Implementation of a technology-enhanced problem-based learning curriculum: A year-long study of three teachers

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Abstract

This paper describes the experiences of three middle school teachers 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 administrators' continuous support and collaboration with other teachers were keys to teachers' successful implementation of technology-enhanced PBL units.

Introduction

In recent decades, teachers, instructional designers, and other educators have increasingly been urged to adopt a variety of constructivist approaches in order to facilitate student-centered learning environments (Becker, 2000: Howard, McGee, Schwartz, & Purcell, 2000). A particular emphasis of this movement has shifted the focus from teacher to learner, inviting learners to take active roles in their learning (Means, 1995; Reigeluth, 1999). Among various constructivist approaches, problem-based learning (PBL) has been advocated as an exemplar because it promotes students' understanding, integration, and retention of concepts, facts, and skills (Gallagher, 1997; Savery & Duffy, 1995).

A PBL learning approach is based on the use of ill-structured problem situations that are complex, requiring students to develop expertise in information seeking and making decision to solve the problem. Because the problem situations are messy, confusing, and complex, students need to gather information in order understand, define, and solve the problems. During an authentic problem solving process, students are able to develop their own approaches and set their own goals. Under the guidance and coaching of a skillful teacher, students work collaboratively to inquire, investigate, and plan their activities (Sage, 2000).

This paper describes the experiences of three middle school teachers as they implemented a technology-enhanced problem-based learning (PBL) approach in their social studies curricula for the first time. We describe the challenges they faced as well as the factors that they perceived enabled them to be successful. Furthermore, we describe various strategies they need in the professional development for the technology integration at the different stage.

Theoretical Framework

Technology changes have resulted in the rapid increase of computer usage 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. Internet connectivity in K-12 classrooms increased from 65 percent in 1995 to 95 percent in 1999 (Web-Based Education Commission, 2000). However, NCES reported that nearly 70 percent of teachers still didn't feel well-prepared to use computers and the Internet 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 technology 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 be based on the same problem-centered methods that are suggested for students in problem-based learning. 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

In this case study we examined the experiences of three teachers' at three different times during the year following a 2-week technology integration summer workshop involving enhanced 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 in developing teachers' ability to implement technology enhanced PBL?

Methods

This study began in July 2002 and continued through June 2003 as 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 provided to kick off the staff development process.

Three teachers from the same middle school, located in a small rural community in the Midwest, participated and 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 in his second year of teaching sixth and seventh grade social studies. The third participant, David, was in his third year of teaching social studies and reading in the sixth grade.

Preliminary survey data were used to assess the participants' computer skills, frequency of technology use in the classroom, and teaching beliefs and practices. Participants responded to 55 questions with 5-point Likert scale adapted from the Becker's survey (e.g., "I ask students to work in a small group." "Students in my class pursue information related to personal interests.") (Becker, 2000). These data were collected at the beginning of the summer workshop, 2002 and at the end of the spring semester, 2003.

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 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, 2002 semester and the final interview in spring, 2003. 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 made connections with how PBL can be implemented in their classrooms. Before the workshop they 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. They were concerned with the reality of actually implementing a real unit.

The teachers reported that the collaboration with professors and colleagues using hands-on activities and development of a unit meeting their 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 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 to practice mini-PBL strategies during class time. Because of these barriers, none of the participants implemented their PBL units in the fall 2002 semester.

Stage 3: Changes Following Implementation of the PBL Unit

All three participants conducted their three week PBL units in spring 2003, during which time they involved their sixth grade students in questions related to the history 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) Student computer use in the classroom also increased (M=2.94, SD= .21) from summer (M= 2.44, SD= 0.08)

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 trouble shooting any problems. Second, they realized the role of teachers as a facilitator and students as a researcher and instructor to other students actively engaged with ownership and responsibility in their learning.

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 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 engagement in learning, and students were learning technology skills more quickly as they helped each other.

Finally, the participants suggested the ideal workshop format for a technology enhanced PBL workshop 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. For the intermediate level, they preferred receiving some practical guidelines that could refresh their knowledge, new technology skills, more hands-on activities with their own units to modify, and 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 scared of encountering technical problems involving software applications and were also more prepared to help students use the technology and implement it in their classrooms. However, one of teachers expressed feelings of being overwhelmed, 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 PBL. Technical problems and feelings of isolation can inhibit teachers from ever 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. As a result of the interview, these two showed new changes in using technology and strategies from PBL where the third missed out on the opportunity to participate in these informal discussions and showed fewer changes. This shows 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, confidence, and shifts in pedagogical beliefs in using technology enhanced PBL. Teachers adopted 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 (Again, use data to support this).

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 with hands-on activities with the unit meeting teachers' needs, and provide opportunities for collaboration with colleagues and experts. Most of all, continuous administrator 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.

Reference

Becker, H. J. (2000). *Findings from the teaching, learning, and computing survey: Is Larry Cuban right?* [PDF file]. Center for Research on Information Technology and Organizations. Retrieved October 2, 2001, from http://www.crito.uci.edu/tlc

Gallagher,S. A. (1997). Problem-based learning: Where did it come from, what does it do, and where is it going? *Journal for the Education of the Gifted, 20*, 332-362.

Hill, J. R. (1999). Teaching technology: Implementing a problem-centered, activity-based approach. *Journal of Research on Computing in Education, 31*, 261-279.

Howard, B. C., McGee, S., Schwartz, N., & Purcell, S. (2000). The experience of constructivism: Transforming teacher epistemology. *Journal of Research on Computing in Education, 32*, 455-465.

Jonassen, D., Howland J., Moore, J., & Marra, R. (2003). *Learning to solve problems with technology: A constructivist perspective* (2nd ed.). Upper Saddle River, NJ: Merrill Prentice Hall.

Lewis, A.C. (1998). A new consensus emerges on the characteristics of good professional development. In R. Tovey (Ed.), *Professional development* (pp.12-15). Cambridge, MA: The Harvard Educational Letter Focus Series No.4.

Means, B. (1994). Introduction: Using technology to advance educational goals. In B. Means (Ed.), *Technology and education reform: The reality behind the promise* (pp. 1-21). San Francisco: Jossey-Bass.

Mouza, C. (2002). Learning to teach with new technology: Implications for professional development. *Journal of Research on Technology in Education, 35*, 272-289.

National Center for Education Statistics (2000). *Public school teachers' use of computers and the Internet*. Washington DC: U. S. Department of Education.

National Center for Education Statistics (2000). *Teachers' tool for the 21st century: A report on teachers' use of technology*. Washington DC: U. S. Department of Education.

Reigeluth, C. M. (1999). *Instructional-design theories and models Volume II – A new paradigm of instructional theory*. Mahwah, NJ: Lawrence Erlbaum.

Sage, S. M. (2000). A natural fit: Problem-based learning and technology standards. *Learning & Leading with Technology, 28*(1), 6-12.

Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology, 35*(5), 31-38.

Torp, L. T., & Sage, S. M. (1998). *Problems as possibilities: Problem-based learning for K-12 education*. Alexandria, VA: Association for supervision and Curriculum Development.

Trotter, A. (1999, September 23). Building the digital curriculum. *Education Week*. Retrieved January 28, 2001, from http://www.edweek.org/sreports/tc99/articles/teach.htm

Web-Based Education Commission (2000). *The power of the Internet for learning: Moving from promise to practice*. Retrieved November 10, 2001, from http://interact.hpcnet.org/webcommission/index.htm