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Why Teach With PBL? Motivational Factors Underlying Middle and High School Teachers' Use of Problem-Based Learning

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ARTICLE

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Abstract

This quantitative study examined factors underlying middle and high school teachers' choices about whether to use problem-based learning (PBL). Survey items measured respondents' perceived competence, autonomy, and relatedness, and the value and costs they placed on implementing PBL. Teachers who have taught with PBL (n = 126) had significantly more formal PBL professional development, higher levels of perceived competence and value for this pedagogy, perceived more support from peers, and perceived lower costs than did the non–PBL use teachers (n = 30). Findings highlight the importance of formal PBL professional development in increasing teachers' intention to implement PBL and recommend the inclusion of experienced PBL teachers to share how the "costs" of implementing this pedagogy can also add "value" for teachers and their students.

Keywords: problem-based learning, active learning, motivation, competence, value, expectancy-value theory, self-determination theory

Introduction

Problem-based learning (PBL) uses problems to foster collaborative, self-directed learning (Savery, 2006). PBL was originally developed to increase the skills of medical students in clinical reasoning and problem solving (Barrows, 1983; Neufeld & Barrows, 1974). In contrast to rote memorization, PBL was an innovative way to increase students' capacity to absorb, understand, retain, and use information in subsequent clinical work. Six core principles of PBL include: (1) a learner-centered approach, (2) small group work, (3) teachers as facilitators, (4) authentic problems to stimulate learning, (5) problem-solving skill development, and (6) self-directed learning (Barrows, 1996). PBL is organized around relevant and realistic problems that engage students in planning, investigating, making inquiries, developing evidence-based explanations, and communicating their ideas and results (e.g., Armbruster, Patel, Johnson, & Weiss, 2009; Cennamo et al., 2011; Evans, Lopez, Maddox, Drape, & Duke, 2014; Kammer, Schreiner, Kim, & Denial, 2015; Kim & Tan, 2013). In PBL, the teacher functions as a facilitator and guides students through the learning process (Hmelo-Silver, Duncan, & Chinn, 2007). The learning climate promoted by PBL encourages teachers to allow students to make choices and accept more responsibility for their own learning (Albanese, 2000). In addition to promoting this autonomy, students who work in PBL groups often share the same goal, feel supported, value the learning, become more competent, and are more likely to persevere when facing learning challenges (Ryan & Deci, 2003; Tan, Van der Molen, & Schmidt, 2016). Studies suggest that PBL has the potential to improve students' higher-order thinking skills, comprehension and application of knowledge, learning attitudes and motivation (Allen, Donham, & Bernhardt, 2011; Dochy, Segers, Van den Bossche, & Gijbels, 2003; Gijbels, Dochy, Van den Bossche, & Segers, 2005; Jerzembek & Murphy, 2013; Walker & Leary, 2009).

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PBL is very different from traditional teaching in that teachers' roles change from givers of information to facilitators, and this can be a difficult transition for many teachers (Ertmer & Simons, 2006; Spronken-Smith & Harland, 2009). In a PBL classroom, teachers "facilitate discussion, provide coaching, challenge student thinking and manage group work" (Ngeow & Kong, 2001, p. 2). Any pedagogical change can have positive effects for teachers overall, but it also brings complications and unknowns, both in the process and final product (Emo, 2015). In order to reach the full potential of PBL, the curriculum needs to be designed to meet the specific instructional needs and constraints of the students, such as their ability to be self-directed in their learning (Hung, 2011). Teachers and students who are new to the responsibilities of this open-ended learning environment may need to adjust to their changing roles (English & Kitsantas, 2013; Ribeiro, 2011). Studies demonstrate that designing effective PBL problems is a time-consuming and research-intensive process (Goodnough & Hung, 2008; Ribeiro, 2011), which can add stress and can reduce the desire of teachers to use PBL in an environment of mandated curricula and pacing guides (Ertmer & Simons, 2006). In addition, assessing students' progress (Hung, Jonassen, & Liu, 2008; Savin-Baden, 2004), addressing students' lack of experience in self-directed learning skills (Hung, 2011), and classroom management (Ribeiro, 2011) can be challenging issues when implementing PBL.

Professional development has been used extensively to help teachers make changes in their practices, which can occur in their classroom, school communities, and professional development workshops (Borko, 2004). Desimone (2009) draws from an extensive literature base to explore what "counts" as teacher professional development: essentially, any informal and formal activities that lead to professional growth. Thus, professional development can include interactive book clubs, reflection on lessons, co-teaching, reviewing curriculum materials, attending workshops, taking a course, and thorough examination of one's own practices. Regardless of the nature of professional development, Desimone asserts that effective teacher professional development increases teachers' knowledge and skills and/or changes their attitudes and beliefs—hopefully leading to improvements in the teachers' instruction and/or their approach to pedagogy and leading to increases in student learning.

Many factors influence teachers' motivation to initiate changes. Studies show that teachers are more motivated to adopt changes and implement innovations when they have higher self-efficacy (e.g., Holden & Rada, 2011; Kreijns, Van Acker, Vermeulen, & van Buuren, 2013), and view the innovation as a useful, valuable, and positive change (e.g., Drent & Meelissen, 2008; Kreijns et al., 2013). In a study conducted by Emo (2015), teachers who identified themselves as innovators, and who had a desire to improve their students' learning and make their teaching more effective, were more motivated to initiate innovations. Although there are many studies of PBL that focus on students' learning outcomes, limited research has been conducted to investigate this pedagogy through teachers' lenses (Hung, 2011; Liu, Wivagg, Geurtz, Lee, & Chang, 2012; Ribeiro, 2011; Tamim & Grant, 2013; Wijnen, Loyens, Smeets, Kroeze, & Van der Molen, 2017). Tamim and Grant (2013) summarize recommendations in the literature from qualitative studies in which teachers who implement PBL ought to be flexible, motivated, and open to changing their practices. A study by Walker et al. (2011) investigated teachers who attended a PD to design PBL activities for their students, using online resources that engaged students with authentic problems. Participants reported large gains in terms of their knowledge, experience, and confidence after participating in the PD. Pecore (2013) conducted case study research in which he examined four teachers who participated in a week-long PBL professional development, which aimed to provide teachers with the understanding and skills for implementing PBL. Study results demonstrated that teachers' level of beliefs in constructivist principles prior to attending the PD affected their extent of aligning these principles to their implementation of PBL. A quantitative study by Wijnen et al. (2017) investigated law students' and their teachers' experiences with PBL. Teachers, who had undergone professional development lasting 5 days, reported that students acquired more knowledge using the traditional teaching method and expressed dissatisfaction with PBL. Collectively, the studies suggest that personal factors and motivation are linked to teachers' use of PBL, and that professional development experiences may lead to different experiences when implementing PBL. Yet, few quantitative studies have been conducted on teachers' use of PBL.

The purpose of this study is to use quantitative methods to investigate the differences in PBL experience and preparation of middle and high school teachers, their perceived ability to teach with PBL, and underlying motivations for their decisions about implementing this pedagogy. In the next sections, the two theoretical frameworks that guided the development of the survey items (Lao, 2016) are described. First, expectancy-value theory constructs (Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield & Eccles, 2000) are described, then self-determination theory (Deci & Ryan, 2008; Ryan & Deci, 2000a, 2000b, 2002) is explained, followed by a description of how these theories intersect. Next, the research methods, results, discussion, and limitations are presented. In the final sections of the article, recommendations for teacher professional development, conclusions, and recommendations for future studies are discussed.

Theoretical Framework

Expectancy-Value Theory

Teachers' motivation to implement PBL. The expectancy-value theory (EVT) by Eccles et al. (1983) has emerged as a model to predict and understand individuals' motivations for achievement-related behavior choices, such as sustained enrollment in STEM courses (Abraham & Barker, 2014; Andersen & Ward, 2014; Bøe, 2012; Bøe & Henriksen, 2013) and implementation of innovative pedagogies (Foley, 2011; Meyer, Abrami, Wade, & Scherzer, 2011; Wozney, Venkatesh, & Abrami, 2006). In essence, EVT states that people's achievement performance, persistence, and activity choices are most directly linked to their expectancy-related and task-value beliefs (Eccles et al., 1983; Wigfield & Eccles, 2000).

Expectancy-based beliefs. Expectancy for success is defined as "individuals' beliefs about how well they will do on upcoming tasks" (Eccles & Wigfield, 2002, p. 119). It is most directly influenced by individuals' perceptions of their ability in a given domain and their estimate of task difficulty, which is shaped by individuals' interpretations of past successes and failures, inputs from culture, and socializers (Eccles et al., 1983). In the context of K–12, this likely includes stakeholders such as peers and principals.

In various studies, expectancies have been assessed by asking participants how well they expect to perform on a specific task. For example, teachers' expectancy for success in using computer technology was measured by their responses to questions such as, "I believe I can implement it [computer technology] successfully" (Wozney et al., 2006). The Factors Influencing Teaching Choice scale, an EVT-based instrument developed by Watt and Richardson (2007), assessed teachers' expectancy for success by posing statements, such as "I have the qualities of a good teacher," and "Teaching is a career suited to my abilities." Although expectancy is suggested to influence task choice and performance, it alone is not enough to explain why people choose to engage in certain tasks (Eccles & Wigfield, 2002). Even if people are confident that they can do a task, they might not be motivated to do it if the task has no value to them or costs too much (Eccles & Wigfield, 2002), as will be discussed in the following sessions.

Subjective task value. Building on Battle's (1965, 1966) work on achievement-related values and Deci's (1972) research on intrinsic (internal; pleasure/enjoyment) and extrinsic (external reward/punishment) motivation, Eccles et al. (1983) defined three subjective task values that can influence individuals' achievement behaviors: attainment value, intrinsic value, and utility value. Subjective task value is determined by both the nature of the task and individuals' needs, values, and identity. As Eccles (2009) stated, "subjective task value is directly related to personal and collective/social identities and the identity formation processes underlying the emergence of these identities" (p. 82).

Attainment value. Attainment value is defined as the importance of doing well on a given task, which refers to how well a certain choice fits with an individual's identity. People will attribute higher value to choices that are consistent with their identities and offer opportunities to them to fulfill their long-range goals (Eccles, 2009). For example, a teacher who identifies him/herself as student-centered may be more likely to implement PBL. Attainment value is affected by individuals' self-schema, such as masculinity, femininity, and/or competence in various domains. An individual will place higher attainment value on a certain task if the accomplishment of it identifies with and enhances the individual's self-schema (Eccles & Wigfield, 2002; Wigfield & Eccles, 1992).

Intrinsic value. Intrinsic value is the enjoyment one anticipates gaining from performing the activity (Wigfield & Eccles, 1992). Ryan and Deci (2000a) defined intrinsic motivation as "doing of an activity for its inherent satisfactions rather than for some separable consequence" (p. 56). Individuals who are intrinsically motivated for a certain task, such as teachers who enjoy teaching with PBL, typically show more interest and confidence compared to people who are externally pressured for the action. The intrinsic motivation is manifested as enhanced performance, persistence, and creativity (Ryan & Deci, 2000b).

Utility value. Utility value or usefulness refers to how helpful a certain task is in reaching current and future goals, such as career objectives (Eccles & Wigfield, 2002). A choice that facilitates an individual's future goals has utility value whether the individual is or is not interested in the task for its own sake (Eccles & Wigfield, 2002). For example, teachers might do professional development in PBL due to curiosity or wanting to learn more for one's own personal growth, or to fulfill the requirement for continuing education units. Although the term "utility value" paints an image of an extrinsic motivator, individuals can accept and endorse the value and perform the task willingly (Ryan & Deci, 2000a), as will be shown in the succeeding section.

Cost. Finally, cost is conceptualized as the perceived drawbacks of engaging in a task (Eccles et al., 1983). Eccles and Wigfield (2002; Wigfield & Eccles, 1992, 2000) considered cost as one of four subcomponents of value that is weighed in a cost/benefit analysis to determine the overall value.

For example, a teacher may consider implementing PBL as important for his/her professional growth (value), but in the meantime is concerned about the extra time and effort that he/she will have to put into it (cost). Both the value and cost factor will play a role in determining the overall value of implementing PBL, to this teacher.

There are three dimensions of cost: perceived effort, opportunity cost, and psychological cost of failure (Eccles et al., 1983). Perceived effort is described as the minimal amount of effort needed to succeed on a task, given the individual's estimate of his/her ability and the difficulty of the task. Effort cost would be considered high if the anticipated benefit is not perceived to be worth the effort. Opportunity cost means the loss of valued alternatives caused by an individual's engagement in a particular task. Finally, psychological cost of failure is described as the anxiety related to the potential of failure at the task (Eccles et al., 1983). Studies have shown that teachers are concerned about the effort and extra time required for planning, implementing, and designing proper assessments for PBL, and the potential negative impact of PBL on their students' scores on high-stakes standardized tests (Ertmer et al., 2009; Ertmer & Simons, 2006; Ribeiro, 2011).

Based on Eccles' EVT model, individuals are more likely to adopt an innovation if they: perceive themselves to have high ability, believe they are likely to succeed in implementing the innovation, place high value on the innovation, and consider that the benefits from implementing the innovation outweigh the costs (Wozney et al., 2006). Therefore, teachers' intention to adopt an innovation, such as PBL, in their classrooms depends on (1) how likely they perceive that they will be successful in implementing PBL; (2) how highly they value PBL, in terms of both their professional growth and their students' learning; and (3) how much they think the adoption of PBL will cost them.

Self-Determination Theory

Intrinsic and extrinsic motivation. Self-determination theory (SDT) (Ryan & Deci, 2000b) assumes that humans are, by nature, motivated to develop "an ever more elaborated and unified sense of self" (Ryan & Deci, 2002, p. 5). That is, people are innately curious, eager to learn, and seek coherence in their knowledge and values (Niemiec & Ryan, 2009). Intrinsic motivation is similar to the construct of intrinsic value previously described in EVT (Wigfield & Eccles, 1992). Through the process of personality development and behavioral self-regulation, people connect with other individuals in their social worlds and fulfill their fundamental psychological needs. However, motivation is not a unitary phenomenon. People not only have different amounts, but also different kinds of motivation, and the type of motivation is generally more important than the amount in predicting life's important outcomes (Deci & Ryan, 2008).

The most basic distinction of motivation is between intrinsic and extrinsic (Ryan & Deci, 2000a). When intrinsically motivated, people engage in activities because they find the activities interesting or enjoyable, and experience positive feelings from doing the activities even when there are no external rewards attached. To the contrary, extrinsically motivated individuals perform an action because it leads to a certain consequence, such as to obtain a tangible reward or to avoid a punishment. Compared to people who are externally controlled for an action, individuals whose motivation is intrinsic typically have more interest and confidence in the task, which in turn is manifested as enhanced performance (Hayenga & Corpus, 2010), engagement (Walker, Greene, & Mansell, 2006), persistence (Duncan, Hall, Wilson, & Jenny, 2010), and creativity (Ryan & Deci, 2000b; Zhang & Bartol, 2010). However, people often are required to perform non–intrinsically interesting tasks in order to fulfill responsibilities or adapt to social norms (Ryan & Deci, 2000a). SDT suggests that people can feel autonomous and willingly perform the extrinsically motivated task, provided that they have internalized and integrated the motivation within themselves (Deci & Ryan, 2008).

Social contexts that maintain intrinsic motivation and promote internalization.

Humans are endowed with intrinsic motivations to seek novelty and challenges, to explore, and to learn. However, these motivations can be either facilitated or undermined by social and environmental factors (Ryan & Deci, 2000a, 2000b, 2002). SDT postulates that humans have three fundamental psychological needs: the need for autonomy, competence, and relatedness (Ryan & Deci, 2000a, 2000b, 2002). Social environments that facilitate satisfaction of these basic needs are crucial for an individual to maintain intrinsic motivation. Additionally, social contextual conditions that cultivate individuals' feelings of competence, autonomy, and relatedness will also facilitate the internalization and integration of extrinsic motivations and promote positive psychological, developmental, and behavioral outcomes (Ryan & Deci, 2000a, 2000b, 2002). In contrast, social climates that thwart satisfaction of these needs would undermine individuals' intrinsic motivation and internalization of extrinsic motivation (Ryan & Deci, 2000a, 2000b, 2002). In their study of teacher satisfaction and retention, Skaalvik and Skaalvik (2011) found that supervisory support and relations with colleagues were positively associated with teachers' sense of belonging and job satisfaction, and negatively associated with their motivation to leave the teaching profession. A

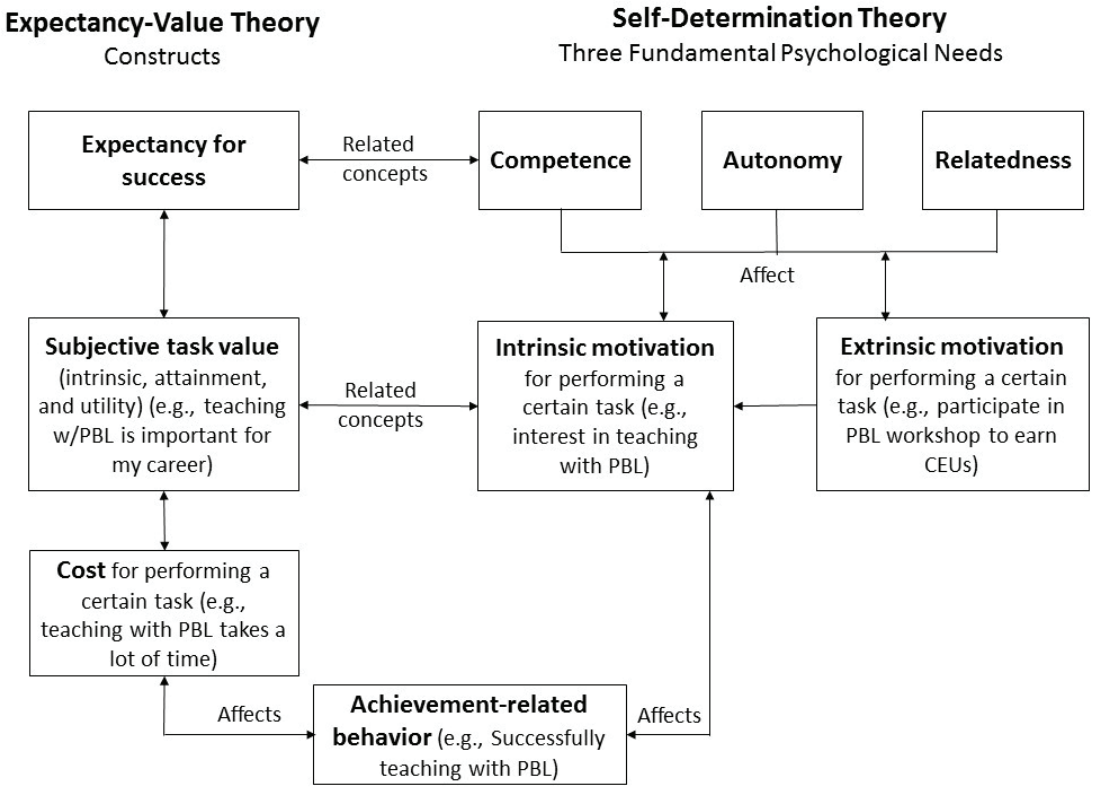

Figure 1. Complementary aspects of expectancy-value theory and self-determination theory (based on Eccles et al., 1983 and Ryan & Deci, 2002).

study by Collie, Shapka, and Perry (2012) showed that the level of collaboration among peers had a positive relationship with their sense of teaching efficacy and job satisfaction, illustrating that teachers' well-being and motivation were influenced by their perceptions of their school environment.

Ryan and Deci (2017) specified factors in social contexts that could affect individuals' intrinsic motivation. Environments that provide rewards, positive feedback, and/or freedom from demeaning evaluations of individuals' behavior will lead to these people's feelings of competence, thus enhancing their intrinsic motivation for these specific behaviors.

A study by Lam, Cheng, and Choy (2010) demonstrated that the school environment can enhance or hamper teachers' motivation to implement an innovative pedagogy such as project-based learning, depending on whether the environment supports teachers' innate needs for autonomy, competence, and relatedness. In this study, teachers who perceived their schools as being strong in collegiality and supportive of their autonomy and competence were more willing to continue with project-based learning in their schools (Lam, Cheng, & Choy, 2010). Examples of a school environment that was supportive of teachers' autonomy, competence, and relatedness included providing teachers professional development for implementing project-based learning, considering the extra time requirement for practicing project-based learning, involving teachers in formulating the direction and content of this new pedagogy, allowing teachers certain degrees of freedom to decide how to supervise their students, and having teachers who collaborated with one another and made a concerted effort to implement project-based learning (Lam et al., 2010).

As shown in Figure 1, EVT postulates that an individual is motivated to participate in a certain task if the individual is interested in performing the activity (intrinsic value), or perceives the accomplishment of this task as either important (attainment value) or useful (utility value) to him/her (Eccles et al., 1983). Based on SDT, these values belong to two categories, intrinsic and extrinsic (attainment and utility value). A task that has only extrinsic value to an individual can still be motivating if the individual is empowered with self-determination to internalize the value (Ryan & Deci, 2002). SDT also proposes that individuals are inclined to maintain their intrinsic motivation and internalize their extrinsic motivation in an environment that satisfies their innate need for autonomy, competence, and relatedness. Therefore, SDT brings another important factor, an environment that facilitates an individual's self-determination, into the complex picture of motivation.

Research Questions

The adaptation of PBL to the classroom is challenging, and teachers need professional development to acquire the necessary knowledge and skills for its implementation (NRC, 2012; Salinitri, Wilhelm, & Crabtree, 2015; Walton, 2014). A survey instrument on PBL developed by the first author (Lao, 2016), using factors of expectancy-value theory and self-determination theory, was administered to teachers in a southeastern U.S. state. Based on the survey results, the following research questions were addressed through quantitative analyses:

1. What are the differences between teachers with and teachers without PBL experience in terms of their perceptions of PBL, preparation, perceived ability, and motivation to implement this pedagogy?
2. What underlying factors affect teachers' intention to implement PBL?

Methods

Survey. This quantitative study employs a cross-sectional survey design (Lavrakas, 2008) in order to make inferences about a population of interest (teachers' choices about using PBL) at one point in time. A survey instrument was developed (Lao, 2016), using EVT and SDT as underlying theoretical frameworks, to investigate what motivates middle and high school teachers to implement PBL (or not). Questions from surveys based on EVT or SDT were compiled (Eccles & Wigfield, 1995; Flake, Barron, Hulleman, McCoach, & Welsh, 2015; Lam et al., 2010; sdt: Self-Determination Theory, n.d.; Wozney et al., 2006) and used as references for survey development.

The first part of the survey collected participants' demographic information and teaching background, such as gender, ethnicity, teaching subjects, and years of teaching. Teaching subject options included English/language arts, mathematics, science, and social studies. Three items measured either years of teaching or PBL training received, and 7 items were used to assess teachers' general conceptions of PBL. The rest of the 33 items were categorized into six groups based on the theoretical framework of this instrument: (1) teachers' perceived competence in practicing PBL, (2) value of PBL implementation to teachers, (3) value of PBL implementation to their students, (4) cost of implementing PBL, (5) teachers' perceived autonomy in implementing PBL, and (6) teachers' perceived support for their PBL implementation. The definition of PBL was provided at two different places in the survey. [For a full explanation of the survey development, please see Lao (2016).]

The first author asked representatives for two regional organizations (both of which conduct workshops, some of which are on PBL) to send the survey invitation to middle and high school teachers who had attended one or more of these teacher workshops. Of the total number of teachers on these lists, 64% (n = 188) of them responded and took the online survey in Qualtrics. Responses that were less than 80% complete were considered incomplete and excluded from data analysis, which gave a completion rate of 91% (n = 171). Out of the 171 teachers who completed the survey, 15 of them taught either at elementary schools or colleges. Their survey results were not used in the analysis, as they were not the target population of this study. This left data from 156 secondary teachers to be analyzed statistically.

Data analysis

The software package Statistical Package for the Social Sciences (SPSS, Version 21.0; IBM, 2012) was used for data analysis. Exploratory factor analysis (EFA) was conducted to identify the latent constructs in the instruments, using responses from teachers who had taught with PBL before. Results from the exploratory factor analysis revealed a 3-factor structure that aligned with EVT and SDT, the theoretical frameworks of this instrument, thus establishing its construct validity (Lao, 2016). Factor 1 explains 35.13% of the total variance and includes 11 items that all belong to the "value" category. Factor 2 explains 6.60% of the total variance. It includes 2 items that measure teachers' perceived competence and 3 items that measure perceived cost in implementing PBL. Finally, factor 3 explains 4.42% of the total variance. It includes 4 items that measure support from schools or peers.

The reliability of the instrument in the current study was assessed by three indicators: Cronbach's alpha, mean interitem correlation, and corrected item-total correlation. Cronbach's alpha has been the most widely used indicator of the reliability of an instrument (Davenport, Davison, Liou, & Love, 2015; DeVon et al., 2007; Streiner, 2003). For the three factors in the current study, Cronbach's alpha values range from 0.768 to 0.891 and fit in either the "respectable" or "very good" category. The corrected-item-total correlation values for all 20 items included in the final 3-factor model range from 0.497 to 0.723, which offer more evidence for the instrument's strong reliability (recommended as at least 0.30 [Nunnally & Bernstein, 1994] or 0.40 [Mattick & Clarke, 1998]). Interitem correlations indicate the extent to which the individual items of a scale are related. Mean interitem correlations (recommended by Briggs and Cheek, 1986) for items in factors 1, 2, and 3 are 0.45, 0.51, and 0.46, respectively, which provide further evidence for the instrument's reliability of between 0.15 and 0.50 (Clark & Watson, 1995; Eisen, Ware, Donald, & Brook, 1979).

Results

Descriptive statistics

There were 156 secondary teachers who responded to and completed the survey, and their demographics are listed in Table 1.

The two groups were designated as "PBL" (n = 126; 81%) and "non-PBL" (n = 30; 24%), based on whether they had previous experience implementing PBL or not. Participants were mostly female (80%), white, non-Hispanic/non-Latino (approx. 90%), and middle-aged (avg. 45.3 years old). Most had less than 10 years of teaching experience (41.7%), and the mean years of teaching was 13.4. More than three-quarters (76.3%) of the respondents were high school teachers. Science teachers accounted for 63.5% of the respondents, followed by a distant second of 11.5% mathematics teachers. A smaller percentage of the participants taught English/Language Arts (9.6%), Social Studies (6.4%), or Other (18.6%) subjects (e.g., Career and Technical Education, Physical Education, Theatre Arts, Special Education, Agricultural Education, and Media).

Out of the 156 respondents, most of them (90.4%) had preparation for teaching PBL, either informal (self-taught or by colleagues) or formal (professional development), and close to half (43.6%) had both informal and formal training. In terms of formal PBL preparation, 26.9% of the teachers had from 2 to 5 days of professional development (PD), followed by 14.1% with more than 2 weeks of PD in PBL, 10.3%

Table 1. Demographics of the middle and high school teachers who completed the survey.

Demographics		**Overall (N = 156)**	**PBL[1] (n = 126)**	**non-PBL[2] (n = 30)**
Gender	Female	125 (80.1%)	103 (81.7%)	22 (73.3%)
	Male	31 (19.9%)	23 (18.3%)	8 (26.7%)
Ethnicity	Black or African American	9 (5.8%)	9 (7.1%)	0
	White, non- Hispanic/ non-Latino	139 (89.1%)	109 (86.5%)	30 (100%)
	Asian or Pacific Islander	1 (0.6%)	1 (0.8%)	0
	Hispanic/Latino	3 (1.9%)	3 (2.4%)	0
	Other	4 (2.6%)	4 (3.2%)	0
Age (ranges from 23 to 78)	23–30	24 (15.5%)	21 (16.7%)	3 (10.0%)
	31–40	28 (18.1%)	23 (18.2%)	5 (16.7%)
	41–50	49 (31.6%)	38 (30.2%)	11 (36.7%)
	51–60	35 (22.6%)	29 (23.0%)	6 (20.2%)
	61–70	18 (11.6%)	14 (11.1%)	4 (13.3%)
	71–78	1 (0.6%)	0	1 (3.3%)
Years of teaching	0–less than 10	65 (41.7%)	49 (38.9%)	16 (53.3%)
	10–less than 20	49 (31.4%)	41 (32.5%)	8 (26.7%)
	20–less than 30	33 (21.2%)	27 (21.4%)	6 (20.0%)
	30–less than 40	6 (3.8%)	6 (4.8%)	
	40 years or more	3 (1.9%)	3 (2.4%)	
Type of schools currently teach	Middle school	37 (23.7%)	30 (23.8%)	7 (23.3%)
	High school	119 (76.3%)	96 (76.2%)	23 (76.7%)
Teaching subjects[3]	English/Language Arts	15 (9.6%)	14 (11.1%)	1 (3.3%)
	Mathematics	18 (11.5%)	13 (10.3%)	5 (16.7%)
	Science	99 (63.5%)	80 (63.5%)	19 (63.3%)
	Social Studies	10 (6.4%)	9 (7.1%)	1 (3.3%)
	Other	29 (18.6%)	22 (17.5%)	7 (23.3%)

Note. [1] "PBL" indicates teachers who had experience in implementing PBL. [2] "non-PBL" indicates teachers who did not have experience in implementing PBL. [3] The total percentage exceeded 100% because some teachers taught more than one subject.

with 6 to 10 days, and 6.4% with 1 day or less PD. The PBL professional development topic that was most desired by teachers was "designing/structuring PBL lessons and units" (75.6%), followed by "assessment" (53.2%).

The PBL group teachers were also asked their level of using this pedagogy at the time of taking this survey. Most of the teachers in this group (98.4%) were using PBL at the time of completing the survey. Of those who currently used PBL, it was most common (45.2%) to use it for 1 or 2 lesson units of a course. Fewer teachers, 29.4%, used PBL for one-fourth of their teaching, and 15.9% for up to half of their teaching. A small percentage (7.9%) of the teachers used PBL for most of their teaching. Teachers who had never used PBL in the past were also asked to select reason(s) for not using this pedagogy. The most prevalent reason provided was the lack of professional training (46.7%), followed by lack of perceived competence (30.0%). One teacher was not interested, and another did not consider PBL implementation important. Seven teachers chose "other" and offered reasons, such as lack of time or did not know how to implement PBL. Teachers' training and use of PBL are summarized in Table 2 (see next page).

Comparisons between teachers who had and teachers who did not have PBL experience

Responses of 43 items from teachers who either had PBL experience (the PBL group, $n = 126$) or did not (the non-PBL group, $n = 30$) were compared and results are listed in Table 3 (see following pages). The Shapiro-Wilk normality test indicated that data from the current study were not normally distributed and therefore the independent samples *t*-test, a parametric statistical method to compare two normally distributed samples, was not used. Instead, the Mann-Whitney U test, a nonparametric analog of the independent samples *t*-test that does not require the samples to be normally distributed, was used to compare the PBL and non-PBL groups (Nachar, 2008). For the Mann-Whitney U test, the sample size of the two groups that are compared can be unequal (Gaddis & Gaddis, 1990; Zimmerman, 1987), up to a 10-fold difference between groups, as in this study (De Winter & Dodou, 2010). For the purpose of these analyses, six choices with the responses "strongly disagree," "disagree," "somewhat disagree," "somewhat agree," "agree," and "strongly agree" corresponded to a score of 1, 2, 3, 4, 5, and 6, respectively (Matell & Jacoby, 1972). Items that showed significant differences in responses from the PBL and non-PBL teachers are summarized in Table 3.

Significant differences in types of PBL training (informal or formal) and amount of formal PBL training (days of professional development) existed between the PBL group and the non-PBL group. For the seven questions that measured teachers' general conceptions of PBL, significant differences between the average responses from the PBL and non-PBL group existed in three of them. For example, teachers who never taught with PBL were significantly more likely to feel that "PBL gives too much responsibility to students" than were teachers who had used PBL before. There also were seven items in the category of "perceived support and autonomy" and in one item, teachers who had PBL experience perceived a significantly higher level of support from peers. However, responses to all 5 items in the "perceived competence" category, 11 out of the 12 items that measured "perceived value," and 7 out of 9 items in the "perceived cost" category indicated significant differences between the teachers with or without PBL experiences. For example, significantly more PBL group teachers felt that "I will be able to implement PBL successfully" and "Teaching with PBL could be enjoyable" than teachers who had never taught with PBL before. On the other hand, significantly more non-PBL group teachers believed that "Preparing to implement PBL would require too much of my time," a cost factor for using PBL.

The Wilcoxon signed-rank test, the nonparametric equivalent of the paired-samples *t*-test, was conducted to evaluate the collective difference between the value of PBL to teachers and for their students, for both PBL and non-PBL groups. Results indicated significant differences existed between these two types of value for the PBL group—the mean for all student value items was 5.21 and the mean for all teacher value items were 4.87 ($p < 0.01$). The same pattern was observed in the non-PBL group—the mean for all student-related items was 4.76 and the mean for teacher value items was 4.27 ($p < 0.05$).

Discussion

Differences between PBL and non-PBL teachers

The PBL and non-PBL group teachers were compared in order to answer the first research question, "What are the differences between teachers with and teachers without PBL experience in terms of their perceptions of PBL, preparation, perceived ability, and motivation to implement this pedagogy?" The findings from the current study are summarized in Table 4 (see following pages). There were highly significant differences between the PBL and non-PBL teachers for all five items in the instrument's subscale that measured teachers' expectancy for success/perceived competence in implementing PBL. Not surprisingly, teachers with PBL experience felt competent and expected to succeed when implementing PBL. On the other hand, teachers who had never taught with PBL did not feel

Table 2. Teachers' training and use of PBL

Teachers' training and use of PBL	**Overall (*N* = 156)**	**PBL (*n* = 126)**	**non-PBL (*n* = 30)**
Teachers' training for PBL			
No training at all	15 (9.6%)	6 (4.8%)	9 (30.0%)
Informal training only	51 (32.7%)	39 (31.0%)	12 (40.0%)
Formal training only	22 (14.1%)	17 (13.5%)	5 (16.7%)
Both informal and formal training	68 (43.6%)	64 (50.8%)	4 (13.3%)
Amount of formal training received			
1 day or less	10 (6.4%)	8 (6.3%)	2 (6.7%)
2–5 days	42 (26.9%)	35 (27.8%)	7 (23.3%)
6–10 days	16 (10.3%)	16 (12.7%)	
More than 2 weeks	22 (14.1%)	22 (17.5%)	
Desired PBL training[1]			
Classroom management	57 (36.6%)	43 (34.1%)	14 (46.7%)
Change from direct instruction to facilitating	64 (41.0%)	48 (38.1%)	16 (53.3%)
Designing/structuring PBL lessons and units	118 (75.6%)	91 (72.2%)	27 (90.0%)
Assessment (formative and/or summative)	83 (53.2%)	67 (53.2%)	16 (53.3%)
Other (e.g., prepare students for standardized tests)	7 (4.5%)	6 (4.8%)	1 (3.3%)
I do not want training on PBL	16 (10.3%)	13 (10.3%)	3 (10.0%)
Current use of PBL			
Currently not using PBL		2 (1.6%)	
Use PBL for 1 or 2 lesson units for a course		57 (45.2%)	
Use PBL for up to 25% of teaching		37 (29.4%)	
Use PBL for up to 50% of teaching		20 (15.9%)	
Use PBL for most of the teaching		10 (7.9%)	
Reason for not practicing PBL[1]			
Lack of professional training			14 (46.7%)
Lack of interest			1 (3.3%)
Don't believe the importance of PBL			1 (3.3%)
Lack of perceived competence			9 (30.0%)
Other (e.g., lack of time, do not know how)			7 (23.3%)

Note. [1] The total percentage exceeded 100% because some teachers made more than one choice.

Table 3. Significant differences between survey responses of teachers with and without PBL experiences.

Category	Survey item (item # indicated in parentheses)	*M*	*SD*	*P*
Types of PBL training	The following statement best describes my training for PBL (1= none; 2 = informal; 3 = formal; 4 = informal & formal) (#10)	PBL: 3.10 non-PBL: 2.13	1.003 1.008	0.000**
Amount of formal PBL training	I have had the following amount of formal PBL training (e.g., professional development): (1 = ≤ 1 day; 2 = 2–5 days; 3 = 6–10 days; 4 = > 2 weeks) (#11)	PBL: 2.64 non-PBL: 1.78	0.991 0.441	0.011*
Teachers' general concept about PBL	In a PBL classroom, the teacher functions as a facilitator and therefore no content teaching is necessary. (#35)	PBL: 2.05 non-PBL: 2.50	0.987 1.196	0.040*
	PBL gives too much responsibility to students. (#36)	PBL: 2.32 non-PBL: 2.77	0.952 0.898	0.010*
	PBL is especially effective for students with low ability. (#37)	PBL: 3.48 non-PBL: 2.97	1.225 0.999	0.044*
Teachers' perceived competence in practicing PBL	I will be able to implement PBL successfully. (#39)	PBL: 4.86 non-PBL: 3.70	0.914 0.877	0.000**
	I do not feel competent to teach with a PBL approach. (#47)	PBL: 2.25 non-PBL: 4.00	1.045 1.313	0.000**
	I may not persist with PBL if my students struggle. (#41)	PBL: 2.96 non-PBL: 3.80	1.169 0.997	0.000**
	I feel confident that I can successfully assess students' learning progress in a PBL setting. (#43)	PBL: 4.67 non-PBL: 3.97	1.110 0.964	0.000**
	I am not sure that I can teach with PBL in ways that meet state and district standards. (#44)	PBL: 2.71 non-PBL: 3.80	1.326 0.925	0.000**
Perceived value of PBL to teachers	I am not interested in implementing PBL. (#50)	PBL: 1.88 non-PBL: 2.93	1.005 1.337	0.000**
	Teaching with PBL could be enjoyable. (#52)	PBL: 5.25 non-PBL: 4.60	0.726 1.037	0.000**
	Teaching well with PBL is important for my career. (#51)	PBL: 4.44 non-PBL: 3.67	1.243 1.124	0.001**
	Teaching with PBL is not important for my professional growth. (#53)	PBL: 2.21 non-PBL: 2.93	0.994 1.258	0.002**
	The skills that I gain by implementing PBL may be useful beyond the classroom. (#55)	PBL: 4.93 non-PBL: 4.57	0.981 0.858	0.019*
Perceived value of PBL to students	PBL does not help students to obtain a deeper understanding of the content knowledge than they do in a traditional classroom. (#26)	PBL: 2.09 non-PBL: 2.53	1.122 1.137	0.030*
	Using PBL causes students to have negative attitudes toward learning. (#32)	PBL: 2.06 non-PBL: 2.47	0.940 0.937	0.027*

Note: Except where noted, 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree; *Significant $p < .05$; **highly significant $p < .01$.

Table 3, cont'd. Significant differences between survey responses of teachers with and without PBL experiences.

Category	Survey item (item # indicated in parentheses)	*M*	*SD*	*P*
Perceived cost of implementing PBL	In PBL, students engage in issues relevant to their lives/communities. (#27)	PBL: 4.99 non-PBL: 4.60	0.847 0.621	0.007**
	PBL stimulates students' creativity. (#25)	PBL: 5.40; non-PBL: 5.00	0.707;	0.005**
	PBL enhances students' collaboration and communication skills. (#29)	PBL: 5.39 non-PBL: 4.93	0.743 0.704	0.002**
	PBL promotes students' critical thinking. (#33)	PBL: 5.39 non-PBL: 5.03	0.740 0.771	0.009**
	I am concerned that PBL can lead to students missing out on learning important basic concepts. (#28)	PBL: 2.90 non-PBL: 3.63	0.765 1.255 1.426	0.010*
	Preparing to implement PBL would require too much of my time. (#57)	PBL: 3.21 non-PBL: 4.30	1.254	0.000**
	Implementing PBL will make classroom management more difficult. (#59)	PBL: 2.75 non-PBL: 3.43	1.368 1.166	0.011*
	It will be too stressful for me to cover the mandated curriculum if I implement PBL. (#60)	PBL: 2.91 non-PBL: 3.77	1.305 1.207 1.104	0.000**
	I worry that PBL might have a negative impact on how my students score on the end-of-course tests. (#56)	PBL: 3.22 non-PBL: 3.97	1.436 1.426	0.016*
	I am concerned that implementing PBL might have a negative impact on my teaching evaluation. (#62)	PBL: 2.28 non-PBL: 2.80	1.136 1.157	0.019*
	I believe that the overall benefits from implementing PBL would outweigh the costs. (#61)	PBL: 4.60 non-PBL: 4.00	1.150 1.145	0.006**
Perceived support in implementing PBL	There are not many people at work who are willing to help me with implementing PBL. (#49)	PBL: 2.97 non-PBL: 3.70	1.258 1.442	0.010*

Note: Except where noted, 1 = Strongly disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree; *Significant $p < .05$; **highly significant $p < .01$.

competent, and questioned their ability to overcome issues such as students' struggling with this pedagogy and meeting rigid state requirements. Actually, close to one-third (30.0%) of teachers in the non-PBL group attributed not practicing PBL to their lack of perceived competence. These findings are consistent with the theoretical motivational models, expectancy-value theory and self-determination theory, which state that individuals are more motivated to engage in certain activities if they perceive themselves to be competent and likely to succeed in the endeavor (Eccles et al., 1983; Ryan & Deci, 2000b).

There were highly significant differences in the intrinsic and attainment values each group placed on PBL, although both PBL and non-PBL teachers recognized the usefulness of PBL to themselves. Indeed, the item that measured teachers' interest in implementing PBL revealed the largest differences between the two groups of teachers, with much higher interest expressed by teachers who had used PBL in their classrooms. Teachers with PBL and teachers without PBL experience both recognized the costs associated with implementing this pedagogy, although the non-PBL group teachers had significantly higher levels of anxiety and concerns about the effort required for this pedagogy.

Although both groups of teachers agreed that PBL would require more of teachers' time than traditional lecture-based

Table 4. Comparison of teachers with PBL experience (PBL teachers) and without PBL experience (non-PBL teachers), in the context of EVT and SDT.

Constructs & Item #s	**PBL Teachers**	**Non-PBL Teachers**
Expectancy for Success (EVT)/Competence (SDT) ***Items #39, #41, #43, #44, & #47***	Felt competent and expected success	Did not feel competent and worried about implementation; questioned ability to help students and meet state requirements
Competence: Preparation (SDT) ***Items #10 & #11***	Had more PD and more of it was formal	Had less preparation, more of it was informal, and gave "lack of preparation" as main reason for not using PBL
Intrinsic value (EVT) /Intrinsic motivation (SDT) ***Items #50 & #52***	Interested in implementing PBL for students and self	Low interest in implementing PBL, even though knew it was positive for students
Cost: Effort, time (EVT) ***Item #34 & #57***	Time required was worth it	Time required too demanding—not worth it
Cost: Anxiety (EVT) ***Items #56, #60, & #62***	Some anxiety about using PBL	Higher level of anxiety about using PBL
Relatedness: Support (SDT) ***Item #49***	Perceived support from administrators and peers	Perceived support from administrators but not peers

teaching, they did not agree in terms of whether they felt this time requirement was too demanding; teachers in the PBL group were more willing to invest their time in this instructional method. Actually, the "PBL requires too much of my time" question elicited the greatest difference between the two groups of teachers among all items in the "cost" category. This finding suggests that the PBL group teachers were aware that teaching with PBL required more time than the traditional teaching. However, they were willing to invest their time because they believed that the overall benefits from implementing PBL would outweigh the costs. This is what would be predicted using the EVT framework: that teachers for whom value outweighs the cost are more likely to choose PBL (Tollefson, 2000). These findings on PBL are consistent with studies that investigated individuals' motivation for other achievement-related behaviors, ranging from teachers implementing computer technologies in the classrooms to students' intention to stay in their STEM major (Perez, Cromley, & Kaplan, 2014; Peters & Daly, 2013; Wozney et al., 2006). In addition, teachers with no PBL experience were less likely to feel supported by peers than were teachers with PBL experience. However, there were no data collected during the current study that help us to understand this perception. It is possible that there was not a collaborative and supportive culture in the schools of the non-PBL teachers (Jurasaite-Harbison & Rex, 2010; Lam et al., 2010).

Factors that affect teachers' intention to implement PBL

In this PBL study, variations in teachers' PBL preparation were associated with differences in their intention to implement PBL. There were two kinds of variations: the type of preparation for teaching PBL (formal and/or informal) and the length of the professional development workshops. Examples of informal training included learning from peers or self-taught; and attending professional development workshops was an example of formal training (Richter, Kunter, Klusmann, Lüdtke, & Baumert, 2011). Not only did significantly more PBL group teachers have formal preparation, they also had a significantly higher *amount* of formal PBL professional development, compared with their non-PBL counterparts. Desimone (2009) asserts that it is not the *structure* of the activity but the *features* of the PD that are important. Professional development, regardless of its focus on PBL or some other pedagogy, should alter teachers' knowledge, beliefs, or practice.

Limitations

Our findings need to be viewed in light of several limitations. First, we are unable to rule out all potential alternative explanations for the differences found between the PBL teachers and the non-PBL teachers due to the research design. Second, our choice of outcomes and how we decided to measure them provides us with a limited picture of teachers' views of PBL. Our findings, as a result, might have differed if we had chosen to target different constructs. Third, the number of participants in this study was relatively small and the nature of their experiences with PBL may have varied greatly due to a wide range of factors that were not captured in this survey. Moreover, the majority of the respondents taught with PBL before, and nearly one-half of the respondents were from a school district that strongly promoted PBL. It is possible that recruiting a different teacher population may have yielded different results. The generalizability of our findings, therefore, may be limited to this population in the current study. Fourth, we analyzed teachers' responses that were self-reported, based on one point in time. We cannot, therefore, be certain that these responses would necessarily capture the same data with another administration of the survey. With these limitations in mind, we will now present our recommendations and conclusions.

Recommendations for Teacher Professional Development

Taken together, these findings lead us to consider what we might do to address the concerns of the teachers who are not currently teaching with PBL, as well as continuing to support those teachers who are currently teaching with PBL. We recommend that PBL teacher professional development be designed to explicitly address these concerns of teachers, perhaps by being led or co-led by teachers who currently implement PBL and who can share that the extra time and work was "worth it" in terms of the payoffs in student interest, engagement, critical thinking, and learning, and professional benefits for the teachers.

Informal learning is an important part of teachers' training and its success is highly dependent upon many factors, such as whether teachers share common values and beliefs, and a school culture that promotes trust and collaboration among teachers (Grosemans, Boon, Verclairen, Dochy, & Kyndt, 2015; Jurasaite-Harbison & Rex, 2010). Formal learning offers structured preparation with a specified curriculum, such as professional development workshops (Richter et al., 2011). In order to promote teachers using a PBL approach, PBL workshops need to emphasize improving teachers' pedagogical content knowledge of this innovative teaching method, which can be accomplished by having highly qualified facilitators who use strategies such as promoting PBL discourse, and establishing, modeling, and maintaining the study group process in a learning community (Donnelly, 2010; Walker et al., 2011; Zhang, Lundeberg, & Eberhardt, 2011). A formal professional learning experience can be a powerful inspiration for teachers to adopt (Emo, 2015) and sustain innovative pedagogies (Owston, 2007); insufficient professional preparation is one of the most frequently cited barriers for pedagogical change (Brownell & Tanner, 2012; Owston, 2007). Indeed, close to half (46.7%) of the non-PBL teachers cited "lack of professional training" as their reason for not practicing PBL.

The review by Walton (2014) recognized the importance of collective participation in professional development trainings. Collective participation means that a cohort of teachers from the same school or grade attend the professional development experience to facilitate "interaction and discourse, which can be a powerful form of teacher learning" (Desimone, 2009, p. 184) and pave the road for future collaboration. Therefore, one recommendation of this study is that schools encourage teachers to take PBL professional development workshops as teams with members who teach different subjects, followed by interdisciplinary collaboration among those teachers. There are two advantages for using this approach: (1) It meets the interdisciplinary nature of PBL, and (2) it provides interaction among teachers that facilitates a social-professional network in which teachers find the relatedness of practicing PBL in their classrooms (Emo, 2015). Ultimately, this could motivate teachers to implement PBL.

Another recommendation is that teachers could join a professional development network to find and share their experiences in developing assessments for PBL, a type of professional development that teachers in this study desired. It could be particularly helpful to develop effective summative assessments that not only evaluate students' learning, but also their readiness for high-stakes standardized tests. It would be a good practice for teachers to approach the issues of developing assessments through the lens of PBL, which offers teachers opportunities to communicate and collaborate with one another. Finally, we saw that the amount of support matters, especially that of peers. Changing to PBL instruction is an arduous endeavor and therefore school administrators who want to promote PBL, in addition to supplying tangible resources, need to provide a collaborative school environment and facilitate and/or support sharing and teamwork among teachers who are interested in PBL. Ultimately, the findings from this study could help educators to design effective

professional development for PBL, which in turn will equip more teachers to implement this innovative pedagogy and prepare more students for 21st-century futures.

Conclusions

There are a number of conclusions that can be drawn from this quantitative study. First, although teachers shared basic conceptions of PBL, the teachers who had taught with PBL before felt competent and expected success in implementing PBL. This was in contrast to the teachers who had never practiced PBL. Therefore, experience with PBL was an important factor in whether teachers felt competent with this pedagogy, and in their expectation for success in implementing it with their students.

Second, although all of the respondents recognized the value and costs associated with implementing PBL, the PBL group teachers had significantly higher levels of the perceived value of PBL across a wide range of aspects for students (e.g., enhanced students' collaboration and critical thinking, deeper student understanding) and for themselves (e.g., important for their career and professional growth, PBL skills useful beyond the classroom) and less concern about the costs of implementing PBL than did the non-PBL group teachers. These results suggest that experience with implementing PBL leads to valuing it more highly. This experience did not lower the perception of the costs of teaching with PBL; rather, using PBL led to teachers being less *focused* on the costs (e.g., time and effort) it took to carry out PBL in their classrooms. In contrast, the non-PBL teachers focused on a range of costs related to its implementation: a perceived lack of peer support to help them implement PBL, concerns about sufficiently teaching "basic content," anxiety and concerns about the required preparation time and workload, and worries about the effects of using PBL on end-of-course test performance of their students.

Third, the type of teachers' PBL preparation matters and formal professional development in PBL positively impacts implementation of this pedagogy. Teachers who used PBL reported having significantly more formal training than did their non-PBL counterparts. Similarly, close to half of the teachers who never practiced PBL before cited a lack of professional preparation as their reason for not using PBL, further emphasizing the impact of formal professional development on teachers' implementation of PBL, and harkening back to Hall and Hord's (2011) assertion that "Change cannot occur without professional learning" (p. 53).

Recommendations for Future Studies

We recommend a future study in which teachers take the survey developed for the current study before and after the PBL professional development. We also recommend that future studies incorporate a wider range of teachers with varying backgrounds, such as their experience of using PBL and their school's policy in terms of promoting PBL implementation. Although these data are still based on self-report, they will provide insight in terms of whether attending professional development is positively associated with teachers' perceptions of their competence, the value and cost they place on PBL, and their intention to implement this innovative pedagogy. Comparison of the pre- and postprofessional development data will also reveal effectiveness of the professional development workshops, evaluated by their impact on teachers' beliefs in various elements of PBL.

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