The Effect of Hypermedia Delivered Modeling on Learners' Self-Directed Study During Problem-Based Learning

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Problem-Based Learning

Problem-based learning (PBL) is an instructional approach which uses problems as the stimulus and focus for student activity (Baud & Feletti,1991). Instruction begins with the presentation of a complex problem situation and all learning occurs as a result of students' efforts to solve the problem. Students work in teams to identify questions raised by the problem, collect and analyze data, form and test hypotheses, and develop a solution plan. Along the way, students discover that they need both factual information and a variety of skills in order to understand the problem, determine all their options, and develop a viable solution. In order to collect this information they engage in self-directed study, searching existing knowledge bases and using the tools experts within the field use to collect new information (Barrows & Tamblyn, 1980).

Research on PBL has revealed a number of benefits. In terms of problem-solving skills, students in classes employing a PBL approach outperformed control groups in their ability to identify and formulate problem statements (Gallagher, Stepien, & Rosenthal, 1992) and solve one-step, two-step, and multi-step word problems (CTGV, 1992). PBL students also improved in their ability to provide a logical rationale for a proposed course of action, shifting from arguments based largely on emotions to ones supported by reason (Stepien, Gallagher, & Workman, 1993). PBL can impact student attitudes toward learning. The Cognition and Technology Group at Vanderbilt found that students who had used their problem-based series, *The Adventures of Jasper Woodbury*, reported less anxiety toward math, saw math as more useful and relevant to their lives, and were more likely to prefer complex challenges than students who had received more traditional instruction (CTGV, 1992). In a longitudinal study on attitudes toward a year-long course using a PBL approach, former students reported that this course was their favorite class in high school, and that it was the most helpful in teaching them problem finding, problem solving, critical thinking, and ethical decision making skills (Stepien, Gallagher, & Workman, 1993). Finally, research from medical education suggests that PBL may help students develop the skills necessary to pursue learning independently (Aspy, Aspy, & Quinby, 1993).

The self-directed study required of students in PBL can be quite challenging. The development of a solution plan requires learners to sift through information, distinguishing that which is pertinent from that which is not. Yet, while good problem solvers are able to organize their knowledge in ways that facilitate development of a solution, poor problem solvers tend to focus on the surface features of a problem, failing to recognize what information is useful (de Jong & Ferguson-Hessler, 1986). Even in the field of medical education, both faculty and students have expressed concern that students may not be able to determine what should be learned (Barrow & Tamblyn, 1980). When attempting to use PBL with young learners, support for the development of self-directed study seems warranted.

Responsibility for this support can be left to the classroom teacher, but this can be an overwhelming task in K-12 environments, where learners may have limited self-directed learning skills and classes may be large. PBL requires teachers to develop a new repertoire of skills, including probing students' thinking, asking questions, monitoring the group process, and helping students frame questions, locate helpful resource materials, and make effective decisions (Aspy, Aspy, & Quinby, 1993; Koschmann, Kelson, Feltovich, & Barrows, 1996). Teachers must provide modeling, coaching, and scaffolding to support student learning, and this support should be delivered "just-in-time" and tailored to individual and small group needs.

Left alone with the responsibility for offering this support, teachers may feel that PBL is not a viable instructional approach. However, one of the potential benefits of computer technology in educational environments is that they can share the responsibility for this support with the teacher. The role of the teacher in a PBL environment is frequently likened to that of a tutor (Barrow & Tamblyn, 1980; Koschmann, et al., 1996). In this role, teachers model the cognitive processes involved in identifying resources, interpreting and organizing data, and building a rationale for their decisions. Collins (1991) argues that one potential of technology is that it can offer good process models of expert performance embedded within the situations in which they are useful. A hypermedia program can be designed to offer these models at the time when they are most likely to be useful, or learners can be given control over their use. The provision of hypermedia models of the tasks students are most likely to need to perform can free the teacher to provide other types of support particular to his or her class.

Research Questions

The purpose of this study is to examine the effects of modeling on students' self-directed learning of information they need to solve a complex problem, and to determine if hypermedia can provide this support as effectively as a teacher. The research questions are

1. Does cognitive modeling affect students' success in identifying information which meets their learning needs?
2. Can a hypermedia-based character deliver that cognitive modeling as effectively as a teacher?

Method

Participants

Three sixth grade classes in a middle school in a southwestern city will participate. These classes will not include students in the gifted and talented program at this school.

Materials

The study proposed here will employ *Alien Rescue*, a hypermedia based program designed to engage sixth-grade students in solving a complex problem. The science fiction premise of *Alien Rescue* takes students to a newly operational international space station where they become part of a worldwide effort to rescue alien life forms. Students take on the role of junior scientists working with experts aboard the space station. In the course of developing a solution plan, students learn about our solar system and the tools and procedures scientists use to gather information about it.

The hypermedia format of *Alien Rescue* creates a rich context for students' investigation of the problem situation. It provides access to all the tools and information students need to develop a solution plan, but is structured in such as way as to not suggest what that solution should be. Students are free to explore the environment of the virtual space station as they determine for themselves what information is pertinent to the problem and the process they will use to gather it.

The modeling element of *Alien Rescue* consists of talking head video clips and audio clips of experts created to coincide with onscreen events. For example, when an expert explains what she would record in her notebook, the notebook tool opens, and that information is automatically typed into a new section. The scripts for the modeling were developed by examining how students used the program without modeling, noting their sources of difficulty, then providing modeling to support them. The goal of this process was to develop the least intrusive support needed. Any additional support students need is to be provided by the classroom teacher. Thus, *Alien Rescue* shares the responsibility for supporting students' cognitive processes with the classroom teacher.

Treatment Conditions

Three different treatments will be used in this study:

In the *hypermedia delivered modeling treatment,* the character of an expert scientist aboard the space station will model the cognitive processes she would use in collecting information pertinent to an identified learning need. This modeling will include strategies such as self-questioning and organization of collected information in the notebook. This expert will actually use the tools available in the program, explaining their features as she uses them. This modeling will be delivered when students are in the section of the program where it is useful, and students will be able to review the video if they choose.

Similarly, in the *teacher delivered modeling treatment,* the classroom teacher will model the cognitive processes he or she would use in the same task. The teacher will model the same strategies as the hypermedia-based expert, but will do so in an unscripted manner. He or she will also use the tools in the program, explaining their features as they are used. Students will be able to ask questions, and the teacher will adjust the modeling to meet the perceived needs of the class. This modeling will be delivered to the entire class simultaneously.

In the *comparison treatment,* students will not receive modeling of the cognitive processes an advanced problem-solver (the hypermedia based expert or the teacher) would use while engaging in self-directed study. Instead, a video-based character will offer to explain the features of the tools students may use while engaged in self-directed study to meet their identified learning needs.

Dependent Variables

Two measures will be used to examine the research questions. First, students' notebooks will be analyzed to determine the percentage of notes taken that actually address an identified learning need, and the percentage of facts available in the program that meet that need that are recorded. In a second measure, students will work with the teacher to identify a learning need that is similar to the first. They will then be given materials to use and asked to identify information that meets the identified learning need. The purpose of this measure is to determine if modeling of self-directed study impacts students' ability to independently identify information that meets a learning need.

Procedure

In all three treatments, students will engage in a teacher-led, whole class discussion aimed at examining a problem situation to identify learning needs. Students will then have approximately ten minutes to explore the section of the program where information to meet those needs is available. At this point, either the video-based expert or the teacher will ask students if they are ready to work with him or her for a few minutes. If students respond negatively, they will be given five more minutes to work independently, then the expert or teacher will interrupt. Depending on the treatment, students will either receive hypermedia delivered modeling, teacher delivered modeling, or an explanation of the features of the tools being used. Students will then engage in self-directed study for approximately forty-five minutes in order to find information that meets the identified learning need.

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