Learning About Transfer in an Online Problem-Based Course

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Abstract: Problem-based learning (PBL) is an instructional method in which students collaboratively learn through problem-solving. Students solve a complex problem, direct their own learning, and reflect on their learning. In a STELLAR course, PBL was adapted for an online CSCL environment for preservice teachers. The study demonstrates that students who participated in a STELLAR course learned more about transfer than students in a traditional course.

Problem-based learning (PBL) is a methodology for student-centered learning that relies on small, facilitated, collaborative groups (Barrows, 1996). In PBL, students learn through solving complex problems and reflecting on their experiences. As students work on a problem, they identify what they need to know in order to solve a problem and engage in self-directed learning to address those needs. The facilitator acts to guide the learning process, helping to promote the development of knowledge and reasoning strategies as well as promoting self-regulated learning. PBL curricula have had positive effects in promoting learning and transfer, particularly in medical education (Gijbels, Dochy, Van den Bossche, & Segers, 2005; Hmelo, 1998). The STELLAR (Socio-Technical Environment for Learning and Learning-Activity Research) system adapts the PBL model to specifically support preservice teachers in gaining an understanding of Educational Psychology that they can transfer to their classroom practice. PBL should promote effective transfer because students repeatedly bring together conceptual ideas underlying a domain with visions and plans of professional practice as they construct what we call a meshed schema representation (Derry, 2006; Derry, Hmelo-Silver, Nagarajan, Chernobilsky, & Beitzel, 2006).

STELLAR is an online PBL environment that enables preservice teachers to engage with Educational Psychology concepts by using video cases as contexts for collaborative lesson redesign. The system consists of three components: an online Educational Psychology hypertextbook (the Knowledge Web); a PBL online module; and a library of video cases that present examples of classroom practice. These cases provide rich contexts that present opportunities for discussion as students engage in redesign of instruction depicted in the cases as well as providing links to the Knowledge Web, helping students identify fruitful learning issues. The PBL online module includes tools that provide a loose script as they scaffold students' individual and group PBL activities (Dillenbourg, 2002). These include a personal notebook where students record initial observations, a threaded discussion, where students share research, and a whiteboard where students discuss proposals for lesson redesigns. These tools embody an instructional planning process based on the backwards design model of Wiggins and McTighe (1998).

STELLAR courses consist of 3-4 problems each lasting 2-3 weeks using a hybrid online and face-to-face course structure. The asynchronous discussions promote reflection and allow a facilitator to work with multiple groups. We integrated domain-specific scaffolding to support principled instructional design activities and help structure the collaborative PBL process. The students' goal is to redesign a lesson based on Educational Psychology principles. They begin by individually studying a video case (STEP 1). In STEP 2, they record observations and brief individual redesign proposals in an online personal notebook that guides students towards lesson features relevant for redesign. This work is shared with group members in STEP 3. The group identifies concepts they need to explore for redesign (STEP 4), conducts and shares research (STEP 5), and collaboratively designs lessons (STEP 6). They use threaded discussions and a group whiteboard as shared workspaces in steps 4-6. The redesign is shared at a poster session. The students meet face-to-face for STEP 4 and again as they present solutions at the completion of STEP 6. Students provide individual explanations of the group proposal in STEP 7 and reflections in STEP 8.

In previous research, we have demonstrated that students who have participated in STELLAR courses demonstrate improved understanding on targeted learning outcomes (Derry et al., 2006). The earlier results demonstrated that students who participated in a STELLAR course learned more about the concept of understanding than a comparison group. The goal of the current study is to examine whether other targeted outcomes were achieved, in this case, whether students learned about the concept of transfer.

The purpose of the current research was to examine 1) students' acquisition of knowledge about the concept and principles of transfer and 2) their ability to generate ideas about instructional methods that would facilitate transfer and the learning process. It was hoped that the questions the participants answered would capture their knowledge along the three dimensions as defined by Sugrue (1995): concepts, the principles that link concepts, and the conditions and procedures under which concepts and principles should be applied. The hypothesis underlying the research was that students in a PBL class would outperform students in a traditional class in both their knowledge acquisition and application of that knowledge.

Methods

Seventy preservice teachers taking Educational Psychology classes in a state university in the northeast United States participated in the research. Thirty-three participants were taught Educational Psychology in the PBL class. The remaining thirty-seven participants were drawn from the Educational Psychology subject pool and received course credit for their participation. The PBL class was organized around five themes: the constructive nature of knowledge (understanding), the social nature of learning, transfer, motivation, and feedback and revision. The STELLAR participants had access to the STELLAR environment described above. They were required to work in groups to discuss their understanding of material and construct group learning artifacts. The groups were formed to be heterogeneous with respect to the different planned teaching specialties. The comparison classes used standard textbooks. Participants in the traditional classes met face-to-face and participated in lectures and other activities that their course instructors deemed appropriate.

Participants viewed a brief video in which high school students learned about electricity, electrical circuits, and how a light bulb works. Before viewing the video, they received a brief written explanation describing how the video clip illustrated a problem the teacher had identified in his teaching. The video explained how the teacher had spent a month covering advanced topics in electricity and provided hands-on experience designed to reinforce those concepts and illustrate how electricity enabled a light bulb to work. The video also showed an interview with a student before and after instruction and demonstrated that she maintained the same misconceptions following instruction. After viewing the video, the participants in both the traditional and STELLAR classes were given pretest questions. They had thirty minutes to answer the following four questions: 1) How do you know that the student failed to learn?, 2) Why did the student fail to learn?, 3) What recommendations would you make to help him improve his teaching?, and 4) What else do you need to know to better understand the teaching-learning situation? What additional questions would you ask? At the end of the semester, the participants in both the traditional and STELLAR classes completed an identical posttest.

On the pre- and post-tests, a rubric on the concept of transfer was used to evaluate participants' responses, and then a rating between 0 and 3 was assigned to the participants' overall responses. The transfer rubric included several features of transfer that participants could use to discuss the video including the fact that transfer: 1) requires understanding, 2) involves activating appropriate prior knowledge and applying something learned in a new situation, 3) involves abstraction and cognitive flexibility, 4) can be near or far transfer, and 5) can be preparation for future learning. The ratings were based on the degree to which the participants included and elaborated upon these features of transfer in their written answers to the four questions noted above. The ratings indicated progressively greater understanding of the concept of transfer and its application. Answers that received a level 0 rating indicated that there was no evidence that the target concept was understood. A level 1 rating indicated incomplete understanding and a lack of causal explanation or application of concepts. A level 2 rating showed greater understanding and elaboration. A level 3 rating showed sophisticated understanding, with explanations that showed cause and connections to other frameworks. This was adapted from the rubric for the concept "understanding" used in Derry et al. (2006). Participants' written responses were scored blind to condition. Two independent raters scored 30% of the data and had interrater reliability of 83.33%. Disagreements were resolved through discussion.

Results

Means and standard deviations for both classes are shown in Table 1. A 2x2 mixed ANOVA was conducted using time as a within subject factor and class as the between subject factor (STELLAR vs. Traditional). The results of the ANOVA showed a significant class x time interaction, $F(1, 68) = 106.18$, $p < .001$. Simple effects tests showed a significant change over time for the PBL class ($t(32)=12.79$, $p<.001$) but not for the traditional class ($t(36)=1$, $p=.32$).

Table 1: Pretest and Posttest Means and Standard Deviations

Type of Class	N	Pretest	Posttest
STELLAR	33	0.71 (0.31)	2.02 (0.69)
Traditional	37	0.61 (0.36)	0.68 (0.34)

Conclusions

The results of this research indicate that students who participated in the STELLAR course constructed a deeper understanding of the concept of transfer and were able to apply their understanding of the concept to generate recommendations for improvements of instructional methods. This evidence helps provides generality to the results of Derry et al. (in press), which demonstrated similar results for another targeted concept.

The STELLAR approach represents an example of a problem-based approach to CSCL. These results suggest that 1) problem-based approaches can foster deep learning and 2) an integrated CSCL system can be used for PBL. Further research is needed to examine the impact of student interaction with different aspects of the STELLAR system, with each other, and with the facilitator.

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