Interdisciplinary Journal of Problem-Based Learning

Volume 8 | Issue 2 Article 2

Published online: 3-13-2014

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IJPBL is Published in Open Access Format through the Generous Support of the Teaching Academy at Purdue University, the School of Education at Indiana University, and the Educational Technology program at the University of South Carolina.

THE INTERDISCIPLINARY JOURNAL OF PROBLEM-BASED LEARNING

ARTICLE

Taking a Leap of Faith: Redefining Teaching and Learning in Higher Education Through Project-Based Learning

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This study examines two aspects of teaching with a project-based learning (PBL) model in higher education settings: faculty definitions of PBL and faculty PBL practices, as evidenced by their self-described successes and challenges in implementation. Faculty participants took "a leap of faith" in their teaching practices to redefine what it means to teach and learn using PBL as an instructional methodology. The findings provide insight into how faculty conceptualization of PBL drives implementation; how the PBL approach challenges college-level teachers; and how instructors' perceptions of their own role in the PBL process impacts how they implement PBL.

Keywords: higher education, college level teaching, project-based learning

Introduction

Over the past two decades, the reform of teaching has focused on increasing the range of students' interests as well as their conceptual understanding of disciplinary content (DeCorte, Greer, & Verschaffel, 1996; National Council of Teacher of Mathematics, 1980; Schmidt, McKnight, & Raizen, 1997). One of the curricular and instructional models that addresses these two aspects is project-based learning (PBL). PBL is an inquiry-based instructional approach that offers one avenue to reform. It reflects a learner-centered environment that concentrates on students' use of disciplinary concepts, tools, experiences and technologies to answer questions and solve real-world problems (Krajcik & Blumenfeld, 2006; Markham, Larmer, & Ravitz, 2003).

While progressive K–12 schools have begun using PBL as an effective instructional model, higher education has been much slower in adopting project-based learning, despite original work with inquiry processes that has occurred in colleges and universities. This study, in particular, documents how professors at a post-secondary institution implement PBL and investigates the successes and challenges of PBL implementation in college classrooms.

The use of the term PBL often needs clarification, given the variety of approaches seen in both K–12 and higher education settings. Problem-based learning (PrBL) and project-based learning (PBL) are similar yet different in conceptualization (Savin-Baden, 2000). Both PrBL and PBL are inquiry methods promoting an action-oriented model of learning to engage students in complex and critical thinking (Savery, 2006). For the purposes of this study, *project*-based learning names a particular approach under the larger umbrella of *problem*-based learning, and project-based learning is defined as "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed projects and tasks" (Markham et al., 2003, p. 4).

The term PBL is commonly used in education reform circles in Indiana, where this study took place, due to the presence of multiple middle and high schools affiliated with the New Tech Network that have built curricula around PBL. In addition, many Indiana secondary schools beyond the New Tech Network are implementing PBL as an instructional model, which means that more and more students are entering college with PBL experience. Given this context, the research questions were the following:

1. What are some successes and challenges faculty encounter with implementing PBL in undergraduate and graduate courses?

http://dx.doi.org/10.7771/1541-5015.1426

2. How do these successes and challenges demonstrate faculty understanding of PBL?

The study's findings lead to a discussion of the implications of this research for incorporating PBL practices into university classrooms.

Project-Based Learning

The dominant PBL model in Indiana is one supported by the nonprofit Buck Institute for Education (BIE). In this version of PBL, which has been developed in the K–12 setting, students go through an extended process of inquiry in response to a complex question, problem, or challenge. While allowing for some degree of student "voice and choice," rigorous projects are carefully planned, managed, and assessed to help students learn key academic content, practice 21st-century skills such as collaboration, communication and critical thinking, and create high-quality, authentic products and presentations (BIE, 2013).

According to the BIE model, the criteria for implementing PBL units are centered on the Six A's for making the project rigorous and relevant (Markham et al., 2003, pg. 34). The Six A's require that 1) the project presents an *authentic*, real-world challenge; 2) the project is *academically rigorous*, demanding breadth and depth; 3) learners *apply learning* by using high-performance skills such as working in teams, communicating ideas, and organizing and analyzing information; 4) learners engage in *active exploration* by gathering information from various resources; 5) learners interact and make *adult connections*; and 6) various formal and informal *assessment practices* are embedded within the unit. As indicated by these six criteria, a PBL curriculum engages learners in studying real, meaningful problems that are important to them while also advancing their creativity and problem-solving abilities.

Pertinent Literature

In order to contextualize the results of the research questions, this literature review describes the research conducted on 1) the challenges of using PBL in K–12 settings including the use of authentic partners, the dilemma of motivating students, and the strategies for conducting appropriate assessment, 2) teachers' understanding of PBL, and 3) the actual implementation of PBL in higher education.

Research on Challenges of Implementing PBL in K–12 Settings

Researchers have described the challenges that K–12 teachers face concerning implementation before and during PBL lessons (Krajcik, 1998; Marx, Blumenfeld, Krajcik, & Soloway, 1997; Thomas & Mergendoller, 2000). Marx et al. (1997) described problems in PBL implementation that relate to managing the classroom, controlling student behavior, using technology, and assessing and supporting student learning. It is this last dilemma that most closely aligns to higher education settings as issues of classroom management are not as critical, and we describe this in more depth below. Thomas and Mergendoller (2000) elaborated on the challenges of using outside experts or community partners to insure authentic experiences, the challenge of motivating students through engagement, and the need to consider alternative models for assessing student work presented in PBL units. Again, each of these challenges is addressed in more depth below. While acknowledging all of these types of challenges, Marx et al. (1997) also indicated that teachers are able to address only one or two challenges at a time when attempting new instructional strategies, and that teachers revert to old instructional habits while still attempting new ones.

Use of Community Partners

Thomas and Mergendoller's (2000) qualitative study of K–12 teachers implementing PBL suggested that one challenge to PBL implementation involves how to find and incorporate community partners. Their study revealed teachers' need to take sufficient time to work through the feasibility and the desired nature of the partnership before PBL lessons begin. Furthermore, their study documented teachers' difficulty with bringing outside experts into class to coincide with when students need information. Thomas' review of PBL research for the Buck Institute (2000) described earlier work by Sage (1996) that found teachers confronting difficulty in developing problem scenarios for authentic work.

Thomas (2000) framed the challenge of working with community partners by calling for future research on PBL:

> Very little is known about the challenges by teachers in developing and enacting PBL on their own. Existing research on implementation is useful for identifying the kinds of training and support teachers need when using packaged or published materials…but these findings may not generalize to or fully capture the challenges of teacher-initiated PBL. (p. 38)

Student Engagement

Research on engaging students through PBL is much better represented in the literature. Ertmer and Simons (2006) suggested that students can exhibit significant frustration if the teacher—now a facilitator—does not provide deliberate scaffolding of their learning. Ertmer and Simons (2006) further indicated the challenges teachers have to address with a PBL model as they move from the role of knowledge provider to a facilitator of learning, and they called for the development

of teaching skills to support such scaffolding. The authors cautioned that the use of scaffolds should be used to foster deeper understanding of the content.

Student participants in Grant's study (2009) saw PBL as engaging, giving them increased freedom and autonomy. The study indicated that students understood the role of weighted grades in a PBL project, with grades assigned for work ethic, collaboration, and aesthetics. They understood that PBL takes more time. Yet other researchers (Bickford, Tharp, McFarling, & Beglau, 2002; Ertmer & Simons, 2006; Grant & Hill, 2006) found that students struggled to discern their roles and responsibilities in a PBL classroom, especially when it came to accepting responsibility for their learning.

Assessing Student Work

A number of studies articulated the challenge of assessing student work with a PBL model (Brinkerhoff & Glazewski, 2004; Tchudi & Lafer, 1996; Thomas & Mergendoller, 2000). The research in this area described the use of peer assessments and new assessment strategies (Frank & Barzilai, 2004); rubric creation in conjunction with student feedback; individual grades vs. group grades (Thomas & Mergendoller, 2000); and the danger of merely assessing superficial project work vs. deeper content understanding (Marx et al., 1997).

Ward and Lee (2002) challenged educators to rethink assessment strategies that are traditionally more product-oriented. As Tchudi and Lafer suggested (1996), educators need to develop valid assessment approaches for process-oriented education, such as PrBL, that are consistent with the needs of 21st-century learners and the assessment of 21st-century skills. Furthermore, Ward and Lee (2002) suggested that if PrBL changes the game, and learning is to be seen as relevant to life, new methods are needed for the teacher to be able to assess student progress. The emphasis should be on being able to locate the necessary information to solve the problem rather than memorizing facts (Gordon, Rogers, & Comfort, 2001; Maxwell, Bellisimo, & Mergendoller, 2001).

Instructors' Understanding of PBL

Transforming classrooms for successful PBL implementation requires teachers, students, administrators, and families to reframe their thinking about how learning occurs and what learning and teaching entail. Inquiry-based instructional approaches such as PBL encourage reform-based constructivist practices (Savery & Duffy, 1995); a constructivist perspective implies that teachers shift from expert providers of knowledge to facilitators of learning. This perspective challenges traditional understandings of learning processes as teachers continue to be content experts who structure the classroom environment to support student learning, but do not lead didactically (Lehman, George, Buchanan, & Rush, 2006; Pecore, 2012).

Teachers' beliefs, views, and preferences about the role of content teaching play a significant, albeit subtle, role in shaping their instructional behavior (Asghar, Ellington, Rice, Johnson, & Prime, 2012; Thompson, 1984). Thornton (2006) described educators' dispositions as "habits of mind . . . [that] filter one's knowledge, skills, and beliefs and impact the action one takes in classroom or professional settings" (p. 2). Research shows that transitioning from a traditional instructional model to a PrBL model is difficult for both teachers and students. Bradley-Levine et al. (2010) and Grant (2009) found that while teachers (and students) understood that the teacher's role was to facilitate the learning process, they struggled to redefine their role in the classroom; they wavered between being an expert and authority figure to being a facilitator and guide. Teachers in Bradley-Levine et al.'s study recognized that PBL required more of them and their colleagues:

> PBL teaching takes *more* time to plan, *more* curriculum and technology resources, *more* day-to-day problem solving about how to scaffold student growth and success in their project work, *more* effort to authentically assess student learning, *more* communication with persons in the community, *more* support from the administration in terms of suitable scheduling and curriculum alignment, and *more* opportunities to collaborate with their teaching colleagues. (pp. 19–20)

PBL in Higher Education

Higher education has lagged behind K-12 education in adopting PBL. Pascarella and Terenzini (2005) indicated that while collaborative and constructivist approaches to teaching and learning have become more common in higher education over the past twenty years, the lecture model remains dominant.

However, higher education research has focused on the history of both PrBL and PBL (Donnelly & Fitzmaurice, 2005; Savery, 2006). Savin-Baden (2000) presented a book-length discussion of the theory and practice of PrBL in British universities and argued that PrBL should play a more essential role in higher education than it does, given its potential to marry the goals of liberal education and professional education. In medical education, case-focused PrBL has come to dominate since its introduction at McMaster University in 1969 (Barrows, 1994, 1996; Donner & Bickley, 1993; Neville 2009). Given the focus of medical schools on PrBL, as well as recommendations from the American Association for the Advancement of Science that science teaching should mirror scientific inquiry, Allen and Tanner have developed a body of work describing PrBL in undergraduate biology education and arguing that PrBL is an effective approach to teaching difficult content (Allen & Duch, 1998; Allen & Tanner, 2003; Tanner, Chatman, & Allen, 2003).

Some studies have appeared on incorporating PBL in teacher education programs. Frank and Barzilai (2004) implemented PBL in a course for science and technology preservice teachers that aimed to prepare these future teachers to teach using PBL by doing PBL. They find several benefits to student learning, including substantial interdisciplinary knowledge acquisition and an increase in motivation and responsibility, and note the importance of incorporating formative assessments throughout the PBL process. Papastergiou (2005) also found that PBL increased preservice teachers' engagement and motivation in a course on educational website design. Wilhelm, Sherrod, and Walters (2008) found that the mathematics understanding of preservice teachers improved significantly after they had completed a science-focused project requiring them to understand and apply particular mathematical concepts.

Other studies focus on PBL in engineering curricula. Lipson, Epstein, Bras, & Hodges (2007) reported that freshmen benefited from belonging to Terrascope, a PBL learning community. In particular, the year-long experience enhanced students' multidisciplinary problem-solving skills and their ability to work effectively in teams. However, Henry, Tawfik, Jonassen, Winholtz, and Khanna (2012) found that PBL presented significant challenges to undergraduate engineering students; in particular, the students missed traditional faculty lectures and struggled to work successfully in groups. In fact, most of the studies cited above echo the findings of Henry et al. that students struggle with the unfamiliarity of the PBL environment, which poses challenges for implementation.

There is more research to be done on PBL in higher education. While Ward and Lee (2002) noted that the philosophies supporting PBL are well established, they complain that the "how-to's are in short supply" (p. 21). Ravitz (2009) suggested that scholars should investigate how PBL is used across disciplines, as well as the effectiveness of particular PBL practices and processes. He also recommended that studies not draw a false dichotomy between PBL and traditional instruction. It is the need for further detail on how university faculty members from different disciplines define and practice PBL that prompts this study.

Methodology

A phenomenological inquiry approach (Creswell, 2013) was most appropriate for this study, given its focus on faculty experiences and perceptions of PBL. Researchers explored faculty participants' interactions with PBL through interviews that allowed for open dialogue focused solely on their classroom experiences. Analysis of data proceeded in ways consistent with the methods described by Giorgi (1985) and Moustakas (1994). Five nonlinear, interlaced, recursive steps were involved: 1) reviewing the data; 2) transcribing the data; 3) determining significant statements in participants' responses; 4) clustering significant statements into themes; and 5) interpreting the themes as sources of individuals' lived experiences. This process helped balance subjectivity and objectivity, and the results provide detailed descriptions of faculty experiences with PBL.

Data Sources and Procedures

Interviews, observation data, and survey data were used to provide information on how and why higher education faculty made decisions regarding the planning and implementation of PBL. Researchers gathered information from four sources in chronological order: 1) video-recorded "before PBL implementation" interviews of faculty who were planning to incorporate PBL in their course (see Appendix A); 2) descriptive surveys soliciting additional information on the PBL unit faculty were planning to teach (see Appendix B); 3) video recordings of classrooms during PBL implementation (see Appendix C for observation protocol); and 4) video recordings of "after PBL implementation" interviews with faculty following completion of the PBL activity (see Appendix D). Throughout the data collection process, the researchers analyzed the data and kept audit trails (research notes), as well as engaged in peer debriefing with each other as the data emerged. Such methods provided the necessary triangulation to ensure the conclusions drawn were reasonable.

Participants

Center of Excellence in Leadership of Learning (CELL) at University of Indianapolis, along with several district and university partners, have hosted statewide PBL professional development (PBL PD) workshops for several consecutive summers. The PBL PD brings together K-16 educators in the summer to share best practices in PBL and to plan PBL curricula for the following year. Researchers identified all faculty members from University of Indianapolis, a comprehensive institution, who had attended the PBL PD and received training in the BIE model. However, there was no expectation on the part of the institution or the researchers that the BIE model would be implemented with fidelity.

Eight faculty members from a variety of academic disciplines accepted the invitation to participate in the study. Participants had between three and sixteen years of higher education teaching experience, and were able to opt out of the study at any time. The faculty participants were: Dr. Physical Therapy, Dr. English, Dr. Chemistry, Dr. Biology, Dr. Kinesiology A, Dr. Kinesiology B, Dr. Education A, and Dr. Education B. We describe their PBL experiences and provide a brief description of their units in Table 1.

Data Analysis

This research study documents participating faculty members' definitions of PBL and successes and challenges they faced in implementation. Following transcription of the interviews, members of the research team created thick descriptions for faculty participants (Geertz, 1973). First, one researcher read through all the data sources of a faculty

Table 1. Description of faculty experiences and PBL units.

Faculty Participant	Description of PBL Experience	Brief Description of PBL Unit
Dr. Physical Therapy	Turned to PBL because he was dissatisfied with the way the course was going when it was taught more traditionally. After attending the PBL PD in 2009, he learned many useful strategies that he has implemented with success. He has taught the course using a PBL format for several years and feels comfortable with the PBL process.	Students worked on several complex fictitious patient cases and developed treatment plans for their patients. They presented their plans to clinical physicians and physical therapists.
Dr. English	Attended the PBL PD in 2010. Uses PBL elements in all his courses to teach professional, technical, and web writing, but does not use the PBL jargon (such as 'driving question,' 'authentic audience,' etc.) that comes from the Buck Institute. Uses client-based projects with the idea of servicing and cultivating community partners to provide opportunities for his students to do real writing.	Students did technical writing and copyediting for their client, a not-for-profit organization.
Dr. Chemistry	Attended the PBL PD in 2009 and uses PBL with candidates in a STEM-focused graduate teacher preparation program. Believes instructor has to have a broad-based knowledge of content because students may take different avenues in solving a project and the instructor needs to be knowledgeable to answer questions as they come up. Comfortable with assessing content skills in a PBL unit, but uncomfortable with assessing "soft" skills.	Students examined safety techniques for handling reagents. They designed a lesson/lab and taught it to college freshmen.
Dr. Biology	Attended the PBL PD in 2009 and tries to use PBL as a mechanism to integrate concepts so that students can see connections. Tries to design projects that are relevant to students' interests, but often feels the units are contrived. Feels that evaluating creativity and group work is a challenge.	Students produced Wikis on various animal phyla. No external audience/partnership was involved with this unit.
Dr. Kinesiology A	Used PBL elements long before attending the PBL PD in 2009. Understanding of PBL has evolved over time, and is comfortable with the PBL process. PBL PD helped her formalize the PBL process in her units. Always integrates community partners into her PBL units so students can use those networks for future internships and employment. Builds reflection time into units to improve student performance.	Students collected data from premium season ticket holders at an NFL game to determine the fans' level of satisfaction. Their findings were presented to the NFL team's boardroom and staff members.
Dr. Kinesiology B	Relatively new to PBL. Attended the PBL PD in 2011 and transformed an older project into a PBL unit. Uses questioning techniques to drive the PBL process so students can develop their critical thinking and problem-solving skills. Sees the instructor as staying in the background to allow students to make their own mistakes and deal with their own struggles and obstacles.	Students proposed ways to increase the number of attendees at their university's basketball games. Ideas were implemented and assessed in conjunction with university's athletic department.
Dr. Education A	Learning about PBL came through various mediums: observing a colleague implement it, evaluating high school students' PBL work, and attending the PBL PD in 2011. Recognizes that facilitating the PBL process requires a lot of work on behalf of the instructor. The instructor needs to plan workshops and have various check-points to make sure students are on track. Borrows some PBL practices (i.e., giving freedom, giving workshops, generating need-to-know questions, etc.) to improve the teaching of other courses.	Students looked at school data and proposed ways to create a climate of instructional change to meet the needs of all learners. Ideas were presented to a school administrator.
Dr. Education B	Has implemented several PBL units since attending the PBL PD in 2010. Sees PBL as a dynamic process where students may unearth additional concepts/ideas, and admits he is becoming more skilled with the need-to-know process. Incorporates authentic audiences for all his projects. Confident in grading the content that is produced, but not comfortable with grading the production quality or creativity of the product.	Students designed a charter school that was relevant for a particular ethnic group, and presented to board members of the city's government council.

participant and created a thick description of the faculty member's approach to PBL. The thick description contained at least two crucial elements: the faculty member's definition of and experience with PBL, and examples of the successes and challenges she or he faced. Next, another researcher read over the thick description and compared it to the original data sources. The two researchers then resolved any discrepancies and prepared a final thick description for the entire research team. Thick descriptions helped the researchers review the data, get to know the participants at a deeper level, determine significant and reoccurring statements for each participant, and cluster these responses into summaries for each participant.

The research team established preliminary themes based on the ideas and experiences contained in the thick descriptions. These themes were then checked against the original transcripts to ensure the accuracy of how participants were articulating their understanding of PBL; doing so helped researchers reflect findings that were significant to the participants' lived experiences. The researchers continued to review themes and refer back to the original data sources to confirm that faculty participants' stories were captured accurately. This process allowed documentation of faculty understandings of PBL and the successes and challenges higher education faculty participants faced in implementing PBL. The results are reported below.

Results

Three prominent themes emerged for faculty participants as they implemented their PBL units: community partnerships, student engagement in PBL environments, and assessment. Each theme includes challenges and successes encountered by faculty while implementing PBL. Participants' comments on their experiences, taken from the transcribed interviews, demonstrate faculty understanding of PBL.

Prominent Theme 1: Community Partnerships

Participants concurred that involving community partners was both challenging and successful. It was challenging to find and recruit a community partner and to maintain these relationships over an extended period of time, often over multiple semesters. However, once faculty built community partnerships and the partners became an integral element of the course, students experienced the projects as authentic, which increased student engagement.

Challenge of Community Partnerships

Many faculty noted that finding and working with a community partner was one of the biggest challenges in the PBL process. Dr. Kinesiology A shared that she might not use the same agencies repeatedly, depending on partners' needs, which means that she must establish and maintain relationships with multiple agencies. Dr. Education A commented on the need to be flexible in revising projects from semester to semester so as to be responsive to district partners' needs, which are often shaped by school improvement plans and professional development priorities. Dr. Biology admitted that her project felt contrived because her students did not have to showcase their wikis to an authentic audience. Other faculty members reflected on the challenge of creating projects that support the course learning objectives while also meeting the needs of the community partner. Dr. Kinesiology A articulated this challenge:

> The biggest challenge is finding something that's meaningful for the students that fits into the class that also meets the needs of the partner. What can the students give that's helpful for the organization? And then what can students take away from that at the same time? So we've been able to find projects that are a win-win, which has been very good for us.

The confines of an academic schedule can create particular challenges for community partnerships. Dr. Kinesiology A, Dr. Kinesiology B, and Dr. English all found it cumbersome to work with community-based partners because the instructor and the community partner had to choose a project that could be completed within the time allotted in the syllabus. Dr. English said that it is important to work with a partner who understands his class goals and who is willing to let his students produce a product. But partners' schedules, he observed, are not organized by semesters, so he has to juggle class schedules and deadlines to meet the partner's needs. Similarly, Dr. Education B found it difficult to coordinate the project timeline with community partners' work schedules, which meant that community partners were not always available when they were needed in the classroom.

Success of Community Partnerships

Although recruiting community partners and maintaining these relationships proved cumbersome, Dr. Kinesiology A found such relationships to be rewarding and long-lasting:

> We're giving opportunities for students to be able to get to know somebody so that they can build on that for an internship and then hopefully for employment down the road…And the fact that we've been able to do repeat projects with community organizations has been a success.

Dr. Kinesiology A viewed community partners as helping students to build their networks in the sports management field, as well as providing authentic feedback on student projects.

Several faculty members commented that using client-based projects helped motivate students to perform in ways that traditional assignments could not because students were required to open their work to public scrutiny. For example, Dr. Education A's community partner was a school administrator who sought ideas from students for ways to create a climate of instructional change to meet the needs of all learners. The school administrator posed the challenge to students, presented data sets from the school, and returned to class on the last day of the project to hear students' suggestions. Dr. Education A reflected on the effectiveness of using a client-based project:

> Well, it was very easy to motivate [students] to investigate, to read material to create the professional development module. That was very easy. I had the right speaker. I mean he was just great at kicking off the project.

Dr. English observed that, as in the real world, the success of students' work in designing an editing handbook was determined by the client's satisfaction with the product. Dr. Kinesiology B recruited the university's Athletics Department as the authentic audience, but later wondered whether partnering with an audience external to the university might improve the students' experience.

Despite the challenges of developing client-based projects with community partners, almost all participants in the study recognized that having authentic projects helped students (and instructors) experience success in the PBL process.

Prominent Theme 2: Student Engagement in PBL Environments

Most participants in the study identified student engagement in the PBL environment as both a challenge and a success. Students demonstrated resistance to some key elements of the PBL model, even as they became engaged in their learning when presented with real-world, authentic tasks.

Challenge in Student Engagement

Multiple faculty members described students' inability to collaborate effectively. Dr. Physical Therapy saw students' resistance manifest itself in how students did not talk to each other or question each other when working collaboratively. Dr. Education B expressed the same sentiment:

> I think culturally we learn that if you want something done right, you do it yourself. And so group work is a challenge for students. And so I have had to learn as well that I need to teach students how to work effectively in groups...and so a lot of the early work is having them look at themselves and to think about themselves. What are the implications if I am this way, if I am more of a task-oriented person, what would be the implications of working with a more relationship-oriented person?

Despite student resistance, Dr. Education B saw this model of teaching as an opportunity for teaching students the collaboration skills needed for effective project-based work.

Dr. Kinesiology B and Dr. Biology concurred that students sometimes show indifference to the work or rush to complete the project without engaging with each other throughout the process. Dr. Kinesiology B indicated that he realized the need to be more adamant about completing the work in a timely way and intended to use a calendar in his next PBL course to make clear students' accountability to the project timeline and to each other.

Faculty encountered resistance from students across disciplines and at all academic levels. Dr. Physical Therapy, who teaches graduate students with a history of academic success, shared that students were not used to the expectations set before them. He indicated that his students were used to sitting in class and being told what to do. When Dr. Physical Therapy encouraged students to seek the answers to their own questions they showed frustration, preferring to take notes and be given the answers. Dr. Kinesiology B's upper division undergraduate students also felt frustrated when he directed them to their group members or course readings to find answers to their questions. Student resistance to PBL also occurred in Dr. Education B's lower division undergraduate course, Dr. Biology's upper division undergraduate class, and in Dr. Education A's graduate level course. Dr. Education A saw the PBL process as requiring a cognitive shift for students:

> Many graduate students are so used to the sit and get approach. I have to tell them from the very beginning what this is going to look like and feel like and I'm not going to let you, you know. . . . I'm not going to let you fail.

Even though Dr. Education A reassured students that she would not let them fail, they resisted her move away from a traditional classroom, saying they "freak[ed] out" when she explained the parameters of the class. The PBL process created discomfort for everyone because professors were redefining students' expectations in unfamiliar ways.

Success in Student Engagement

Faculty members saw the PBL model as successful because their projects were grounded in the real world and focused on meaningful student learning outcomes. Students seemed to be most engaged when their learning outcomes were dependent on meeting a community partner's needs. For

example, Dr. Kinesiology A's project revolved around students collecting data from premium season ticket holders at an NFL game to determine their level of satisfaction, and the students presented their findings to the NFL team's boardroom and staff members. Students were extrinsically motivated by this high-powered audience to perform their best, and they learned the different skill sets necessary to manage projects effectively. Dr. Kinesiology A reflected on the success of the project:

> But I didn't have any complaints about them giving up Sunday to do [the project]. I didn't have any complaints about driving up to the [stadium] to do this. Nobody asked, "Are you going to reimburse me for my gas or anything?" So I guess . . . they got the idea of linking this to a real world thing.

Dr. Kinesiology A's project included a community partner so students could see the applicability of this particular course to their future careers. Similarly, Dr. English used real clients as an authentic audience to judge the work his students produced because that would elicit more effort and commitment from students than a standard college paper or project often requires.

Several faculty members observed that students' intrinsic motivation increased through engagement in PBL. Dr. Education B, an instructor who created a PBL unit around designing a charter school, wanted students to see the relevance in what they were learning and doing. He commented:

> I think the uniqueness of the project allows the students to become passionate about what they're learning . . . I don't have to convince them about the relevance of the topic or the project because they can tell. "Oh wow, we're actually doing something that makes a difference," and I heard that feedback from students. "This is the first time I really felt like I'm really doing something that can really make a difference, you know like in my college career."

Whereas Dr. Education B's project empowered students to have agency in helping the community envision education reform, other faculty found that students became engaged in the PBL process because it mimics the work environment and prepares them for future careers. For example, Dr. Chemistry required prospective chemistry teachers to safely set up and prepare reagents. Dr. Physical Therapy's students worked on patient cases to understand the knowledge, skills, and dispositions of a physical therapist. These uses of PBL shifted instruction away from memorizing and regurgitating information towards learning and using information to complete real-world tasks, with the side benefit of motivating students in their own learning.

Prominent Theme 3: Assessment Practices

Most faculty members in the study expressed concerns about their inexperience with assessing student work in a PBL setting. These concerns derived from each faculty member's own familiarity, or unfamiliarity, with a variety of assessment strategies.

Challenge in Assessment Practices

The difficulty of assessing student work in the context of PBL centered on two primary areas: 1) the challenge presented by assessing the products through which students demonstrated their understanding of course content and 2) the instructors' post-project realization that using intermittent benchmarks would have assisted in guiding student progress on the projects.

Various faculty expressed discomfort with assessing products other than exams and papers, as well as discomfort with assessing the soft skills that are part of the PBL process. Dr. Biology reflected the discomfort suggested by a number of the study participants:

> I have been trained in the science part. So I can tell whether or not they've got the correct factual information . . . but some of the more ephemeral stuff is harder for me, like creativity. The more subjective stuff in projects is harder for me to evaluate. I also have a hard time evaluating . . . group projects. That sort of balance between group work and individual work is a big challenge.

Several of the study participants described confusion when students produced creative products, such as films or brochures, that fell outside the faculty member's area of expertise. Faculty members also expressed frustration with grading certain aspects of presentations, such as how effectively a student communicates or interacts with an audience.

Faculty, though, realized upon reflection that the use of intermittent benchmarks could serve as an assessment tool. Dr. Education B noted, "I need to structure the group interactions and accountability better. Group dynamics create tensions. Students need something like contracts and/or check points." Dr. Education A said, "Probably multiple check-in points and progress checks to make sure that the students are staying on top [of the material or project are needed]."

Success in Assessment Practices

Most of the faculty expressed some success with implementing assessment strategies. The use of rubrics to guide assessment was frequently mentioned, and was a new strategy for some of the faculty. Dr. Kinesiology A described her approach this way:

> They'll have the grading rubric ahead of time and I'll use that rubric to evaluate [their work]. And then sometimes there are peer evaluations that are involved. . . .

> And then I always give them the feedback from whatever the community partner says.

A number of the faculty members explained that they were successful incorporating feedback from peers and from community partners. Dr. Kinesiology B described how he used "peer evaluation as the key criteri[on]," even more so than the feedback of community partners. Nonetheless, while many study participants used peer evaluation as an assessment strategy, the researchers did not consistently see it used as the primary measure of success.

Faculty Understanding of PBL

Faculty participants recognized that PBL includes engaging students in self-directed learning and incorporating community partners to ensure the authenticity of assignments. They described PBL in a variety of ways. Dr. Physical Therapy shared that he viewed PBL as an unpredictable process that requires "taking a leap of faith," as compared to lecture-based teaching where the faculty member has "complete control over what is being said and what is being learned or what is being . . . emphasized." Dr. Kinesiology A observed:

> [PBL] was an opportunity to infuse real-life experiences in my courses, to be able to take some of the content I'm teaching and provide an application for the students so that they could . . . play with it in their hands.

Dr. Chemistry focused on PBL as a form of teaching that required chemistry students to "do a lot of research on their own and then to come back with questions." Dr. Biology saw PBL as a way to create integrated biology units "around a central problem or project" that created linkages between otherwise "disjointed lectures." And Dr. Kinesiology B represented the view of several faculty members when he noted that PBL "helps students to start thinking like a practitioner."

Although all of the faculty members participating in the study had attended the PBL professional development and had been trained in the Buck Institute approach to PBL, none of them chose to implement that model with fidelity. Dr. Kinesiology A represented the group's perspective: "I'm probably . . . taking pieces from the Buck Institute model." Dr. Chemistry expressed discomfort with the Buck Institute structure:

> What I'm not very good at is the nuts and bolts of doing it the Buck Institute way with the needs to know and the critical friends and the workshops. I guess I don't really know the lingo that well.

Dr. English also said that he doesn't use the language of PBL that comes from BIE, although he recognized the relationship between the Buck Institute model and his practice. He argued for a discipline-based understanding of PBL, observing that a PBL model has been "common pedagogy in professional writing, English departments, and rhetoric and composition" for more than 25 years.

Faculty varied in their reliance on the BIE model of PBL based, in part, on their perceptions of student needs. Dr. Chemistry suggested that the graduate teacher candidates with whom she works don't need the "formal framework" provided by the Buck Institute. On the other hand, Dr. Physical Therapy argued that his graduate students were initially quite resistant to PBL and that over several years of PBL teaching, he and his collaborator have found a way to frame and scaffold students' experiences with PBL. Dr. Kinesiology B represented a group perspective when he noted that PBL reorganizes the classroom so that "the education process doesn't always have to be a teacher-driven, teacher-centered process. . . . What [PBL] has definitely done is open my eyes to how I can do things so that students are becoming more active learners." Dr. Education B expressed the most comfort with the Buck Institute model, seeing it as flexible enough that he could customize projects for different courses and student populations.

Engaging in PBL teaching encouraged faculty to continually revise their classroom practice. Dr. English described the successful management of teamwork as a continual learning process: "How do you keep class moving and keep learning happening?" Dr. Education A said that PBL teaching had shaped how she designs projects that she assigns in non-PBL courses. Dr. Education B noted that "[PBL] provides feedback for me in terms of what I can do differently" and also provides feedback to departments about how students are being prepared. Dr. Physical Therapy stated, "This will be the fourth year that we've done a version of this (project), and we keep doing it better and better. And we're getting more and more comfortable with it."

Discussion

The results of this study raise several issues regarding the questions that we posed earlier; that is, what successes and challenges do higher education faculty encounter when implementing PBL, and how do the successes and challenges demonstrate faculty understanding of PBL. We elaborate on each of these questions below, and discuss the implications of our findings for PBL practice in higher education settings.

Successes and Challenges of Implementing PBL in Higher Education

The study identified successes and challenges that faculty in higher education faced when implementing PBL and how faculty understandings of PBL emanated from successes and challenges. Some of the successes and challenges that faculty faced with PBL implementation were similar to those that

K–12 teachers faced when implementing (Thomas & Mergendoller, 2000), while others appeared to reflect processes and attributes unique to higher education.

Use of Community Partners in Higher Education

Thomas (2000) suggests that the predominance of packaged PBL units in K–12 settings has resulted in little research around the challenges of collaborating with community partners. However, this study revealed several challenges with developing community partnerships, including the following: aligning projects with the needs of community partners as well as course objectives; coordinating projects to fit community partners' timelines within the framework of a college semester; and maintaining community partnerships over multiple iterations of a course offering. While the challenge of timing a project is consistent with K–12 teachers' concerns about implementing PBL (Thomas & Mergendoller, 2000), the challenges that higher education faculty articulated around meeting the needs of community partners and cultivating ongoing relationships with them extends the discussions in previous research.

In university settings, where faculty develop curriculum tailored to the needs of their students, their programs, and sometimes their accrediting body, issues related to collaboration with community partners emerged as essential. Notably, faculty in this study tended to engage discipline-specific community partners who became clients of the students. This finding begins to answer Ravitz's (2009) call for more research on how PBL is used across disciplines in higher education. As indicated by Dr. English, Dr. Education A, and Drs. Kinesiology A & B, authentic projects provided the services that their clients required and provided career preparation for students. In fact, when Dr. Chemistry and Dr. Biology used projects that did not include community partners as clients, their challenges with project authenticity became apparent.

Student Engagement in Higher Education

The results of this study align with Ertmer's and Simons' (2006) findings about the struggles K–12 students and teachers face when their roles are redefined in the context of PBL. Like K–12 teachers, faculty members articulated the challenges of clearly defining students' roles and their own roles throughout the project and of anticipating the frustrations that would arise for students as they struggled to use their knowledge to find answers and make decisions. Consistent with the literature addressing K–12 PBL implementation, faculty participants also reflected on the need to scaffold projects more carefully in order to ensure effective group work and to minimize student resistance. This study also indicates that graduate students and undergraduate students struggled equally in their initial encounters with PBL. The struggles of older, more experienced students mirror those of K–12 students as they encounter PBL for the first time.

On the other hand, findings suggest that some implementation challenges may be unique to PBL implementation in higher education. Dr. Physical Therapy and Dr. Kinesiology A both articulated the need to introduce PBL activities piece by piece early on in an academic program, prior to launching full-fledged PBL, in order to change the instructional culture. They described the benefits of implementing PBL in cohort-based programs where groups of students advance through coursework together. This consistency, more likely to be found in university-based professional programs than in other settings, provides a context in which students can learn the new expectations for their performance across several courses, and can come to redefine the roles of student and teacher over time.

Use of Assessments in Higher Education

Research shows that the K–12 teachers struggle to assess PBL activities effectively. Evaluating group work and process-oriented skills prove particularly challenging (Frank & Barzilai, 2004; Marx et al., 1997; Ward & Lee, 2002). Faculty participants in this study evidenced these same struggles as they articulated quandaries on how to evaluate deeper content understanding, group processes, alternative products, and soft skills.

That being said, the study demonstrates further frustration with assessment as faculty struggled with redefining what it means to be an *expert,* as that term is valued and rewarded in higher education. Faculty described their fluency in assessing students' content knowledge, particularly using familiar strategies such as quizzes, exams, and papers, but expressed anxiety about their ability to assess other aspects of student performance typically assessed in PBL. Faculty reliance on a definition of *expertise* that is based solely on content knowledge becomes a barrier to assessing other essential components of PBL such as group work, individual work ethic, and presentation skills.

Faculty Understanding of PBL

Faculty in this study did not wholly adopt the Buck Institute PBL model and implement the model with fidelity. Instead, they embraced the PBL approach as a guiding framework and incorporated some PBL instructional techniques alongside traditional and discipline-specific methods, thus resisting a false dichotomy between PBL and traditional instruction (Ravitz, 2009). These eclectic choices influenced the success of implementation to some degree. The faculty members who were more successful in implementation were willing to redefine their teaching role as facilitative and ar-

ticulated a commitment to building and maintaining strong external partnerships. Marx et al. (1997) describe the tendency for new implementers of PBL to adopt one or two strategies, rather than initially incorporate a fully developed new instructional model. The same was true for participants in this study. It may be that those who perceived less success in implementation were less likely to see the whole. In other words, it is possible they saw PBL as a set of procedures or methods rather than as a holistic change to their instructional pedagogy. Without acknowledging the integrated nature of the PBL process, faculty experiencing less success may have had a skewed understanding of PBL.

Teachers face challenges when incorporating new instructional strategies as they attempt to move toward PBL (CELL, 2009). Supovitz and Turner's (2000) findings indicate that content preparation has a powerful influence on teaching practices and classroom culture. Higher education faculty members bring a strong content orientation that has been shaped by common pedagogical and assessment practices in their particular disciplines, as well as discipline-specific definitions of 'expertise.' PBL instruction emphasizes how learners demonstrate content skills and process skills such as work ethic, group collaboration, creativity, presentations of products, etc. This study suggests that PBL challenges higher education faculty to shift traditional notions of pedagogy, assessment, and expertise to include performance along with content knowledge.

Implications for PBL Practice in Higher Education

This study suggests several implications for PBL practice in higher education. In particular, for individual practitioners to experience success with PBL and for PBL to become more integrated into university curricula, institutional supports must be put into place. First, induction programs for new faculty should include substantial training on how students learn and on assessing student learning, as well as on a variety of teaching methods, including PBL. While some graduate programs have begun to offer pedagogical training to future professors, the majority of faculty members still come to teaching with no pedagogical training and little or no teaching experience. Second, faculty members require ongoing professional development and mentoring in order to develop as reflective PBL practitioners, as well as peer support from colleagues who are experimenting with PBL. It takes a long time to adopt new teaching practices, and even longer to change habits of mind (Thornton, 2006). Third, faculty resist pedagogical innovation because of the time it takes to retool courses; a perceived lack of collegial and supervisor support; and concerns about how poor student evaluations might impact annual merit evaluations and promotion and tenure decisions. Like K–12 teachers, faculty in this study indicated the need for systemic change that would support their use of PBL, including administrative support for implementation and a reconsideration of how teaching is evaluated (Bradley-Levine et al., 2010; Ertmer & Simons, 2006; Marx et al., 1997). Finally, questions remain regarding the sustainability of PBL over time, given the essential role of community partnerships and, in some locations and disciplines, the limited number of partners available.

Future Research

Participants in this study explained the challenges of reflecting on their teaching and rewriting existing courses and curricula accordingly. Dr. English, Dr. Physical Therapy and Drs. Education A & B described the successful adjustments they had made to their PBL courses over time. Research describes how personal dispositions are a factor to how one thinks about instruction (Garmon, 1998, 2004; Thornton, 2006; White, Murray, & Brunaud-Vega, 2012). More research is needed to understand the role of faculty dispositions in PBL implementation.

For example, higher education faculty members operate autonomously in their classrooms and do not necessarily perceive themselves as wedded to a particular model of instruction. They choose elements of PBL to implement in their classrooms. Use of structured frameworks, like the BIE model, is often not integral to higher education teaching practices. What does it mean, then, to talk about implementing PBL with fidelity in college classrooms? Additionally, while some faculty in the study engaged in self-reflections to understand their choices, not all showed the depth of pedagogical reflection generally needed when implementing a responsive pedagogy like PBL. Thus, the study raises questions about how and why faculty members make the choices they do when implementing innovative teaching practices. All the faculty participants valued increased student engagement, but not all were successful in winning the students over. What made the difference?

Faculty participants took a leap of faith in their teaching practices to redefine what it means to teach and learn using PBL as an instructional methodology. Despite the challenges they encountered while implementing PBL, the participants in this study felt that the benefits for student learning made the move to PBL worth the time and effort.

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Appendix A

"Before PBL Implementation" Interview Questions

1. What do you know about project-based learning (PBL) as an instructional model?
   a. Where did you learn about PBL?
   b. Describe what PBL planning and instruction looks like to you.
   c. How would you or do you begin planning for a PBL project? How would you or do you choose a project topic?
   d. How would you or do you facilitate PBL during class time?
   e. How would you or do you evaluate the work completed by students in a PBL project?
   f. How would you or do you know if you are successful?
2. What are some successes and challenges you have had designing projects?
3. What are some successes and challenges you have had implementing projects?
4. What are some successes and challenges you have had evaluating projects?
5. How have you adjusted the way you teach your content since you started using PBL? Give two are three examples.
6. Is there some aspect of your teaching with projects that you want to improve? If so, what do you see as growth area(s) for yourself?

Appendix B

Descriptive Survey for Additional Information on Faculty's PBL Unit

1. Name
2. Which class(es) have you chosen to do PBL? Why this/these specific class(es)?
3. Describe one project you have designed, implemented, and evaluated or that you will be using the next time you teach a class.
4. Why was the project designed?
5. How did/will you launch the project?
6. What was/is your driving question?
7. What concepts, knowledge, and skills were you addressing or will you address?
8. What were/are the most important outcomes for the project that you want for students?
9. How did you decide the length of time for the project?
10. How did/will you bring closure to the project?
11. How did you know students successfully completed the PBL? What kind(s) of evaluation criteria did you use? Why?
12. How were students held accountable for ongoing work?
13. Did students work together in groups? If so, how and when did you use group processes so that students were successfully learning?
14. Did you modify your PBL project during implementation based on your assessment of student learning? If so, how?
15. Did expectations for students change during the PBL implementation? Why?
16. Please share anything else that you did differently in PBL than what you had intended to do.

Appendix C

Observation Instrument During PBL Implementation

Instructor & Site:
Date of Observation:
Time of Observation:
Observer:
Day in Project (Day x of X):

Section One: Contextual Background and Activities

1. What is the total number of students in the class at the time of the observation?
2. Note any other factors affecting planned activities (e.g., tornado drill, shorten schedule, large number of students absent, etc.)

Section Two: Conceptual Focus

1. Describe the major concepts focused on during the lesson (i.e., objectives). If various groups had different focuses please note the differences.

Section Three: Classroom Instruction

Indicate the major instructional approaches (e.g., whole class discussion, mini workshops, small group work time, etc.) used in this lesson. List any resources or written documents provided to the students for each approach. If various approaches were used throughout the lesson, indicate the sequence, overall amount of time on the various activities (i.e., individual computer work for 15 minutes, whole-group demonstration for 15 minutes, workshops for 30 minutes, etc.), and the actual time when activities changed (e.g., 9:45: whole group demonstration, 10:05 students began to work in groups). If groups were engaged in different activities at the same time please note these differences throughout your description.

Section Four: Comments

Please provide any additional information you consider necessary to capture the context of today's lesson. Note any details you observed that may not be captured on a camera. Note any particular questions that you have as a result of observing today's activities.

Section Five: SUMMARY OF CAMERA FOOTAGE

Table C.1. Table provided for Section Three response.

Time	Duration	Type of Activity

Appendix D

"After PBL Implementation" Interview Questions

1. What went the way you thought it would and what did not as you implemented the project?
2. What surprised you about the students, the work, your own teaching?
3. What challenged you the most?
4. What did you find the easiest to accomplish?
5. How did the project enhance students' conceptual learning? How do you know?
6. If you use this project idea again, how will you adjust your teaching?
7. What do you now understand about PBL that you did not before?