Issues in Problem-Based Learning in Online Teacher Education

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Dr. Brenda I. López Ortiz began her 20-year long professional career as a middle school teacher helping low-income students achieve English language standards. Early on, she began reaping the benefits of technology for teaching and learning by creating educational materials that were tailored to the needs of these students. Throughout her career, Dr. López has conducted teacher professional development workshops on various aspects of instructional technology. She has worked as instructional designer, educational website developer/editor and as instructional technology assistant professor. Dr. López has guided learning in face-to-face, hybrid and online environments. Her current research focuses on online problem-based learning in teacher education. Specifically, she has examined issues related to online collaboration, supporting technologies and strategies for co-authoring group projects and products.

Abstract

This chapter presents a review of research in online problem-based learning (PBL) in teacher education. The goal of this chapter is to present a critical analysis of the body of research that has emerged as a result of the adoption of PBL in online teacher education. To this end, the chapter begins by defining PBL and online learning and strategies used for literature search and analysis. Next, the chapter summarizes findings of research organized by the issues related to implementing online PBL in teacher education. Finally, it discusses implications for research and practice derived from a critical examination of the conglomerate of studies, which intersect a larger set of instructional technology issues.

Keywords: online learning, teacher education, review of research, problem-based learning, instructional technology

Problem-based learning (PBL) is an instructional method that was originally designed for face-to-face (F2F) medical education. Over time, it spread to other educational levels and professional fields including teacher education (Hung, Jonassen, & Liu, 2007). PBL has also been adopted in online learning, and has been characterized as one of its predictors of pedagogical excellence (Bernard et al., 2004). In considering the adoption in different contexts and for new audiences, fresh opportunities for research have arisen. The problems teachers face are different than those in the medical field (Jonassen & Hung, 2008). Distance education research has suggested that the technologies that support learning have an impact on the interaction of teachers and students (Carabajal, LaPointe, & Gunawardena, 2003; Gunawardena & McIsaac, 2004; Johnson & Johnson, 2007). Thus, the activities and processes originally developed for classroom-based PBL in the medical field may need to be modified for online PBL in teacher education.

The goal of this chapter is to present a critical analysis of the body of research that has emerged as a result of the adoption of PBL in online teacher education. To this end, the chapter will begin by defining PBL and online learning and strategies used for literature search and analysis. Next, the chapter will summarize findings of research organized by the issues related to implementing online PBL in teacher education. Finally, it will discuss implications for research and practice derived from a critical examination of the conglomerate of studies, which intersect a larger set of instructional technology issues.

Definitions

PBL

PBL constitutes a radical departure from traditional teaching methods. The learning experience does not begin with a lecture followed by application problems. Rather, it begins with a practice or research problem that serves as the stimulus for learning (Barrows & Tamblyn, 1980). An increase in student responsibility aims at developing self-directed learning, a skill that is necessary for life-long learning (Barrows, 1998). Furthermore, the problem does not draw on discrete concepts or skills to discover a single right answer. It is an authentic problem that students would normally face in practice, and it cuts across whatever disciplines are relevant for the solution (Barrows, 1998). PBL has never involved individual problem solving, but rather has always incorporated collaboration. Finally, students evaluate and reflect on their learning in an effort to solidify learning (Barrows & Tamblyn, 1980).

Online Learning

The terminology used to describe learning experiences that occur when the teachers and students do not share a geographical location and/or class time has varied over the years (Rudestam & Schoenholtz-Read, 2010). This chapter will use the term online learning to refer to the learning experiences described above. However, it will only focus on those in which access to information and communication occurs via Internet-based technologies (ranging from email and discussion boards to web 2.0 tools).

Method

Literature Search

Research design literature provided guidance on article search and analysis strategies to ensure a systematic approach to finding relevant studies. The first step consisted of identifying keywords relevant to the purpose of this survey (Creswell, 2009; Dolowitz, Buckler, & Sweeney, 2008; Machi & McEvoy, 2009; McMillan, 2004; Slavin, 2007). The main keywords were “problem-based learning”, “online learning” and “teacher education”. The next step focused on querying the thesauri of article databases to identify the best term match for these keywords. Finally, the archives of journals that specifically focus on online learning (e.g., *American Journal of Distance Education*) were also queried. The search process continued until no new sources of primary research could be found. The search produced 34 sources including journal articles, dissertations, conference proceedings, and books.

Inclusion Criteria

The next step was to screen articles’ abstracts (McMillan, 2004; Slavin, 2007; Wiersma, 2000) with two purposes in mind. First, the screening helped identify those that were central to the purpose of this survey (Creswell, 2009). Twenty-four articles met the criteria of describing research in problem-based learning in teacher education. Then, the process of abstract examination focused on screening out non-empirical studies. Criteria for inclusion also included article date, (2005 – 2011). The list was narrowed to 22 articles. The studies in this survey span many areas of teacher education. The following table describes the number of studies per topic.

Table 1

*Number of Studies per Teacher Education Topic*

|  |  |
| --- | --- |
| Subject | Number of Studies |
| Child Development | 1 |
| General Teaching Methods | 3 |
| Learning Sciences / Educational Psychology | 4 |
| Instructional Technology | 9 |
| Special Education | 4 |
| Vocational | 1 |
| Library & Information Sciences | 1 |

*Note*. One of the studies examined online PBL in more than one teacher education area.

The articles were evenly split between hybrid and online contexts with 11 studies each. Studies conducted in hybrid or blended settings (i.e., when some of the learning activities happened in physical classrooms during established time periods) were included inasmuch as the PBL portion of the experience was mainly conducted online. The research questions focused on design features of online PBL (e.g., problem design), implementation issues (e.g., the collaboration process) and online PBL effects (e.g., critical thinking skills).

Analysis

The next step in surveying the literature was to summarize and analyze the studies (McMillan, 2004; Slavin, 2007; Wiersma, 2000). A “literature map” served to develop a sense of the broad picture of the literature (Creswell, 2009; Machi & McEvoy, 2009). For the purposes of this chapter, a spreadsheet was used to classify articles depending on format (hybrid or online), type of participants (students, teachers, administrators, etc.), sampling strategies, type of research designs (quantitative, mixed, qualitative), types of data sources (pre/post tests, documents, interviews, etc.) types of data analysis (content analysis, descriptive statistics, etc.), and the focus of the research questions (e.g., the design, the process, learning). The literature map served as the basis to write this survey.

The final step in surveying the literature of online PBL in teacher education was to integrate research findings in a manner that explained important issues (Machi & McEvoy, 2009; McMillan, 2004; Wiersma, 2000). The following section is divided into five subsections. The first presents issues that surface when transitioning to learning in online PBL (i.e. student characteristics and attitudes, access to necessary technologies, technology and PBL literacy). The second deals with issues related to collaborating via technology (e.g., group formation, student roles, communication, technical support). The third examines the facilitation of online PBL. The fourth identifies assessment issues. The final subsection expands on issues that arise when designing online PBL for intensive courses.

Results

Transitioning to Learn in Online PBL

The design of an online PBL experience may incorporate the most effective strategies described in the literature, but that does not mean students will be able to spontaneously benefit from them. Recognizing students’ knowledge, skills, attitudes and access to tools is an important step in this design process. This section describes some of those along with suggestions on how to accommodate for them.

Engaging Students of Diverse Characteristics, Perceptions and Attitudes

Overbaugh and Lin (2006) studied the interplay between learner characteristics and performance in two modalities of a course in instructional technology: F2F and online. They used a research-validated rating scale of learning styles to classify students. Introverted students tended to perform better in the online modality than the extroverted ones. Students who constantly needed more immediate feedback and tended to procrastinate were at a disadvantage during online courses. Designers can select either of two approaches to incorporate these findings. They may guide students to identify their own characteristics and to understand whether the online mode is suitable for them. Alternatively, they may incorporate mechanisms to support diverse students regardless of learning styles.

Students are initially apprehensive about group work experiences online (López Ortiz & Lin, 2005; McLinden, McCall, Hinton, & Weston, 2006). Variables related to the diversity of student knowledge, skills and attitudes towards online group work and group dynamics (and how they can evolve online) are important here. Nelson (2007) discussed working styles, work ethic, and attention to communication as issues of tension. In their design of the online PBL experience, McLinden, et al. (2006) included induction activities to introduce students’ to principles of online learning. In spite of that, 40% of the students still failed to feel confident about this. The authors suggested the use of structure, especially towards the beginning of the experience, to scaffold student participation. In addition, they highlighted the need to provide guidance to course instructors to facilitate student engagement. In the research of López Ortiz and Lin (2005), course instructors sought to have students explicitly share their prior experiences with online group work. The purpose was to acquaint students with issues that classmates considered important for the success of a group. Presently, newer features of online collaboration tools (e.g., the revision history of wikis) can also help assure students that individual accountability will be established. These features can help instructors to monitor the quality, frequency and timeliness of individual student participation. Students’ concerns can be minimized when they know that instructors appraise each individual’s contribution fairly.

Accessing Supporting Technologies

The number of technologies available for 21st century education has grown exponentially. Along with this comes challenges in accessing these tools to support the learning experience. This is one of the initial design aspects to consider (Donnelly, 2006). The location from which students access course interfaces (e.g., home vs. work) and the type of connection (e.g. broadband vs. dial-up) may have an impact on the kinds of activities they can engage on a regular basis (McLinden et al., 2006). Access may be available at work, but network restrictions and policies can prevent students from completing educational tasks. In a separate study, Derry, Hmelo-Silver, Nagarajan, Chernobilsky, and Beitzel (2006) elicited student responses to the activities and tools in the online PBL environment they designed. Students’ responses were mainly positive, but a further analysis uncovered problems with the supporting technology. The authors indicated that the frequency of technology problems decreased over time as access to broadband connections became more widespread. The reliability of available technology is also a main concern reported in literature (Donnelly, 2006). Having access to the necessary technologies and being able to use them reliably represent challenges in online PBL for teacher education. Disseminating the technology requirements prior to student enrollment in a course as well as providing means for students to satisfy those requirements (e.g., download all necessary plug-ins) are ways to mitigate the effect of these challenges.

Knowing How to Use the Technology

Instructional designers are always looking for innovative technologies to support the learning process. Using technology for learning can help build literacy skills (Lambe, 2007; McLinden, McCall, Hinton, & Weston, 2010). However, when students are immersed in a learning experience, and technology is their only means of communication and access to information, a certain level of technology literacy becomes as much a prerequisite (McLinden et al., 2010) as a learning outcome. The result is an additional layer of challenge especially for the more novice technology users (Nelson, 2007).

McLinden, et al. (2006) focused on computer literacy as an aspect of student interaction with mediating technology when participating in online PBL. 80% of students had little or no experience with course-management systems or contributing to online discussions. Students also reported difficulties participating in synchronous communication events because of their keyboarding skills. This last finding is consistent with the research of Donnelly (2006). In other studies, while the researchers do not directly attribute low achievement to knowledge of supporting tools, they do consider the potential of the relationship between those two aspects (Jeong & Hmelo-Silver, 2010). Overbaugh and Lin (2006) found that online students needed more technical help than students in traditional classrooms, and this may require training on the supporting technologies (e.g. using a discussion board). In a study about multiple scaffolds supporting geography problem solving, Doering and Veletsianos (2007) found that the scaffold that provided guidance in learning the supporting technology (video tutorials) had a positive and significant relationship with problem-solving ability. However, it also increased students' self-reported cognitive load. Students felt frustrated because of their lack of knowledge of the tool and wanted additional time to solve the problem.

Another study provided evidence on how the lack of knowledge on working with the technologies and their novelty features can interfere with learning. Omale, Hung, Luetkehans, and Cooke-Plagwitz (2009) examined how avatars, 3D space, and bubble dialogue boxes affect the social, cognitive and teaching presences of participants in 3D multi-user virtual environments (3D MUVE’s). Briefly, cognitive presence refers to the ability of learners to construct meaning making through communication; teaching presence refers to design and facilitation of the learning experience; social presence relates to the ability of learners to project themselves as “real people” (Garrison, Anderson, & Archer, 1999). These researchers found that, while 3D MUVE’s can be engaging, their features can also drive learners off task. The ability to “see” each other and walk around a virtual environment was positive for social presence. Cognitive presence did not benefit as much due to students’ lack of knowledge of the tool and the novelty of its features.

McLinden et al. (2010) interestingly noted that technology may be more ubiquitous on today’s teachers’ professional lives. However, this may not automatically translate to using technology for learning. The level of computer literacy skills of students has implications that must be taken into account in order to facilitate meaningful online PBL. Lack of familiarity with the online context in which learning unfolds can become a limitation of this environment, but literacy leads to confidence in using technology as a tool to support learning (Donnelly, 2006). A fine line may exist between introducing new beneficial technologies for learning and overwhelming students with the novelty. Designers of online PBL in teacher education must strike that balance to maximize benefits and minimize the challenges. Training, induction activities and instructor guidance can help achieve this so the novelty wears off and students develop the necessary technology skills.

Understanding PBL as a Learning Strategy

Research studies have provided evidence of students’ need to become comfortable with PBL so they can succeed in their learning efforts. For example, McLinden, McCall, Hinton, and Weston (2007; 2010) requested student feedback with regards to the design of two consecutive problem scenarios. Students reported a preference for more tutor guidance and had difficulty navigating the first scenario, but not as much during the second one. The variation of student ability to navigate scenarios over time suggests the development of familiarity. An and Reigeluth (2008) also reported the need for “practice” as one of their guidelines for online PBL. Donnelly (2006) also found a positive effect in the use of explanatory materials as an induction to the PBL process and described it as a necessary design component. Similarly, the students in the Derry, et al. (2006) study reported difficulties with self-directed learning and collaboration. Self-directed learning in PBL is related to the initiative of students to direct the learning experience by engaging in activities such as finding instructional resources, evaluating their quality, controlling the pacing of and assessing their own learning (Barrows & Tamblyn, 1980). Derry et al. (2006) found students improved their self-directed learning skills as familiarity with the task increased. In this case, the authors designed an online PBL experience that utilized videos to present cases so students would apply knowledge and skills of learning sciences. The researchers found that student use of the videos changed over time. As students became more experienced in online PBL, they were able to notice important problem-related details on the first screening of the video, so they did not have to continually review it to further their understanding. In addition, students shifted from focusing on characteristics of the videos to those of the actual problems. These research findings point to the need to foster the progressive development of skill and confidence in working through online PBL experiences. The results are consistent with Björck (2002) in his descriptions of the need for readiness when working on online PBL.

Collaborating Via Mediating Technologies

Barrows (1998) listed collaboration as one of the essential characteristics of PBL. The reason for this is the evident need for it in the 21st century workplace (Partnership for 21st Century Skills, 2004). The benefits of collaboration and the importance of the individual student contributions within learning groups have been thoroughly described (Johnson & Johnson, 2007). Teachers play an important role in helping students develop these skills. Experiential learning can help teachers develop collaborative skills themselves so they can later guide their students in achieving this educational goal. In the online environment, collaboration is mediated by a variety of technologies with different features. As a result, it is important to consider challenges related to collaboration via mediating technologies when designing online PBL for teacher education.

There appears to be no etymological reason for establishing a difference between the words cooperation and collaboration (Merriam-Webster Dictionary; Oxford English Dictionary). Both describe the act of working together with shared purposes. What does exist is a difference in how students work together to achieve the common goals. Salomon (1993) characterized the difference as off-loaded vs. shared cognition. Off-loaded cognition refers to a division of labor. Different group members assume responsibility for discrete parts of the collaborative task and then stitch them into an artifact that becomes the group product. Shared cognition characterizes a truly joint effort during which all group members negotiate understanding throughout the process. This collaborative dimension of PBL has been identified as an important learning mode within teacher education (Lambe, 2007). It is said to yield more educational benefits to individual student cognition. The literature reviewed in this survey seems to favor shared cognition. For example, when Jeong and Hmelo-Silver (2010) studied the use of information resources in online PBL, they found that groups that gravitated towards shared cognition derived more benefits from using the resources. Yeh (2010) found a relationship between the degree of shared cognition and final grades indicating that a decrease in shared cognition translated into lower grades.

Despite hopes for encouraging shared cognition, scholars have found that off-loaded cognition characterizes group work more often than not (An & Reigeluth, 2008). The division of labor instead of the co-construction of problem solutions is part of the evidence that these authors provide to support this claim. An and Reigeluth (2008) identified the emphasis on product vs. process during student evaluation as a key contributor to this. They did report a case in which students switched from off-loaded to shared cognition upon realization of the need for the latter. The authors listed instructor facilitation as another guideline derived from their research to steer student collaboration patterns towards shared cognition.

Forming Groups

Collaboration in PBL implies the formation of groups of students who will work together in the resolution of problems. In their multi-case study, An and Reigeluth (2008) found that groups of four to five students were more beneficial to the discourse of the group than larger or smaller groups. The dialogue among fewer students may lose momentum at times. Continuous conversation in a small group has potential cognitive benefits that are associated with exposure to multiple perspectives at every step of the learning process. At the same time, an appropriate number of group members helps make the process of achieving consensus during decision-making efficient and should minimize the problem of social loafing. An and Reigeluth (2008) also suggested that designers consider the nature of the problem and the supporting communication technologies when determining the size of groups for online PBL. Group assignment is another aspect of collaborative work that researchers have examined. An and Reigeluth (2008) reported voluntary group formation is aligned with the belief that student interest should drive this process. When this is the case, course designers should provide tools that (a) have the right features to enable students to become acquainted with potential group members, and (b) are convenient for students to access and use (Lin & López Ortiz, 2009).

Researchers have often resorted to instructor-led assignment of students to small groups using a variety of criteria. Nelson (2007) noted that this approach can be troublesome if characteristics like teaching experience and subject matter are not considered. Finally, researchers have considered the topic of group composition. Yeh (2010) found that more homogeneous groups (e.g., same major) were faster in achieving consensus than less homogeneous groups. A shared history among group members can help facilitate communication and collaboration (Duffy, 2000 as cited in Yeh, 2010). Group size, composition and assignment have always been important variables to consider in students collaboration. The online context introduces communication challenges that need to be accounted for when design guidelines from F2F literature are adopted in this regard.

Assigning/Assuming Roles

Ideally, when a group of people undertake a collaborative task, each individual member should be equally responsible for the achievement of the collaborative goals. Whether students engage in off-loaded or shared cognition (Salomon, 1993), the contribution of each member of the group should be clearly specified. A design feature that was put in place in a study of online PBL was the assignment of student roles (chair and summarizer) prior to the beginning of the experience (McLinden et al., 2006). The chair was defined as the student in charge of coordinating group efforts and the summarizer was the student responsible for incorporating group ideas into the problem resolution document. These researchers also allowed the rotation of roles with flexibility to change the rotation upon mutual agreement. All students strongly agreed or agreed that this was a useful feature. An alternative approach – to establish the roles simultaneously as the process evolves – may be less efficient because of the delayed nature of communication characteristic of the online environment. The result may be the inability of students to decide on responsibilities and concurrently fulfill them in a timely fashion (López Ortiz, 2011).

Communicating Synchronously and Asynchronously

At least two modes of communication exist when learners get together to solve problems online: synchronous and asynchronous. The synchronous mode resembles the traditional F2F approach of group meetings in that learners gather at the same time, although not necessarily at the same place. The asynchronous mode allows learners to contribute to the conversation over time and from distributed locations. In their most basic versions, course management systems (CMS) provide course information and access to both communication modalities. In a reflection about the potential of translating the PBL model for online implementation, the creator of the model pondered whether this is truly possible (Barrows, 2002). The mediation of technology in its synchronous and asynchronous modes was the cause for this concern.

A necessary step during the design of online PBL is to carefully think about the advantages and disadvantages of each approach and the tools that support them. This is because research has shown that there are differences in terms of the cognitive activities that different modes seem to support best (Hawkes, 2007). For example, Yeh (2010) contrasted the use of F2F communication with online discussion. The author found that students used F2F for in-depth dialogue and “multiple-perspective thinking”. They used online discussion more for coordination of problem-solving efforts, in preparation for F2F conversations, as a follow-up, or to make up when unable to meet in person. The nature of learning tasks also influenced the frequency of conversation. Nelson (2007) also reported that synchronous meetings served to push for completion of milestones and that lack thereof had a negative impact on making progress. Greene (2005) described student use of the discussion forum to follow up on synchronous conversations.

Donnelly (2006) examined how blending the PBL methodology with the online environment could enhance learning. Her findings highlighted the capability of technologies to help support the socio-cultural context in online PBL. Students reported increased ability to socialize and to contact each other online when compared to F2F communication. Donnelly (2006) also suggested that the archival nature of the online conversations was a beneficial feature of this modality. The reflective affordance of online asynchronous discussion was also contrasted with the immediacy of responses of F2F encounters. These findings are echoed in two other research studies: McLinden, et al. (2006) and Edwards (2005). In particular, McLinden, et al. (2006) reported that a majority of students responded positively with regards to access to and use of the discussion board for asynchronous conversation.

On the flip side, Donnelly (2006) cited the communication delays that may interfere with clarity of communication as a limitation of the online medium. Researchers have also reported that students still find asynchronous communication too impersonal or feel uncomfortable posting messages using their own names (Greene, 2005). In addition, students do not necessarily dedicate appropriate time in their asynchronous discussions to understand the problem or implement the solutions (Ng & Tan, 2006). Course instructors can engage students on induction activities like the ones described earlier to help them become adept at these stages of the PBL process via asynchronous communication.

Fewer students in the McLinden study responded positively to access and use of chat rooms for synchronous conversations. Two aspects of the nature of discussions via chat rooms may be intimidating for online students especially those with limited technology literacy skills. On the one hand, discussion through this technology tends to be fast-paced (Greene, 2005; McLinden et al., 2006). Students with limited typing skills are at a loss not because of their ideas, but because of their ability to share them at the same speed as their classmates. In addition, discussions branch out into threads within the same stream. Those can be difficult to keep track of in the fast-paced environment. Reducing the number of students in a chat session may ameliorate these challenges (Greene, 2005). Interestingly, at the onset of the experience, students’ expected that the chat room would be the main hub of communication under the assumption that it would resemble F2F discussion. The qualitative analysis of the data gathered by Doering and Veletsianos (2007) revealed that students used the chat room to seek and provide mutual support during online PBL. However, the quantitative analysis evidenced that there were negative although insignificant relationships between problem-solving ability and time spent in the collaboration zone. Other studies also discussed the negative impacts of synchronous work on online groups. Scheduling issues occur when attempting to incorporate synchronous communication to online PBL in teacher education (Nelson, 2007). Students choose online learning because of the flexibility of furthering their education without the requirements of being at a specific place at a specific time. Nelson also stated that life’s expected and unexpected distractions (e.g., family events and even weather issues) also interfere with communication. Yeh (2010) reported that individual members felt disappointed when teammates could not be online for chatting as promised or when members were distracted during conversations (which is likely to happen when learners are home with their families). Yeh reported an increase in the need for F2F communication over time. This is perhaps because of the inability of online media to fulfill all of learners’ communication needs during group work. Nelson (2007) reported students need F2F interaction because of response delays in communication and feelings of isolation. The lack of visual cues to gauge the effects of individual students’ ideas is also another factor that contributes to students’ preference for F2F communication (Greene, 2005). These results suggest caution in the incorporation of synchronous conversation for online PBL in teacher education.

In spite of the challenges mentioned above, there are still benefits to be reaped in the use of this technology. The research of An and Reigeluth (2008), Edwards (2005) and Wheeler, Kelly, and Gale (2005) provided a more positive perspective on student acceptance of the synchronous tools. The synchronous interaction resembles F2F communication, and students appreciate that when compared to the delay in communication of asynchronous tools (An & Reigeluth, 2008). From the instructor’s perspective, An and Reigeluth (2008) reported that chat sessions were valuable during two stages of the online PBL process: at the outset (to enable student acquaintance) and during decision-making stages (to facilitate the process).

Edwards (2005) described the archival nature of synchronous communication as beneficial for the participants in her study. It allowed not only for the review of communication exchanges, but also for catching up with class discourse when a student had not been able to participate in the conversation in real time. In addition, the chat functionality extended class time as it provided a place for the exchange of ideas beyond the physical classroom. Edwards (2005) stressed the fact that chat was a pedagogical tool. In other words, pedagogical needs drove the use of the tool. Other authors also reported on support of this tool for problem-solving, one-on-one or one-on-small group support and group development (Donnelly, 2006). Wheeler, et al. (2005) arrived at similar conclusions with regards to video conferencing as a synchronous communication tool.

The study of technology to support online PBL has not been limited to mainstream course-management tools. In their study of 3D MUVE’s, Omale, et al. (2009) found that participants were able to engage in brainstorming, negotiation and clarification, but were not equally able to agree on ideas and organize them to arrive at problem solutions. The authors stated that technical barriers were responsible for this, namely, the lack of embedded collaborative interfaces that could serve as catalysts for decision-making. Participants used email to complement the virtual place to achieve consensus.

Ultimately, An and Reigeluth (2008) concluded that the use of a combination of synchronous and asynchronous technologies would allow students to reap the benefits of both approaches. The advantages consisted of the convenience of communication at a time when the student is ready and the expediency of the decision-making process. Perhaps the mission of “finding a harmonious balance” (Osguthorpe & Graham, 2003 as cited in Yeh, 2010, p. 1637) in obtaining convenient access to both information and human resources can be useful here. Yeh claimed that hybrid PBL (i.e., the combination of F2F and online conversation) contributed to the creation of a community. It is possible that, as we find ourselves in the intersection of transitions between F2F and online, traditional and PBL types of education, it is necessary to have a combination of media and methods to overcome the challenges of any single approach.

Supporting Students with Technical Problems

There are three layers of technology that mediate student learning during online PBL in teacher education: student computers, their Internet Service Providers and the university systems. This will inevitably result in the need for technical support. Indeed, researchers have reported the presence of technical issues that have affected the learning experience (Nelson, 2007). Hardware malfunction has been occasionally blamed for failure to submit assignments (Yeh, 2010). McLinden, et al. (2006) reported that about two-thirds of the students in their study had issues that required technical support. Twenty-five percent of these had to contact technical support providers. Regardless of the source of the need for support (the university’s systems or the student’s computer/Internet access), McLinden, et al. (2006) emphasized the importance of a smooth experience where the technology does not interfere with learning. Lambe (2007) noted that in a blended/hybrid mode, occasional technical problems do not affect negatively the learning experience. The hybrid learning option will not always be feasible. Ensuring the availability of resources for technical support especially early in the process is one of the implications for practice.

Facilitating Online PBL

The transformed role of the course instructor is another of the essential characteristics of PBL (Barrows, 1998). The main function of the instructor is to provide guidance; not information. This is aligned with PBL’s goal of developing self-directed skills in students. Barrows & Tamblyn (1980) went so far as to state “the teacher should respond to direct inquiry from the students only after he is sure they have exhausted their own logic or information base” (p. 108). Notwithstanding, online PBL in teacher education research has produced results that are at odds with this notion. Nelson (2007) described how students were initially uncomfortable with PBL because of the instructor’s role as described above. Donnelly (2006) argued that the facilitator in online PBL needs to support students who have challenges when studying remotely, communicating without visual cues or without knowing their peers. Because of this, the author contrasted the role of the online learning tutor with that of the PBL tutor. Students reported appreciating the commitment and flexibility of course facilitators and their ability to (a) provide support when technology was failing, (b) guide the experience, (c) foster reflection by summarizing F2F activities, and (d) create group cohesiveness. In addition, the role of the tutor was crucial in fostering the use of critical communication structures that were in place online, but which would be underused otherwise. Finally, the tutor had an important role in taking the learning experience beyond the mere dissemination of course materials via online media, which was the original approach to the design of online learning.

An and Reigeluth (2008) studied online PBL in the context of three different cases. Using data from instructor interviews, observations and document analysis, these researchers reported variations on how instructor participation was perceived. In one case, participants described instructor participation as insufficient. The instructor, though, was following suggestions from constructivist perspectives on learning by monitoring the conversation without participating in it. Students reported the need for more structure in the form of guidance from the instructor. The findings from another case illustrated how the instructor provided structure by making progress checklists available for student self-monitoring on a voluntary basis. The findings of this research point to the need for online PBL course facilitators to adjust guidance levels according to contextual circumstances. This is consistent with the findings of other studies. Researchers have described the evolution of the online PBL facilitator’s role as moving from organizational to affective (Gressick & Derry, 2010) and from facilitating the process to playing devil’s advocate during the discussion of issues (Lambe, 2007). The interplay between innovative educational methodology (PBL), unfamiliar learning context (online) and the technical challenges it brings with it may require that facilitators, at least initially, provide more guidance. A number of factors may make the case against waiting for students to exhaust their options. These include (a) the spread of discussion over longer periods of time because of communication delays, (b) the lack of visual cues, and (c) the dispersion of messages across a range of media with their idiosyncratic technical challenges and potential to add to the cognitive load.

Assessing Student Performance

Assessment in the context of PBL should be geared to verify the application of content knowledge and the development of problem-solving and self-directed learning skills (Barrows, 1998). As a result of their study of three cases of implementation of online PBL, An and Reigeluth (2008) proposed that the process be as much the subject of assessment as the product. The purpose of this is to drive student focus on engaging in shared cognition, thus obtaining the maximum benefit from the collaborative experience. The online environment has features that facilitate accountability by making explicit who participates in group work and to what extent (Donnelly, 2006). However, the challenge lies precisely in striking the balance between process and product. Instructors who are used to assessing content knowledge will find it hard to accommodate for grading of the process when they have designed the course grading to account for every piece of relevant knowledge of course topics. Grading the process could also potentially increase the time online PBL instructors must invest. This is plausible given the increased amount of time it takes to read student contributions (as opposed to listening to them during class time). Instructors who already grade weekly discussion would be in better shape to transition into the assessment of process. They could refocus those conversations by merging whole-group dialogue about course topics (the trend in online learning) with small group discussion about their application.

Implementing Online PBL in Short-Term Situations

Chen and Hsu (2005) designed an instructional design course that took advantage of both constructivist and objectivist strategies. Their justification was the intensive nature of the course: a 5-week, fully online summer course. A problem-based learning approach was used to engage students in a meaningful, realistic technology integration experience. These researchers used the responses to online course evaluation surveys along with the analysis of student reflections and final submissions to evaluate their course design. In general, students responded positively to the design of the course. They particularly valued the authenticity of projects, instructor feedback and technology. In addition, they performed well in their lesson designs with all students obtaining at least an A-. This led the researchers to believe that the combination of constructivist and objectivist strategies was successful in the context of a short intensive online summer course. Students were able to fulfill demanding learning goals without feeling the pressure of the time-consuming aspects of constructivist learning. The findings reported in this study support the adaptation of problem-based learning to include traditional education aspects such as individual work and instructor guidance when planning intensive online courses. Designers, though, would have to come to terms with the idea of retaining characteristics of traditional education in a context that should be more open-ended.

Discussion

Implications for Research and Practice

It could be argued that the nature of the research surveyed in this chapter is consistent with the status of online PBL for teacher education: there is an incipient field of practice based on an emerging body of knowledge. Research illustrates that students now have to grapple not only with new content in a course, but also with new instructional methods and new supporting technologies simultaneously. Questions related to increased course loads for both faculty and students have been examined before (Lefoe & Albury, 2006; Singleton & Session, 2011). Generations have been acculturated into an educational process as a transaction between a teacher presenting the content on one or more textbooks and a group of students taking notes on notebooks with pencils. Now, teacher education students and faculty are facing a shift on what the educational process entails. Course instructors are not just responsible for knowing and supporting students on their domains of expertise. They must now know and support students using innovative tools and educational methodologies. Savin-Baden’s (2008) discussion of strategies to prepare faculty and students includes pedagogical and technical aspects. This is evidence to illustrate that the shift is already taking place. A question that transpires is whether cognitive loads can become unbearable for both teachers and students under these circumstances. Further study can help establish whether online PBL in teacher education is more suitable for students with specific characteristics or whether and how it can be successfully implemented for all. Research can also shine some light on ways that can serve to support students to become comfortable with new educational strategies and instructional technologies whether simultaneously or as a prerequisite of the learning experience. In an era when the time frames for course delivery have either remained consistent or shrunk (as with the emergence of intensive, short-term degrees) but have never lengthened, it is important to find the balance between the three types of literacies that students must develop.

With the transition to more student-centered approaches to learning, the incorporation of activities in which students take the initiative for their own learning has become a favored approach. However, true student participation in activities ranging from the design of a course to the negotiation of the work in small groups requires a level of coordination and exchange of ideas that may be prohibitive for online PBL in teacher education students. How can instructors support student decision-making in light of delayed communication so effectiveness is not overshadowed by inefficiency? How can they balance the requirements of an extended exchange of ideas to ride on the waves of its cognitive benefits with the flexibility that students are seeking in online education? There seems to be another paradox here, or perhaps some really provocative research questions.

The initial fears associated with computer use were related to the isolation of people and their machines. Fast forward 25 or 30 years and the word *social* is tightly associated with the word *technology*. Early on, Turkle (1995) described the transition from a culture of calculation (as when individuals find themselves alone programming their computers) to a culture of simulation (where individuals interact with each other via the computer). A 180-degree turn in the evolution of information and communication technologies has helped shift the way they are perceived. Nevertheless, a few issues remain relevant. Yes, society is becoming more social, but some have posed the question of whether socialization is restricted to the technologically-mediated world or whether it translates to the physical world. Evidence of student feelings of isolation still surfaced in the studies cited in this survey. These feelings may still be tied to students’ individual characteristics. How can education professionals take advantage of the social capabilities of synchronous and asynchronous communication for online PBL for teacher education without inadvertently perpetuating its potentially negative consequences?

A widely studied trend in society has been identified as the shift towards product consumption. Concepts like “diploma mills” and the “mcdonaldization of society” (Ritzer, 2000) have emerged. Another paradoxical, although hopefully evolutionary reaction to this is the growing trend of advocating for the development of critical thinking, problem-solving and decision-making skills in students which emphasize skill in conducting a process rather than preponderantly focusing on the accumulation of knowledge (i.e., acquiring a product). At least one of the studies reviewed in this chapter was attempting to balance meaningful learning through online PBL with the efficiency of short-term intensive time frames. With these two seemingly competing forces, how can online PBL researchers and practitioners convince students that the process is valuable so they invest the time and effort in it? What kind of evidence is necessary to define the amount of time that is ideal for students to efficiently engage in the process while making the most out of it? In the era of accountability and high-stakes testing, what is the role of assessment as a tool to reinforce the importance of learning about and engaging in the process as much as the product?

Conclusion

Authors have contemplated the question of whether PBL for teacher education can be implemented online. The theme of adaptation continuously comes to mind. The designs examined in the research included in this chapter met most of the essential characteristics of PBL (Barrows, 1998). However, different types of technology and their particular affordances and constraints mediated collaboration, and this introduced issues that proved to be important to consider when designing online PBL for teacher education. When those issues generate transformation on the processes that unfold, can we still use the PBL designation to describe the transformed problem-based learning experiences in online teacher education? Is there an educational loss in such implementations? If so, what and how much of it is lost from the original PBL experience? Are the educational benefits worth the sacrifices? How can we balance that?

One more thought precedes the conclusion of this chapter. The range of technologies that support learning in the studies cited here includes Web 1.0 and some Web 2.0 technologies. Researchers and practitioners are barely understanding the educational benefits of learning mediated by one set of technologies when a new set emerges, blowing away the old technologies along with the understanding that was founded on their use. In discussing diffusion of innovation theory and its potential to inform educational research, Zaritsky, Kelly, Flowers, Rogers, and O'Neill (2003) proposed that studies focus on the variables that maximize the rate of adoption of innovations. Researchers should be able to communicate the perceived advantages of innovative tools and strategies if they are to promulgate the benefits of online PBL in teacher education. Will each new technology bring entirely unique affordances and constraints that will need to be examined anew in the context of this educational strategy? An affirmative answer to the question will profoundly impact this field if researchers can never fully understand its challenges because a new technology constantly supersedes an old one. After all, not all problems are created equal (Jonassen & Hung, 2008). Will this confine the field of online PBL in teacher education to an ever-emergent status?

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