed explanations and complete the assignment. Their focus was on completing the task rather than developing an understanding of what they were doing. The instructor moved around the lab encouraging the preservice teachers to follow directions exactly, praising their efforts, pointing out typos, and providing technical assistance when necessary. Before long, completed home pages began to appear on monitors. Following the directions exactly provided preservice teachers with identical projects—if they had typed the information correctly, they got it *right*. The underlying assumption was that since they have produced the correct product, they had learned the important concepts through the process.

A brief multiple-choice test was administered at the beginning of the next class period as a traditional assessment of what had been learned. Test items were taken directly from the detailed explanations on the worksheet (which few students had even read). A review of the right answers followed with considerable praise as a reinforcer for those who had managed to choose correct responses. At this point, a fairly large group of preservice teachers felt frustrated and angry. They had accomplished the task and produced an acceptable product, but the quiz forced them to reflect on how little they had learned. Interestingly, preservice teachers criticized the nature of the instruction and their perception of what the instructor should have done, and refused to accept responsibility for their own learning.

The class discussion that followed focused on tying the activity to behavioral learning theory—expert designed outcomes, focus on product, detailed sequential instructions, ongoing praise and feedback, and tests of factual information in which the teacher determines what is important and what counts as a right answer. The instructors explained how didactic instructional principals had been used to design, teach and evaluate the lesson, and many preservice teachers acknowledged that this activity was fairly representative of their previous school-based learning experiences. The heart of the discussion, however, centered on learning.

Preservice teachers felt satisfaction from completing the home page but questioned whether they had learned anything meaningful from the activity. Some preservice teachers had experience with HTML and did not believe the activity had added to their knowledge. Others had no experience with HTML and, although they had produced a home page, did not believe they had learned the skills and understandings necessary to independently create a home page, much less teach their future students to do it. Most preservice teachers confessed to having adopted a "get it done" strategy with little concern for developing an understanding of the HTML code. They were unwilling to spend time outside of class to work on the assignment, nor had they reviewed the handout to try and make sense of what they had done. All admitted that, although the activity was fun, and seeing the finished product was rewarding, they had not really learned much that would be useful in the long term.

Further discussion addressed the appropriateness of the activity for the desired outcomes. If the goal for the activity was to help preservice teachers develop an understanding of how to develop a homepage using HTML, the instructional method was inappropriate and preservice teachers' approaches to learning were ineffective. However, our goal as instructors for the course was met. Preservice teachers were forced to critically examine both the fairly traditional instructional methods used for the lesson and their role as a learner.

Constructivist Activity

The second activity involved creating a home page through a more active constructivist approach. The assignment involved developing a home page around an academic theme. Preservice teachers had a good deal of flexibility in planning and implementing the project. They learned to search the web for relevant information and sites, read source code from other pages to get ideas for features for their own page, and learn from and teach each other. Preservice teachers were encouraged to be creative, to share their work and expertise with their classmates, and provide suggestions and help for each other. The assignment helped the group develop into a community of learners and they continued to help and support each other through the remainder of the course. The activity was spread over several weeks so that students would have ample time to develop deep and connected understandings of the process.

The preservice teachers initially experienced a good deal of frustration and anxiety working on the project. As the project progressed, they recognized the considerable time and effort needed to engage in meaningful learning. The instructor was available as a resource, guiding preservice teachers in potentially fruitful directions and asking questions to challenge thinking rather than providing information and giving directions.

A group evaluation session allowed each preservice teacher to present their work, explain some of the features they had incorporated, and address questions from their peers. Preservice teachers shared their ideas, criticisms, and suggestions freely. All participants benefited from the information shared during the formative evaluation session. In the ensuing discussion, the class explored the components of a constructivist learning orientation that were apparent in this activity—student agency in designing the activity; actively seeking, organizing, and producing knowledge, cooperation with peers, and holistic evaluation of the project.

Preservice teachers stated that the project had been an excellent learning experience, although it had been extremely time consuming and frustrating. They reported that the project took on personal significance as they worked through their difficulties and many went beyond what was required because of their high level of interest and engagement. The discussion was structured to encourage preservice teachers to reflect on the nature of meaningful learning, roles of the learner, and roles of the teacher. Taken together, the didactic and constructivist learning activities provided an experiential referent that the preservice teachers could draw on as they considered the role of educational technology in the learning process.

Building on the Foundation

These learning activities met several of the course goals. First, class discussions prompted reflection. The preservice teachers were encouraged to think about the strategies they employed to complete the activities, how their motivation and goals differed relative to the projects, and the differences in their levels of understanding of HTML relative to the two activities. The activities also provided a common experience-based referent for reflecting on two important theoretical orientations toward learning—behaviorism and cognitive constructivism. Readings and class discussions about learning theory that occurred concurrently with the activities were greatly enhanced because preservice teachers were able to relate the theory to their own personal learning experiences. These experiences enabled them to examine the relationship between the assumptions underlying the theory and the instructional methods used in the class. Other course activities built on this foundation.

Software Evaluation

Software evaluation focused on the underlying theoretical assumptions about learning that guided its design (e.g., behavioral principles in drill-and-practice and tutorial software, and constructivist components in programs like SimLife and the Geometer's Sketchpad). Class discussion of software evaluation focused on how the same piece of software could be used to support more traditional didactic instruction (e.g., teacher PowerPoint presentations) or a more constructivist orientation (e.g., student PowerPoint presentations). Potential learning objectives were examined relative to how various types of software supported different learning goals (e.g., memorizing, problem solving, exploration, etc.). Thus, preservice teachers used their own learning experiences as a referent for analyzing assumptions about learning inherent in instructional uses of technology.

Field Experience

Preservice teachers were required to conduct observations and interviews with teachers during a two-week field experience. They examined the types of software teachers used, how teachers used the software, and teachers beliefs about the role of technology in education. Learning theory provided a framework for the preservice teachers to critique and understand classroom applications of technology. This activity addressed the goal of helping preservice teachers explore and critique the nature of school-based learning experiences and analyze the assumptions underlying various instructional methods.

Student Outcomes

Student feedback revealed a range of opinions concerning the value of the course. Most students reported increased motivation and a better understanding of material learned through constructivist methods; however, some students failed to see the relevance of connecting theory to practice. Thus, although they claimed to enjoy constructivist learning activities, students questioned the need to understand learning theory. Excerpts from course evaluations reflect their thinking: "[You] might want to back off from all the psychology and philosophy material. I felt we spent too long on this subject. In fact, very long with respect to this being a computer introduction class." And "I do not feel that this course will help me as a teacher in the area of technology. I believe the behaviorist/constructivist [information] could have been taught in the first couple of weeks, then we could have studied more useful things."

Other students; however, embraced the importance of the learning theory component of the class: "This was a great class. It was difficult and challenging which really made me think and examine my own motivations and knowledge." And "The information we learned . . . was useful to me and helped me understand new concepts. I think I understood the differences between behaviorist and constructivist approaches better than in any other classes

where we've talked about these things." Learner variables, such as whether preservice teachers were willing and able to be active learners and reflect on their own learning processes, influenced what students gained from the course activities. Making connections between the readings and discussions about learning theory, their personal learning experiences, and the instructional practices they observed required effort on the part of the student.

Conclusion

The actual activities (learning to write HTML code) is not critical to the value of the course. We chose this topic because it was unfamiliar to most of our students. Any novel and complex learning activity could be framed to contrast the differences between didactic and constructivist instructional methods.

Preservice teachers developed increased confidence and competence in their ability to use computers by the end of the course. Skills were learned in a highly motivating "project-based learning" context (see Blumenfeld, Soloway, Marx, Krajcik, Guzdial & Palincsar, 1991), in which students take responsibility for determining what they need to know and how to go about learning it. Support was available, including peers, instructors, and lab technicians, and students decided how to best use these resources. Students had developed many skills for using technology as they completed the course. They had also learned strategies for getting new skills when they were needed.

However, students in the course learned more than just competencies for using computers in the classroom. The learning theory backbone of the class enables them to make decisions about how different types of computer programs can support different learning goals, how to select software that meets learner needs, and how to evaluate new educational technologies from a student learning perspective. The connections they make between learning theories, their own learning, and educational technology provide a solid experiential base that will serve them well in the teaching profession. Students developed a theoretical orientation to learning that guides decision making about how to use technology in their instruction, rather than specific ways to use computers that will soon become outdated.

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