

## Implementation of a Technology-Enhanced Problem-Based Learning Curriculum: Supporting Teachers' Efforts

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This paper describes the experiences of three middle school teachers during the year following a two-week summer workshop in which they were introduced to a technology-enhanced problem-based learning (PBL) pedagogy. Based on their collaborative experiences during the school year, developing and implementing a PBL unit, the three teachers increased their confidence in using technology and indicated shifts in their pedagogical beliefs regarding classroom instruction. Results suggest that administrative support, collaboration with other teachers, and the development of a school culture that valued the sharing of teachers' experiences were keys to teachers' successful implementation.

*Keywords : technology-enhanced problem-based learning (PBL) pedagogy, collaboration, teacher's implementation*

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## **Theoretical Framework**

Technology changes have resulted in the rapid increase of computer access in schools. According to the National Center for Education Statistics (NCES, 2000), nearly all public school teachers (99 percent) reported having computers in their schools. Additionally, Internet connectivity in K-12 classrooms reached the 95 percent mark in 1999 (Web-Based Education Commission, 2000). However, NCES reported that nearly 70 percent of teachers still don't feel well-prepared to use computers in their teaching. Teachers' preparation and training to use technology is a key factor to consider when examining their instructional use of computers and the Internet.

In 1998, Lewis listed a number of barriers to effective professional development including opportunities to practice, access to outside resources and expertise, and support from the community, and emphasized the importance of having on-site assistance and support while teachers attempt to develop and implement new instructional practices. According to Trotter (1999), teachers who received instruction related to both technology skills and integration ideas felt significantly more prepared to use technology in their teaching compared to teachers who received instruction of just one type.

Sage (2000) contended that a problem-based learning (PBL) approach was an effective way to integrate technology into the classroom. She defined PBL as "experiential learning, organized around the investigation and resolution of messy, real-world problems" (p. 7). Also, Hill (1999) suggested that teacher technology development can comprise the same problem-centered methods that are suggested for students. Because technology is a critical tool for information searching, modeling task or content decision making, and presenting solutions during PBL activities, technology integration with PBL can be a meaningful learning experience for both teachers and students (Jonassen, Howland, Moore, & Marra, 2003).

Although some literature is available regarding the benefits of staff development

focused on promoting a technology-enhanced PBL approach, previous research has not looked at how teachers adapt their classroom practices to implement the suggested strategies over an extended period of time.

## **Purpose of the Research**

In this case study we examined the experiences of three middle-school teachers' at three different times during the year following a 2-week technology integration summer workshop involving problem-based learning (PBL). Specifically, the research questions guiding data collection and analysis included:

- What are teachers' perceptions of and pedagogical beliefs about technology-enhanced PBL?
- What kinds of barriers and support do teachers encounter while implementing technology-enhanced PBL?
- What strategies are perceived as being most important in developing teachers' ability to implement technology-enhanced PBL?

## **Methods**

This study was a part of a Technology Innovation Challenge Grant, funded by the U.S. Department of Education. A 2-week summer institute, focused on technology-enhanced PBL, was used to kick off the staff development process.

Three teachers from the same middle school, located in a small rural community in the Midwest, developed a PBL unit together during the summer institute. The first participant, Carrie, had taught both science and social studies in the sixth grade for four years. The second participant, Jake, was beginning his second year of teaching

sixth and seventh grade social studies. The third participant, David, was beginning his third year of teaching social studies and reading in the sixth grade.

Preliminary survey data were used to assess the participants' current levels of computer skills, past frequency of technology use in the classroom, and teaching beliefs and practices. Participants responded to 55 questions using a 5-point Likert scale, adapted from the Becker's (2000) survey (e.g., "I ask students to work in a small group.", "Students in my class pursue information related to personal interests."). These data were collected at the beginning of the summer workshop and at the end of the spring semester.

Qualitative data were collected from various sources including teacher interviews, field notes, and teachers' journals. The first week of the summer institute focused on an introduction to PBL, a PBL modeling activity, and use of various software applications (Internet search techniques, web page development, spreadsheets, and an online course management system called ANGEL). During the second week of the institute the teachers worked collaboratively to develop their own PBL unit. A daily reflective journal was kept by each teacher and the first interview was conducted at the end of the workshop. The second interview was conducted in the fall semester and the final interview occurred in the following spring semester. The researchers also observed classroom activities and final student presentations that culminated the PBL unit.

## **Results**

### **Stage 1: The Summer Institute**

The participants indicated that, overall, the summer workshop was very beneficial in improving their technology skills and knowledge and all three reported an increase in confidence levels through hands-on activities. Through the PBL modeling activity,

which included collaborative activities completed with k-12 students, teachers gained insights into the role of the teacher and how PBL can be implemented in their classrooms. Before the workshop all three teachers indicated that they felt uncomfortable using technology in the classroom. One indicated that using technology was a hassle and unreliable in improving student achievement. However, after the workshop, they all felt comfortable using a variety of software and demonstrated improved skills in almost every area. Although the participants felt, overall, that the workshop was very beneficial to them, there were a few areas needing improvement. The teachers wanted to have more examples and evidence of how a PBL unit can actually work in their classrooms.

The teachers reported that the collaboration with professors and colleagues using hands-on activities and development of a unit meeting their specific curricular needs were very positive features.

## **Stage 2: Changes Following the Summer Institute**

Following the summer workshop two of the three participants indicated that they were using technology in the classroom with much greater frequency and all of them felt more comfortable with various software applications.

The researchers hoped that the participants would have implemented their PBL units by the time of this interview, but instead found that the teachers had faced many barriers. The first barrier was losing their common team preparation time. Because of this, teachers could only communicate while passing each other in the hallway or by meeting before or after school. Another barrier was the time needed to prepare students for, and to give, the standardized tests required by the state at the beginning of the semester. This left teachers with little time to introduce technology to the students and they were unable to use mini-PBL strategies during class time. Because of these barriers, none of the teachers implemented their PBL units in the fall semester, as originally planned.

### Stage 3: Changes Following Implementation of the PBL Unit

All three participants implemented their three week PBL units in the following spring semester, during which time they involved their sixth grade students in questions related to the uniqueness of their community. Survey data collected at this time indicated that the teachers increased in their technology expertise ( $M= 3.43$ ,  $SD= .31$ ) from the summer ( $M= 3.05$   $SD= .30$ ) and demonstrated shifts in their beliefs about student-centered learning ( $M= 3.33$ ,  $SD= .94$ ) from summer ( $M= 3.08$ ,  $SD= 1.56$ ). Teachers' perception of student computer use in the classroom also increased ( $M=2.94$ ,  $SD= .21$ ) from summer ( $M= 2.44$ ,  $SD= .08$ ).

Based on qualitative data, teachers perceived that their levels of technology confidence and PBL understanding were higher than before implementation. First, teachers' technology comfort level was improved through using a variety of software; they reported only minor technical problems during the PBL units. Furthermore, the network system was improved and technical support personnel were very quick in troubleshooting any problems. Second, they were able to adopt the role of facilitators and to allow students to serve as researchers and instructors to other students.

Although teachers believed they had succeeded with the PBL unit, they experienced barriers related to time and resources. Forty-five minute class sessions were too short for students to use computers for brainstorming, locating information, discussing topics, and organizing information. Teachers were required to work together after school because of losing team preparation time. In addition, the PBL topic, focused on the community's history, made finding online resources difficult and students had to be more dependent on the local library and interviews with community members. Fortunately, the school district has subsequently extended class time to sixty-five minutes and re-implemented the team preparation time for the next school year. The local library is also supporting the unit and adding student incentives by displaying the students' work to the community.

Based on their experiences with their PBL units, there was a distinctive change in

teachers' pedagogical beliefs pertaining to using technology-enhanced PBL. Due to lack of comfort and technical issues experienced in the past, all of the participants used to think of technology as a nuisance unnecessary for student achievement and learning. However, teachers became confident using technology-enhanced PBL. They also realized that the students were more actively engaged in learning, and students were learning technology skills more quickly as they helped each other.

Finally, the participants suggested that the ideal workshop format for learning about technology-enhanced PBL is one that includes other teachers with different levels of technology and PBL experience. For teachers at the beginning level, hands-on activities, combined with developing their own units alongside teachers with previous experiences, was perceived as most beneficial. More advanced teachers preferred receiving some practical guidelines that could: refresh their knowledge, teach new technology skills provide more hands-on activities with their own units, and allow for feedback from other teachers outside of their own groups.

## **Discussion and Implications**

Through this study, we found changes at each stage of staff development implementation. In the first stage involving the PBL modeling activity and hands-on activity, teachers developed technology skills and described increases in feeling "comfortable" with technology. The researchers interpreted this to mean that they were no longer afraid of encountering technical problems involving software applications and were also more prepared to help students use the technology during class lessons. However, one of teachers expressed feelings of being overwhelmed and concerns about time allocation, collaboration with other teachers, and technical problems. These are significant barriers that must be addressed before teachers can go back to their classrooms and implement technology-enhanced PBL. Technical problems and feelings of isolation can inhibit teachers from even trying this different approach.

At stage two, we found that two of the three participants were able to talk with each other everyday about teaching issues, technology, and PBL because their rooms were adjacent to one another. Following the semester interview, these two showed changes in using technology and PBL strategies. However, the third teacher missed out on the opportunity to participate in these informal discussions and showed fewer changes. This suggests how important the team preparation time is for collaboration among teachers. Administrative support in areas like scheduling can have a large impact on the implementation of new teaching methods.

The largest changes were found in stage three, following the implementation of the PBL units. All three participants showed increases in the frequency of technology use in their classrooms and an increase in comfort and confidence, as well as shifts in pedagogical beliefs in using technology-enhanced PBL. Teachers implemented mini-PBL activities with technology in other units before their three-week PBL collaborative unit. It is important to note that the largest changes in the areas of comfort, confidence, and pedagogical belief came after the teachers had actually experienced leading a PBL unit in their own classroom through collaboration.

How can we encourage teachers to get to the point that they are willing to implement PBL in their classrooms? Data from this study suggested that effective staff development should provide opportunities for teachers to practice both technology skills and PBL strategies through hands-on activities as well as opportunities for teachers to collaborate with colleagues and experts. Most of all, continuous administrative support in providing team preparation time and creating a school culture that values the sharing of teachers' experiences was perceived as being critical to the success of teachers' efforts to initiate change in their classrooms.



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