

Systematic Design of Blended PBL: Exploring the Design Experiences and Support Needs of PBL Novices in an Online Environment

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Abstract

Designing problem-based learning (PBL), especially blended PBL, is very different from designing traditional teacher-centered instruction and requires a new set of knowledge, skills, and attitudes. To be successful, teachers must step out of their comfort zone, adopt new roles and responsibilities, and develop new knowledge and skills required in PBL environments as well as technology integration skills. The purpose of this study was threefold: (a) to examine the difficulties and challenges that PBL novices faced as they designed their first blended PBL in an online environment, (b) to explore effective strategies for supporting PBL novices in the design process, and (c) to examine the impact of PBL design experience on PBL novices' perceptions of PBL. The researcher collected qualitative data from multiple sources, including an online survey, initial design documents, feedback meeting notes, revised design documents, and reflection papers. The findings of this study provide practical insights into how to support PBL novices in designing blended PBL. The implications for teacher professional development, especially online professional development, and suggestions for future research are discussed.

The current information age society needs people who can think critically and creatively and can effectively use ever-increasing amounts of data to solve ill-structured problems, to make decisions in the face of uncertainty, and to collaborate with other people. In response to the emerging needs of our society, the International Society for Technology in Education (ISTE) published National Educational Technology Standards (NETS) for students, teachers, and administrators. The NETS for Students (ISTE, 2007), in particular, included (a) creativity and innovation, (b) communication and collaboration, (c) research and information fluency, (d) critical thinking, problem solving, and decision making, (e) digital citizenship, and (f) technology operations and concepts.

The Partnership for 21st Century Skills (2011) presented a set of skills needed by 21st-century graduates, which included learning and innovation skills, information, media, and technology skills, as well as life and career skills. Few would argue the assertion that the traditional teacher-centered instructional methods are incompatible with the evolving demands of the information age and often fail to equip students with 21st-century skills. The learner-centered instructional approaches, including problem-based learning (PBL), better meet the complex needs of the information age since they focus on developing real-life skills, such as collaboration, higher order thinking, and problem-solving skills, beyond knowledge acquisition (Bransford, Brown & Cocking, 2000; Cornelius-White & Harbaugh, 2009; McCombs & Whisler, 1997; Reigeluth, 1994).

Research shows that many teachers are unfamiliar and uncomfortable with the new roles and responsibilities required by open-ended, learner-centered strategies (Land, 2000). Further, although teachers are learner centered in philosophy they are often teacher centered in actual practice. Becker (2000) pointed out that teachers are much more constructivist in philosophy than in actual practice. Research studies have documented incongruence between teachers' beliefs and practices (Lim & Chan, 2007; Peterson, 1990; Polly & Hannafin, 2011; Wilson, 1990).

Recently, An and Reigeluth (2011) found that lack of knowledge about learner-centered instruction is one of the factors that prevent teachers from creating learner-centered classrooms, even though they are learner centered in philosophy. Most participants in their study indicated that they wanted to learn more about learner-centered instruction, especially practical strategies.

This paper describes major challenges that PBL novices face as they design their first blended PBL lesson in an online environment and discusses implications for teacher professional development programs.

Literature Review

Problem-Based Learning

PBL was first developed in medical education in the 1960s in response to students' unsatisfactory clinical performance that resulted from the emphasis on memorization of factual knowledge in the traditional health science education (Barrows, 1986; Barrows & Tamblyn, 1980). PBL has become a primary instructional method in medical schools throughout the world, and it has also been adopted and used by other disciplines in higher education, including nursing, architecture, business administration, and education.

Over the past few decades, PBL has gradually gained popularity in K-12 settings as well, and it has been used across various levels and subject areas (Goodnough & Hung, 2008; McGrath & Sands, 2004; Torp & Sage, 2002).

PBL begins with the presentation of an authentic, complex, and ill-structured problem, around which all learning content is organized. Like most problems encountered in everyday life, ill-structured problems are complex, ill-defined, and open-ended. Unlike well-structured problems, they seldom have a single, correct, or best solution. They typically have multiple alternative solutions and multiple solution paths, and the actions needed to solve them are not readily apparent. Also, they often require the integration of several content domains (Jonassen, 1997, 2000).

In PBL, students no longer passively receive content knowledge from the teacher. Instead, they actively identify learning issues and engage in self-directed learning and collaborative inquiry to solve the problem (Barrows, 2000; Hmelo-Silver, 2004; Savery, 2006; Savery & Duffy, 1995). If designed and implemented effectively, PBL can help students develop self-directed learning, problem-solving, higher order thinking, and collaboration skills, as well as deep understanding of subject matter content.

Using a qualitative metasynthesis approach, Strobel and van Barneveld (2009) compared and contrasted the findings of the meta-analytical research on the effectiveness of PBL. Their results indicate that PBL is significantly more effective than traditional instruction when it comes to long-term knowledge retention, performance improvement, and satisfaction of students and teachers, whereas traditional approaches are more effective for short-term retention.

Problem-based learning and project-based learning are frequently used as synonyms. In fact, they are similar in that both take a learner-centered approach and use authentic, real-world tasks. However, project-based learning is different from problem-based learning in that it focuses more on end products. According to Blumenfeld et al. (1991), projects have two essential components: a driving question or problem and activities that result in a series of artifacts or products. In project-based learning, students are usually provided with specifications for a desired end product, and the expected outcomes drive and shape the learning process. In problem-based learning, on the other hand, students play a greater role in setting the goals and outcomes for the problem. Problem-based learning helps students develop the ability to both define the problem and develop a solution (Buck Institute for Education, 2012; Savery, 2006).

PBL and Blended Learning

Blended learning, an integration of face-to-face instruction and online instruction, is becoming more commonplace in schools. Students not only attend face-to-face classes, they also communicate and collaborate electronically outside of the classroom using course management tools such as BlackBoard, Desire2Learn, and Moodle. Blended learning has a number of features that are favorable for PBL. First, it provides students with a more flexible and constructivist learning environment where they can take control of their learning and work with rich and dynamic resources. In blended learning environments, students and teachers are freed from the time and space constraints of the traditional classroom. Second, blended learning promotes interactions and collaboration among students and the teacher by enabling them to communicate and collaborate with each other both inside and outside the classroom. This feature is also well suited for PBL in that it depends on collaborative learning.

Finally, blended learning has the potential to provide students for whom English is a second language (ESL) or those who are shy in face-to-face environments with opportunities to actively participate in collaborative problem solving. Research has shown that ESL students tend to participate more online than they do in face-to-face settings (Al-Salman, 2009; Bonk & Graham, 2006; Bonk & King, 1998; Chong, 1998; Cooney, 1998; Gerbic, 2006, 2010).

PBL and Teacher Education

PBL has become increasingly popular in teacher education since the 1980s (De Simone, 2008). It has been used in the preparation of preservice teachers (e.g., Butler & Wiebe,

2003; De Simone, 2008), as well as for the professional development of in-service teachers (e.g., Walker et al., 2011; Weizman et al., 2008).

Research studies show that PBL has positive effects on teachers' pedagogical and problem solving skills. For example, Weizman and her colleagues (2008) examined the effectiveness of a PBL model of professional development that was intended to help in-service teachers examine problems of science content and pedagogy in a self-selected content area (e.g., Earth science). In their study, science teachers participated in a 2-week-long workshop followed by nine monthly meetings during one academic year. The results of their study showed that the PBL approach to professional development advanced teachers' pedagogical content knowledge (PCK), while content knowledge gains were limited to one group of teachers. Specifically, participants demonstrated positive change in two subcomponents of PCK: curriculum knowledge and knowledge of assessment. In terms of conceptual understanding, only one group, the Physics participants, demonstrated a noticeable increase, while the Earth Science and Life Science groups did not demonstrate a significant change in conceptual understanding.

In a similar vein, De Simone (2008) examined the impact of PBL on prospective teachers' problem-solving abilities. The participants were prospective teachers enrolled in two classes in a teacher education program. One of the classes was experimental group; the other was the control group. The experimental group used PBL while the control group used a more traditional approach. The participants in the experimental group were significantly better than the control group in identifying the main issue, relating their solutions to the problem, and using multiple resources. PBL appeared to foster the participants' pedagogical problem solving skills.

The literature reveals that teacher education and professional development programs have often used a PBL approach to prepare teachers to solve problems in the classroom. For example, teachers who participated in the PBL for Teachers model of professional development worked on problems designed to improve their content knowledge and teaching practices (Weizman et al., 2008). Relatively little attention has been given to how to prepare teachers to design a PBL lesson.

PBL Problem Design

Designing effective problems is a critical part of PBL design and implementation. Ineffective PBL problems could undermine the effectiveness of PBL by having a negative influence on students' activation of prior knowledge, self-directed learning, generation of learning issues, and group processing (Dolmans, Gijsselaers, Schmidt, & van der Meer, 1993; Gijsselaers & Schmidt, 1990).

Over the last few decades, a small number of researchers have provided guidelines for developing PBL problems (Barrows, 1986; Dolmans & Snellen-Balendong, 1997; Duch, 2001; Schmidt, 1983; Weiss, 2003). Pointing out that previous discussions and guidelines have been general and inadequate in guiding practitioners to design effective PBL problems, Hung (2006) recently proposed the 3C3R PBL problem design model, which consists of two classes of components: core components and processing components.

Core components, which include content, context, and connection, are primarily concerned with the issues of appropriateness and sufficiency of content knowledge, contextualization, and integration and are used to support content and concept learning in a discipline. On the other hand, processing components, which include researching,

reasoning, and reflecting, are used to support students' cognitive processes and problem solving skills.

The 3C3R model addresses educators' concerns regarding sufficient content coverage in a PBL curriculum by emphasizing the importance of content knowledge acquisition as well as reasoning and problem solving skills. Hung argued, "It is a misconception that PBL trades content sufficiency for problem-solving skills development. On the contrary PBL values content knowledge acquisition" (pp. 57-58).

Based on the 3C3R model, Hung (2009) developed the nine-step problem design process to help practitioners apply the 3C3R model. The nine-step process consists of the following:

- Set goal and objectives.
- Conduct content/task analysis.
- Analyze context specification.
- Select/generate PBL problem.
- Conduct PBL problem affordance analysis.
- Conduct correspondence analysis.
- Conduct calibration processes.
- Construct reflection component.
- Examine inter-supporting relationships of 3C3R components.

Goodnough and Hung (2008) examined how teachers engaged with the nine-step problem design model and found that the nine-step model enabled practitioners to consider critical components of a PBL problem systematically, but the process could be streamlined. The participants suggested that a modified model be teacher friendly, practical, realistic, and more simplistic, as teachers do not have the luxury of time to go through all the steps in their hectic daily lives. It appears to be a challenge to find a balance between the amount of analyses and tasks necessary to make a PBL problem effective and the limited time teachers have.

Purpose of the Study

PBL design involves much more than creating a PBL problem, but little research has examined the whole picture of PBL design. Helping teachers design PBL requires understanding what kinds of challenges they face in the design process and what kind of support they need. Much is known about the challenges teachers experience when implementing PBL (Ertmer & Simons, 2006; Park & Ertmer, 2008), but the challenges teachers face when designing PBL are less understood. By examining the difficulties that a group of PBL novices faced as they designed their first blended PBL lesson, this study aims to inform teacher educators, professional development specialists, and researchers how they can better support teachers in designing blended PBL, especially in online environments. The following research questions were addressed:

- What difficulties and challenges did teachers who are PBL novices face as they designed their first blended PBL lesson?
- What are effective strategies to support PBL novices in designing a blended PBL lesson in an online environment?
- How did the PBL design experience impact PBL novices' perceptions of PBL?

Method

A qualitative case study approach (Stake, 1995; Yin, 2003) was used to explore the difficulties faced by PBL novices as they design their first blended PBL lesson, as well as their support needs and perception changes.

Participants

Patton (1990) identified a number of types of purposeful sampling, which seek information-rich cases for in-depth study. This study used criterion sampling, in which all cases that meet some predetermined criteria are selected. The criteria for participant selection were as follows:

- Have little or no experience in designing PBL.
- Have little or no experience in designing blended learning.
- Pursue an education-related major.

Participants were 5 students enrolled in an online graduate course in summer 2011 at a university in Texas who met the criteria and completed the informed consent form. They were all female and ranged in age from late 20s to early 50s.

Lindsey, a high school teacher, had been teaching for 19 years. She had taught mathematics for 16 years and business and technology courses for four years. Kimberly was also a high school teacher and had been teaching for 13 years. She had taught special education for 4 years and physical education for 9 years. Katie was a university instructor. Working on her master's degree in adult education, she taught undergraduate courses. Erin was a new teacher. She just began teaching 11th-grade science and math at a high school. She worked as a microbiologist in the past. Nancy had just changed her career from business to education. She was pursuing alternative teacher certification.

All participants had no prior knowledge of PBL. Although they had taken one or more online or blended courses as students, they did not have any prior experience in designing blended learning.

Procedures

The study focused on an individual project, which required the participants to design a blended PBL lesson for their selected target audience. Qualitative data were collected from multiple sources, including an online survey, initial design documents, feedback meeting notes, revised design documents, and reflection papers. Triangulation was achieved through the examination of multiple data sources (Lincoln & Guba, 1985). The data collection period lasted 5 weeks (Table 1).

Online Survey. An online survey was administered in the first week of the semester to collect general demographic data of the participants (e.g., gender, age, major, job) and to examine their prior knowledge and experience with PBL, online learning, and blended learning, as well as their teaching experience and technology skills.

Initial Design Documents. After learning the basics of PBL and blended learning, the participants were asked to design a blended PBL lesson. For the design of blended PBL, I provided the participants with a design document template, which consisted of the following nine sections:

Table 1
Study Procedures

Week	Study Procedures and Data Sources
1	<ul style="list-style-type: none"> • Online survey • Asynchronous discussions on PBL and PBL problem design
2	<ul style="list-style-type: none"> • Asynchronous discussions on blended learning
3	<ul style="list-style-type: none"> • Asynchronous discussions on facilitation and scaffolding strategies • Initial design documents • Reflection paper 1
4	<ul style="list-style-type: none"> • Individual feedback meetings
5	<ul style="list-style-type: none"> • Revised design documents • Reflection paper 2

- PBL Lesson Title
- Subject/Topic
- Learner Characteristics
- Authentic Problem/Task
- Learning Objectives
- Problem Scenario
- Learning and Problem Solving Processes
- Facilitation and Scaffolding Strategies
- Assessment

The design document template was developed to facilitate systematic design of PBL (Dick, Carey, & Carey, 2005). Beyond creating a problem scenario, the participants were required to describe the learning and problem solving processes, to determine what activities should be done face to face and what activities online and to develop facilitation, scaffolding, and assessment strategies. Guidelines were provided for each section. For example, for the Learning Objectives section, the participants were required to include skill development objectives as well as content objectives (Hung, 2009). They were also given instructions on how to write SMART (specific, measurable, achievable, realistic, and time-bound) objectives.

For the Problem Scenario section, the participants were reminded of Hung's (2006) 3C3R model and given sample scenarios. Also, I emphasized that PBL scenarios should not include all the necessary information required for problem solving so that students can collaboratively identify learning issues and engage in free inquiry or research (Duch, 2001; Hung 2006, 2009; Savery, 2006). For the Learning and Problem Solving Processes section, the students were asked to fill out a table containing four columns: (a) Task/activity, (b) Face-to-face/online, (c) Duration, and (d) Tools and resources required. I emphasized the importance of evaluating both product and process for the Assessment section (as in Savery, 2006).

Individual Feedback Meetings. After providing written feedback on the participants' initial design documents, I had synchronous meetings with individual participants at the beginning of the fourth week to monitor their progress and to provide further support. The students were given three options for the individual meeting: face to face, Skype, or telephone. Each meeting lasted 30-60 minutes, and I took notes during the meetings.

Revised Design Documents. After receiving individual feedback, the participants revised their design documents. Nancy and Kimberly changed their topic during the individual feedback meeting and developed a new design document.

Reflection Papers. The participants were required to write a reflection paper twice: once after submitting their initial design documents and once after submitting their revised design documents. A number of questions were provided to facilitate their reflection. The following are sample questions provided for reflection papers:

- What were the most challenging parts of the design process? Why?
- What lessons did you learn from the PBL design process?
- How did the PBL design experience change your perception of PBL?
- What knowledge and skills would you like to further develop to design and implement effective PBL, especially in blended or online environments?

Data Analysis

Qualitative data from design documents, reflection papers, and feedback meeting notes were analyzed by using the constant comparative method (Glaser & Strauss, 1967; Strauss & Corbin, 1990). To identify the difficulties and challenges faced by participants as they designed their first blended PBL lesson (Research Question 1), I first analyzed their initial design documents using a rubric. A number of challenges were identified through open coding. I constantly compared the data as I coded more data from feedback meeting notes, revised design documents, and reflection papers.

To identify the strategies and tools that effectively supported the participants in designing a blended PBL lesson (Research Question 2), I carefully reviewed their reflection papers and feedback meeting notes. I also compared participants' initial design documents with their revised design documents to see the improvements they made.

To determine the impact of PBL design experience on the participants' perceptions of PBL (Research Question 3), I examined and compared qualitative data from the online survey and reflection papers. Participants' first reflection papers and second reflection papers were examined separately to review their changes in perception.

Results

Difficulties and Challenges PBL Novices Face in Designing Their First Blended PBL Lesson

Selecting/Developing a Moderately Ill-Structured Problem. The participants had difficulty selecting or developing an ill-structured problem appropriate for their learners. Lindsey, for example, initially developed a typical math story problem, which was well structured and had one right answer.

The most challenging part was to design the authentic problem to be solved that was ill-structured. I am accustomed to working and designing problems that have a unique solution. (July 10, 2011)

On the other hand, Katie and Erin developed problems that were highly ill structured and too broad in scope, and it was not clear what they wanted their students to do. They had to narrow the scope of their problems.

The hardest part for me was coming up with the exact problem or topic for my 11th-grade students. I kept going back and forth with different ideas and problems. I struggled over which problem to use for several days.... I think it is very important to consider your target audience when choosing your topic. (Erin, June 21, 2011)

Identifying the Knowledge and Skills Required for Problem Solving. The participants focused on lower level outcomes (knowledge and comprehension) rather than higher order outcomes and did not include skill development objectives, focusing on content outcomes only. They often stated their learning objectives using nonmeasurable verbs such as learn and understand. One of the participants simply described what she was going to teach. All participants needed additional support for identifying all the necessary knowledge and skills required for problem solving (content/task analysis) and for writing effective learning objectives. I provided individual participants with both written and oral feedback on their initial learning objectives, and it helped them improve their learning objectives. Overall, their revised learning objectives were much more specific and comprehensive and included more higher order thinking skills.

Providing Sufficient Information in the PBL Scenario. Most participants failed to provide sufficient information in their PBL scenarios. For example, Erin wanted her 11th graders to investigate the causes of the food poisoning that students were getting from eating in the cafeteria of a high school. Specifically, she wanted her students to be able to differentiate between different types of bacteria, identify bacteria that are associated with food poisoning, and discuss good and bad practices of handling and preparing food. However in her scenario, she did not provide any information about the cafeteria food.

The XYZ High School has around 1,500 students and is located in South Texas. The majority of students come from low income homes. The attendance is usually very good because students have a better atmosphere and food at school than at home. Over the past several months during March and April, there have been an unusually high number of absences. Many students tend to go home sick in the afternoon. The teachers and school nurse have noticed that they are typically absent 2-3 days and most of them complain of stomach pains and have fever. You will be a member of the science team investigating the source of the food poisoning that students are getting from eating in the cafeteria. (July 1, 2011)

Although Erin and Kimberly found Hung's (2006) article on the 3C3R model to be helpful, they still needed considerable help. I emphasized several times that, although PBL scenarios should not include all the necessary information required for problem solving so that students can collaboratively identify learning issues and engage in free inquiry or research, teachers still need to provide some basic information to support students' reasoning and research. After receiving individual feedback, most participants made considerable improvements to their PBL scenarios.

Designing the Blended PBL Process. The participants were asked to describe the learning and problem solving processes and to determine what activities should be done face to face and what activities online. The initial design documents showed that the participants were accustomed to face-to-face, teacher-centered learning. They described teacher-centered learning processes, in which the teacher tells students what to do rather than having students interpret the given problem, identify learning issues, engage in research and inquiry, and collaboratively solve the problem. The participants also had difficulty in blending face-to-face and online learning.

After receiving individual feedback and additional tips, however, most participants were able to design the learning processes that reflected the characteristics of PBL. Once they understood the PBL process, they were also able to blend face-to-face and online learning without much difficulty. For example, Kimberly's revised process descriptions showed her deep understanding of PBL. In her revised design document, she also demonstrated her understanding of blended learning and technology integration skills by combining face-to-face and online activities appropriately and also by choosing appropriate tools, such as wikis and Skype, for online communication and collaboration. Only one of the participants, Lindsey, failed to make much change to her initial process descriptions. She simply elaborated her initial teacher-centered process.

Developing Facilitation and Scaffolding Strategies. Along with the learning and problem solving process, the participants were also asked to describe how they would facilitate and scaffold students' self-directed learning and collaborative problem solving. Developing facilitation and scaffolding strategies appeared to be one of the most challenging parts of the design of blended PBL. Despite the given resources and discussions, the participants failed to develop appropriate strategies. During the individual feedback meetings, I helped the participants understand the facilitative roles of teachers in PBL and think about different ways to scaffold students' learning and problem solving processes. Through interactive questioning and discussions, the participants finally understood different roles of PBL teachers and came up with a variety of strategies for facilitating students' learning and problem solving processes. Interestingly, they showed special interest in scaffolding strategies. In their second reflection papers, the majority of participants commented that they would like to further develop scaffolding strategies, for example:

It was interesting to think about the teacher being more of a facilitator or coach and allowing students to explore possible solutions to the problem....It is a completely different way of teaching. I really started to think about scaffolding and how a teacher, peer, resource or another individual can assist the student in the learning process....I would like to further develop the scaffolding aspects of PBL in a blended environment. (Nancy, July 10, 2011)

Specifically, Erin wanted to learn more about "how to keep students on track" and "what prompting questions" she should ask as a facilitator in the PBL process.

Developing Assessment Strategies. For the last section of the design document, the participants were required to describe their assessment strategies and evaluation criteria. Although the importance of evaluating both product and process was emphasized in the beginning of the project, the participants did not pay enough attention to process evaluation. They initially planned to evaluate the final products, presentations, or reports only at the end. Through the feedback on the design documents and individual feedback meetings, the participants were once again reminded that assessment should be an ongoing process rather than a one-time event. They were also reminded that assessing the

quality of the problem solving process is important, as well as assessing the solutions, to help students develop problem solving and other real-world skills.

In their revised design documents, the participants added specific strategies for process evaluation and presented more comprehensive and balanced evaluation criteria. Katie, for example, planned to evaluate the process by having her students write weekly reflection papers and process reports. Kimberly planned to use a wiki for the evaluation of online participation and collaboration. She also included weekly research data posting, self-assessment, and peer assessment surveys for the process evaluation. Erin added individual bacteria worksheets, participation, and collaboration with peers to the evaluation criteria.

Effective Strategies to Support PBL Novices

Design Document Template. Participants reported that working with the design document template was helpful. They believed that it would be a useful tool for other PBL novices. Lindsey and Kimberly commented that it would be better to provide a sample PBL design document along with the template.

Written Feedback and Individual Feedback Meetings. During the first few weeks, the participants were given resources on PBL, problem design, blended learning, and scaffolding problem solving. Asynchronous discussions were used to facilitate their learning and to check for their understanding. They were required to read assigned articles and PowerPoint materials and to respond to a number of discussion questions. All the discussions were directly related to the PBL design task. I read all discussion posts and provided feedback. The participants' initial design documents, however, revealed that they were still struggling with the concept of PBL after all the discussions. It was necessary to provide customized feedback and tips to help them better understand PBL and revise their design documents.

I first provided the participants with written feedback on their initial design documents using Microsoft Word's track changes feature. After providing written feedback, I had a synchronous meeting with each participant to provide further scaffolding. The participants were asked to review my written feedback on their initial design documents before the feedback meeting. Katie and Erin chose to meet face-to-face, and three other participants chose to use a telephone. Each meeting lasted 30-60 minutes.

Most participants appeared to need further clarification and support. I helped them better understand PBL, develop new ideas, and articulate their thoughts through interactive questioning. The synchronous communication enabled me to assess their understanding and to provide tailored scaffolding. Nancy and Kimberly changed their topic during the individual feedback meeting.

I appreciated the feedback with the balloon comments and especially the phone tips. The phone call with you helped me go deeper into understanding the problem. I felt overwhelmed until I talked with you. Then, I got a direction to go for improvements. (Lindsey, July 10, 2011)

My phone conference with the instructor made the process more explicable....Her comments and advice guided my completion of a revised PBL design. This scaffolding strategy as well as the others provided sufficient intervention to get me through my difficulties. (Kimberly, July 10, 2011)

Summaries and Checklists. After the meetings, I provided a summary of PBL, a summary of the characteristics of PBL problems, a checklist for PBL scenarios (see [appendix](#)), and additional tips, which turned out to be effective. Katie and Nancy commented in their reflection papers that the scholarly articles on PBL were difficult to understand and that the summary better helped them understand PBL.

I really enjoyed the bullet points and information on PBL you gave us recently. Give the tips to the students when the PBL assignment is given. (Nancy, July 10, 2011)

I would include and encourage the use of the PBL scenario checklist. The application of the checklist and PBL packet of notes would profit them significantly. (Kimberly, July 10, 2011)

The Impact of the Experience on Novices' Perceptions of PBL and Blended Learning

Participants had no prior knowledge of PBL and had little experience with blended learning. Blended PBL was a new and different way of teaching for them. In their reflection papers, the participants reported that the blended PBL project made them "think outside the box" and design a lesson "from a facilitator's perspective." Although they struggled in the beginning of the project, they developed a positive view of PBL and recognized the benefits of blended learning through the design experience.

I have a much more positive view about Problem Based Learning now! I think it is like everything else in life. We must give something a try before we make a judgment about it....It also gave me a better understanding of how face-to-face work hand in hand with online learning (Erin, July 10, 2011)

They also gained confidence in their ability to design and implement blended PBL through the feedback and revision process. In the beginning, most participants appeared to lack confidence about the PBL design. For example, Katie mentioned that it seemed almost impossible for her to develop a PBL lesson. After revising their PBL lessons, however, the participants felt more confident about PBL design and excited about implementing their first PBL lesson.

The first one was not a PBL lesson....I can say now that I completely understand the function and components of PBL. There is still much needed practice but I am leaving with a better understanding of the structure of this approach. (Kimberly, July 10, 2011)

I feel very good about the final revised PBL lesson....I believe that I will be able to use my project in my classroom, which will be a very engaging way for the students to learn....I am very confident about implementing my PBL in the classroom! (Erin, July 10, 2011)

Implications for Professional Development Programs

The findings of this study provide useful insights into how to support PBL novices in designing a blended PBL lesson in an online environment. Specifically, the results of this study suggest that professional development programs provide PBL novices with (a) an opportunity to design the whole PBL process using a systematic approach, (b) synchronous, interactive questioning sessions and customized scaffolding, (c) concise and

easy-to-understand guidelines and checklists, and (d) opportunities to have a successful experience with PBL design.

Systematic Design of PBL

Designing blended PBL is different from designing traditional teacher-centered instruction and requires a new set of knowledge, skills, and attitudes. To be successful, teachers must step out of their comfort zone, adopt new roles and responsibilities, and develop new knowledge and skills required in PBL environments as well as technology integration skills. The results of this study suggest that supporting PBL novices requires a comprehensive and systematic approach. In order to help PBL novices effectively design a truly problem-based lesson, teacher educators should have them think through all aspects of PBL, from designing a PBL problem to assessment.

Some might think that they are finished with PBL design once they come up with a good PBL problem or task. However, a good PBL problem does not necessarily mean good PBL. The participants in this study initially designed teacher-centered learning processes and had difficulty designing learner-centered PBL processes, even after developing an appropriate PBL problem.

PBL novices can still teach in traditional ways even with a good PBL problem. In the design process, PBL novices should be given a chance to design the whole process, including their facilitation and assessment strategies, in addition to the PBL problem. This strategy will help them understand PBL more thoroughly, and it will also better prepare them for PBL implementation. The design document template used in this study was developed for the systematic design, and the participants found it to be helpful. Professional development programs should consider using a similar template for PBL novices.

Synchronous Meetings and Customized Scaffolding

Saye and Brush (2002) distinguished between hard scaffolds and soft scaffolds. Hard scaffolds refer to “static supports that can be anticipated and planned in advance based on typical student difficulties with a task” (p. 81). In contrast, soft scaffolds are dynamic and situation-specific supports provided based on learner responses. Although the results of this study are not generalizable, they are consistent with previous research (An, 2010). The hard scaffolds provided to support PBL design, including the design document template with guidelines, a summary of PBL, and a checklist for PBL scenarios, were helpful to the participants. Soft scaffolding was necessary, however, to support their design efforts. The participants had different support needs, and they often had difficulty articulating their thoughts. Customized feedback, synchronous discussions, and interactive questioning were required to help them design their first blended PBL lesson. The findings of this study suggest that professional development programs should include synchronous meetings and provide customized scaffolding in order to support PBL novices in online environments.

Concise and Easy-to-Understand Guidelines and Checklists

Although many journal articles and books provide valuable guidelines for designing PBL, they might not be effective resources for busy practitioners. Several participants in this study commented that the scholarly articles were difficult to understand and overwhelming. One of them mentioned that she wished there was a “PBL design book for dummies.” The participants found the bullet-point summary of PBL and the checklist for

PBL scenarios ([appendix](#)) to be helpful, even though the content was from the journal articles they were given.

The PBL novices seemed to prefer concise and easy-to-understand guidelines and checklists rather than lengthy academic materials to support their design effort more effectively and efficiently. Journal articles may be used, but should be made more accessible to practitioners to reduce unnecessary extraneous cognitive load (as described by Sweller, 2005). Providing summaries and checklists early in the process might reduce the amount of soft scaffolding teacher educators need to provide in the design process.

Successful Experience

People commonly assume that favorable attitudes toward an innovation lead to adoption. However, according to Rogers (2003), the formation of a favorable attitude toward an innovation does not always lead to an adoption decision. The results of this study also show that favorable attitudes and actual adoption are disparate. The participants had no prior knowledge of PBL. When they first learned about PBL, they appeared to be excited about the potential of the new instructional method. They believed that PBL was a great instructional method that enables students to develop 21st-century skills as well as deep understanding of subject matter content. Indeed, their discussion posts showed their positive attitudes toward PBL.

Their initial design documents, however, revealed that they did not yet adopt the new method. They produced teacher-centered lessons after all the discussions of PBL. After revising their design documents they reported that they were excited and confident about implementing their PBL. Professional development programs should provide teachers with opportunities to have a successful experience with PBL design beyond discussing the advantages of PBL and providing examples. The results of this study show that examples are not helpful enough when teachers do not fully understand what PBL entails. Teachers may not adopt the new approach until they feel confident about it, even though they believe it is beneficial for their students.

Suggestions for Future Research

Future studies should further explore the PBL design experience of teachers in different school districts, states, and countries. Research could explore ways to improve the design document template and other scaffolding tools used in this study. Additional research could also explore how teachers implement their first PBL, what challenges they face in the first implementation, and how they want to revise their PBL lesson, in addition to the design process. Once these issues are further explored, an online professional development program based on the data could be developed and evaluated.

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Appendix
Checklist for PBL Scenarios

Contextual description – Include an appropriate amount of contextual information to situate the learning in an authentic (real-life) context.	
Incomplete information – Do NOT contain all the necessary information required for problem solving. Include incomplete information and engage students in research.	
Authentic, ill-structured task – Clearly state an authentic and ill-structured task.	
Trigger interest .	
Promote higher-order thinking .	
Promote self-directed learning .	
Promote collaboration .	
Resources and tools – Explain what resources and tools should be used for problem solving (Optional).	
Reflection – Include reflection components.	