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SPECIAL ISSUE ON COMPETENCY ORIENTATION IN PROBLEM-BASED LEARNING

Engaged Learning: Impact of PBL and PjBL with Elementary and Middle Grade Students

Sharon Dole, Lisa Bloom, and Kristy K. Doss (Western Carolina University)

Abstract

This study used structured online interviews with teachers to examine the impact that inquiry-based teaching methods had on their students. The research question was the following: What are the effects on student learning and motivation as a result of teachers using problem-based and project-based learning? Interviews were conducted with 36 teachers, followed up by telephone interviews with four teachers. Participants had taken a hybrid course consisting of four weeks online followed by a one-week intensive field experience facilitating problem-based and project-based learning with children in grades 1–9. Student-related themes that resulted from the data analysis are grouped under the main categories of learning attitudes, learning behaviors, and learning preferences.

Keywords: problem-based learning, project-based learning, inquiry learning, learner-centered pedagogy

Introduction

The traditional paradigm of teaching in which teachers transmit prescribed knowledge and students memorize facts that are assessed on standardized tests is no longer adequate for today's world. Teaching methods must focus on providing students with a strength-based, more personalized education by cultivating their learning so that they can meet the demands of a rapidly changing world (Henshon, 2017). Many of the jobs that existed in the past 20 years will be obsolete in the future. For example, the U.S. Department of Labor (2015) reported that the fastest growing job from 2014–2024 in the United States will be wind turbine service technician, predicted to grow 108%. Fullan and Langworthy (2013) argued for pedagogical models that require deep learning to ensure that students leave school ready to face the challenges of the 21st century. They have identified deep learning skills as character education, citizenship, communication, critical thinking and problem solving, collaboration, and creativity and imagination (p. 3). Similarly, the Hewlitt Foundation (2013) outlined the elements of deeper learning as content mastery, critical thinking, problem solving, collaboration, effective communication, self-directed learning, and academic mindsets. Problem-based learning (PBL) and project-based learning (PjBL) show promise for nurturing deep learning skills in children and youth.

For the past 15 years, all three researchers of this study have been involved with a course in creative thinking and problem solving and its follow-up field experience in which teachers facilitate PBL and PjBL with children in grades 1–9. Over the years we have seen transformation in both teachers and children and wanted to document and analyze those changes. The change in teachers' pedagogy from teacher-centered to learner-centered as a result of the course and the field experience was discussed in a previous article (Dole, Bloom, & Kowalske, 2016). A second article focused on the importance of the field experience in connecting theory to practice (Dole, Bloom, & Kowalske Doss, 2016). The major purpose of this particular study was to determine the effects PBL and PjBL had on the learning and motivation of their own students when teachers continued to use these methods in their home schools.

Literature Review

The variety of models and practices of both PBL and PjBL pose a challenge for a literature review. For example, what is considered a real problem or project? Some models use "packaged"

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problems or projects and in other models students are given more autonomy in choosing problems or projects. Secondly, both PBL and PjBL can vary within and across schools. It can be teacher-initiated at the classroom level or a school-wide instructional approach such as High Tech High and the New Tech Network (see New Tech Network, 2015). A third challenge is that the acronym PBL is often used in the literature to describe both problem-based and project-based learning. There are similarities as well as differences in the two methodologies. PBL and PjBL are similar in that both models involve problems or projects that are integral to the curriculum; give rise to the generation of knowledge; deal with authentic, real-life problems or projects; engage the teacher as facilitator; and involve a significant amount of student autonomy (Gallagher & Gallagher, 2013; Thomas, 2000; Barrows, 2002; Walker & Leary, 2009). However, there are significant differences in the two learning models.

First introduced in medical school in 1958, PBL involves the attempt to solve an authentic, ill-structured problem (Barrows, 2002; Walker & Leary, 2009). While the majority of PBL studies have been in the field of medical education, the best results shown in the meta-analysis conducted by Walker and Leary (2009) were in the field of teacher education. Fewer studies on PBL have been conducted with young children than with middle school and high school students. Albeit limited, the research on PBL with elementary students has yielded positive results. A pilot study conducted by Drake and Long (2009) on fourth graders receiving PBL in science revealed that there was considerable growth in content knowledge and test scores four months after the teaching of the unit. In their study of using PBL with low-income middle school students, Gallagher and Gallagher (2013) found that more students revealed characteristics of advanced academic potential in a PBL environment.

Jerzembek and Murphy (2013) conducted a review of six problem-based studies with children ages 11–18 and found that, compared to traditional methods, PBL had the following effects on students:

(1) enhancement of student understanding (Azer, 2009);
(2) more highly organized student notebooks (Simons & Klein, 2007);
(3) higher intrinsic goal orientation and task value; higher levels of critical thinking, metacognitive self-regulation, effort regulation, and peer learning (Sungur & Tekkaya, 2006);
(4) support of student interest, motivation in independent work, increase in self-efficacy, and improvement in the learning environment (Cerezo, 2004);
(5) increase of intrinsic motivation and follow-up performance (Zumbach, Kumpf, & Koch, 2004); and
(6) increase in self-confidence in collaborative online work and development of social and leadership skills; and increase in competence in using online collaborative tools (Wang, Poole, Harris, & Wangemann, 2010).

Similar to PBL, the research on PjBL shows that it can have positive effects on student learning and motivation. Thomas (2000) defined PjBL simply as a model that organizes knowledge around projects (p. 1). Unlike PBL that has its origins in medical school, PjBL has its origins in the progressive movement that emphasized student-centered and experiential approaches to learning (Peterson, 2012). Thomas's (2000) comprehensive review of student outcomes of PjBL provided evidence that it can be more effective than traditional models of teaching and learning.

There are research studies to show that students in PjBL classes and schools performed better on assessments of content knowledge (Hernandez-Ramos & De La Paz, 2009; New Tech Network, 2015; Tretten & Zachariou, 1995; Vega, 2012). In addition, students were more motivated and engaged and demonstrated improved critical thinking and problem-solving skills when participating in PjBL (New Tech Network, 2015; Tretten & Zachariou, 1995). Finally, PjBL has helped students develop collaborative skills (Barron & Darling-Hammond, 2008; ChanLin, 2008; Horan, Lavaroni, & Beldon, 1996; New Tech Network, 2015).

On the opposite side of the argument regarding the amount of instructional guidance needed for learners, particularly novice learners, are the cognitive load theorists. Cognitive load theory, developed by Sweller in 1988, relates to the amount of information that working memory can hold at a given time. Since working memory has a limited capacity, an instructional strategy should avoid overloading it by including activities that do not relate directly to the learning activity (Sweller, 1988). Cognitive load theorists suggest that direct instruction is needed for students to learn the concepts and procedures of a particular discipline, and students should not be left to discover these on their own (Kirschner, Sweller, & Clark, 2006; Klahr & Nigam, 2004; Mayer, 2004; Sweller, Kirschner, & Clark, 2007). Direct instructional guidance occurs when information is provided "that fully explains the concepts and procedures that students are required to learn as well as learning strategy support that is compatible with human cognitive architecture" (Kirschner et al., p. 75).

While there is research to support both sides of the argument, the research on direct instruction has focused largely on science and medical education in randomized, controlled experiments, looking primarily at the acquisition of content knowledge. Whereas the research on PBL and PjBL indicates that, in addition to content knowledge, these instructional models can have the following positive benefits for students: (1) both result in real-world knowledge for students, (2)

both increase student motivation and engagement, (3) both increase critical thinking skills and problem solving, and (4) both increase collaboration skills (Capon & Kuhn, 2004; Chang & Barufaldi, 1999; Hmelo, 1994; Hmelo-Silver, 2004; Gallagher & Gallagher, 2013; Gallagher & Stepien, 1996; Gallagher, Stepien, & Rosenthal, 1992; Vernon & Blake, 1993). The present study adds to our knowledge base of these additional benefits of PBL and PjBL.

Rocket to Creativity

Rocket to Creativity (RTC) is the name given by children to a one-week summer day camp held on the campus of a regional state university in the southeast. The camp is the field experience for teachers in the Academically or Intellectually Gifted (AIG) licensure program at the university. The online AIG licensure program consists of four courses plus the field experience, and, at completion, teachers are eligible for the AIG license, which can be added to any teaching license. Although the AIG license is required by the state to teach children identified as gifted in pull-out gifted programs, gifted children spend most of their time in general education classrooms so it benefits classroom teachers to obtain the AIG license. In addition, the instructional methods the teachers learn in the program are valuable for teaching all children, not just those identified as gifted. The first course in the AIG program focuses on the characteristics of gifted children, including underrepresented groups such as culturally and linguistically diverse, economically disadvantaged, twice exceptional (gifted with a disability), and creatively gifted children. The remaining three courses are methods courses focusing on instructional methods and models, differentiating instruction, and promoting creativity and facilitating PBL and PjBL.

Teachers in the AIG program take the online course, Creative Thinking and Problem Solving, in which they learn about promoting creativity and facilitating PBL and PjBL in the four weeks preceding RTC. Children are accepted for RTC on a first come, first served basis, and online registration begins in the spring. A child does not need to be identified as gifted or be in a school-based gifted program to be accepted for RTC, and scholarships are available. In the 15 years that RTC has been offered, we have found that interest is the strongest motivating factor for children to initially attend the program. A large number of children have returned year after year and have attended all of the years of their eligibility. Approximately 80 children participate each summer, largely from the surrounding rural area.

RTC serves children in grades 1–9 who work in groups of 4–5 in their areas of interest derived from interest inventories that the children take at the time of registration. A team of two teachers from the class facilitates each group. During the week of RTC students brainstorm real problems or projects that they can complete that week; conduct research in the computer lab; consult experts; use authentic tools of professionals; and then present their projects or problem solving process before a real audience. Getting to choose what problem to solve or what project to complete has made a significant difference in the enthusiasm and motivation of the students, as well as in the quality of the work they have produced. A sample of the PBL problems that have been tackled in the past 15 years include the following:

- Did dragons exist and, if not, why are they such a prevalent icon across cultures? The highlight of the week for this PBL group occurred when they had a conference call with a paleontologist who told them never to stop believing in dragons.
- How can hemlocks be saved from the wooly adelgid? The group studying the wooly adelgid, a fungus that is slowly destroying the hemlocks in western North Carolina, impressed the groundskeepers at the university with their vast knowledge of the disease.

Perhaps the most challenging PjBL project has been the construction of a hovercraft. This group of inventors made a 4' by 4' hovercraft from materials like plywood and leaf blowers that actually lifted 6 inches off the ground and moved around the room. No one was more amazed by their success than the group of young inventors! Additional PjBL projects have included a Red Bull sculpture made entirely from recycled materials; a Viking reenactment in which the children wrote the script and designed and made the costumes and set; folk tales the children wrote and animated; and a spy robot with a hidden camera.

With the assistance of the teachers, the children develop rubrics during the week for the self-assessment that occurs at the end of RTC. On Friday, the last day, parents and friends are invited to a celebration in which the children share their problem solving processes and projects. The learning and motivation of the children participating in RTC was documented in another article (Bloom, Dole, & Kowalske, 2016). We found similar outcomes in our research and observations of children attending RTC as those found in the literature on PBL and PjBL (Capon & Kuhn, 2004; Chang & Barufaldi, 1999; Hmelo, 1994; Hmelo-Silver, 2004; Gallagher & Gallagher, 2013; Gallagher & Stepien, 1996; Gallagher, Stepien, & Rosenthal, 1992; Vernon & Blake, 1993). These outcomes include authentic learning, creativity, autonomy, critical thinking and problem-solving, motivation and engagement, and collaboration (Dole & Bloom, 2011; Bloom, Dole, & Kowalske, 2016). In the current study, we were interested in seeing if comparable effects could be found on their own students when teachers continued to use PBL and PjBL after completing the course and field experience.

Methods

We conducted this study to understand how RTC impacted the completers of the program, and subsequently, their students. We sought to answer the following research question: What are the effects on student learning and motivation as a result of teachers using inquiry-based methods in their own classrooms, specifically problem-based and project-based learning? We conducted a case study, a traditional method in gifted education (Buchanan & Feldhusen, 1991; Merriam, 2009), and we used an exploratory, single case design. Exploratory case study design, according to Yin (2003), is appropriate when studying a practice or intervention, in our case PBL and PjBL, that does not have clear predictable or set outcomes. Further, a single case design focuses on a single unit with embedded subunits. From our unit of study, the teachers participating in RTC, we collected and considered data from within subunits, the teachers' own classrooms. The exploratory single case design allowed us to examine the outcomes of PBL/PjBL from multiple subunits.

Qualitative case study design is a useful model in the education of teachers for informing policy, for evaluating teachers and educational programs, and for researching educational innovations (Eisner, 1991; Merriam, 2009; Stake, 2005). At the foundation of this approach is the search for meaning and understanding.

Data Collection

We gathered data in three ways: structured interviews using Qualtrics, an online survey tool, with 36 teachers who had completed the course and the field experience; in-depth follow-up phone interviews with four of the teachers; and observations of teachers during the week of field experience. The interviews were comprised of 29 open-ended and demographic questions. The questions investigating PBL and PjBL covered the following points: (1) a description of how PBL and/or PjBL were implemented in their teaching, (2) if they had used these methods prior to RTC, (3) how the field experience influenced their teaching, (4) how the methods have benefitted their students, (5) how learning these methods influenced their pedagogy, (6) what obstacles they faced when implementing these methods, (7) how they overcame these obstacles, (8) if they would recommend these methods to others, and (9) if they have provided professional development on these methods. In addition, teacher participants were also given an opportunity to provide further comments.

For the follow-up interviews with teacher participants, a graduate assistant (GA) conducted in-depth telephone interviews with four participants, taking detailed notes. The GA asked for further descriptions of how they used PBL and/or PjBL; how they assessed these methods; if they had combined these methods with other teaching/learning models they had learned in their coursework; how students had responded to these methods; examples of how the field experience influenced their teaching; examples of how the methods promoted deeper learning in the students; if testing requirements from the state influenced their decisions to implement the methods; and for additional comments.

Participants

We collected email addresses of 164 participants from the last 15 years of RTC and emailed them the structured online interviews two times. Fifty participants started the online interviews. Five responded that they did not use the methods, and the survey ended for them. Nine participants did not provide specific details about how they implemented the techniques. Thirty-six of the participants completed all parts of the interviews. We based our findings on these completed interviews. Of the 36, four expressed interest in participating in a subsequent interview. Of the 36 participants, thirty-five were AIG classroom teachers and one was an AIG coordinator. Observations of teachers and field notes during the field experience have been documented for the 15 years that RTC has been held.

Data Analysis

Before beginning the analysis, each researcher read through the interview data numerous times. Using open-coding (Merriam, 2009), we recorded our initial thoughts. After this, we began to develop potential themes (Patton, 2002). The three of us examined data at this point in order to establish inter-rater reliability (Wetherall, Taylor, & Yates, 2001). We agreed on themes that emerged from the participants' comments such as increased autonomy (Seidman, 2006). Next, we crafted questions for the follow-up interviews in order to understand more about specific topics. Notes from follow-up interviews were sorted and coded according to the themes independently reached by each researcher. We met to check for reliability and to reconcile differences on two disagreements within our coding. We correlated the results with observations and field notes (Farmer, Robinson, & Elliott, 2006) in order to establish credibility. In addition, all three of us have co-taught the course or coordinated the field experiences, providing us insider status (Wetherall, Taylor, & Yates, 2001). An advantage of having insider status is that we had interactions with the teachers on a daily basis during RTC through observing their teaching and through debriefing and facilitating their reflections at the beginning and end of each day of RTC. Also, we kept daily field notes of our observations and met at the end of the week to compare notes. Maintaining an objective stance was a key priority as we conducted research. Understanding our roles as both researchers and coordinators of the program helped us to recognize possible

biases and potentially build stronger themes (Unluer, 2012). We paid particular attention to the questions we crafted to ensure data received addressed all perspectives, both positive and negative. The information from the surveys was anonymous, allowing participants to disclose details without being identified, unless they volunteered for subsequent interviews.

Results

The student-related themes that resulted from the data analysis can be grouped under the main categories of learning attitudes, learning behaviors, and learning preferences (see Table 1). The themes involving learning attitudes were a positive attitude toward learning and improved academic mindset. The themes under learning behaviors included increased motivation and engagement, creativity, perseverance, and divergent thinking. The themes involving learning preferences included autonomy and collaboration.

Table 1. Impact on students.

Impact	Participants
Learning Attitudes	
Positive Attitude Toward Learning	*N* = 11
Improved Academic Mindset	*N* = 8
Learning Behaviors	
Motivation and Engagement	*N* = 21
Creativity	*N* = 11
Perseverance	*N* = 8
Divergent Thinking	*N* = 9
Learning Preferences	
Autonomy	*N* = 23
Collaboration	*N* = 17

Learning Attitudes

Positive attitude toward learning. In the follow-up interviews, teachers described how they implemented PBL and PjBL into their classes. They discussed how students spent time in and out of class discussing their topics with peers and with parents. Students approached topics with enthusiasm and researched on their own time. Many noted how their students' engagement and enthusiasm resulted in situations where students did not realize how hard they were working or how much they were learning. One teacher shared, "They don't know how much they are learning and how much their thinking is changing until it is over." By researching on their own time, students gained critical insights about the ideas they were exploring. They made connections with the real world. One participant said,

> My students are invested in their learning with their projects. They have a lot of choice (i.e., in which stocks they choose) and get the opportunity to explore the skill we're working on in a variety of ways (and most of the time they don't even realize they are working!).

Because PBL and PjBL allow teachers to create problems and projects that incorporate concepts and skills from multiple subject areas, students made connections and pursued them outside the boundaries of class. One participant said, "It has increased student interest and encouraged independence as learners. It has enabled me to integrate many subject areas, skills, and concepts throughout the projects."

Improved academic mindset. After implementing PBL or PjBL into their own classrooms, teachers described how their current students worked toward mastery learning instead of simple task completion. They described how their students became immersed in their learning, often asking to spend extra time on assignments. One explained,

> They seemed to love it. No one ever complained! Amazing! Groups almost always exceeded the number of work sessions I anticipated because they chose to work together more often and chose to present their individual work to the group for review/final suggestions before submitting checkpoint work to me. My only requirement was that their out-of-class work sessions be held in my presence, and they'd arrange among themselves to work during lunch or after school/before practice as suited their commitments.

In addition to describing the intense focus students demonstrated while completing PBL/PjBL problem solving or projects, another participant described how the growth in academic mindset encouraged the development of 21st century learners. Teachers emphasized how these skills surfaced throughout the experiences involved in the PBL/PjBL process without the instructor directly focusing on them. The students' learning became a natural outcome of the experience. One participant shared,

> They have benefited from the depth of learning, choices, problem solving abilities, engagement, motivation, character, leadership skills, life skills. PBL has truly taught them to be 21st century learners. It encompasses all of the skills, especially when you include service learning as part of the PBL.

The teachers discussed the importance of their students being able to ask vital questions, defend arguments, and debate opinions. The teachers used topics that provided depth

and layers for students to explore. As students researched the topics, the teachers explained how students engaged in real-world discussions. One participant shared,

> Students do not take classes in elementary, middle, or high school that teach them HOW to ask good questions; they have to learn how to do this on their own, somehow. Unfortunately, most educators do NOT model good questioning skills and so students never learn this life skill. Some of the greatest things about PBL are that it forces students to think of and develop engaging questions, to muddle through a series of questions and answers, and continue to use critical thinking skills throughout the entire learning experience to analyze, synthesize, and evaluate their findings and outcomes. Students learn to challenge and debate their peers, write about and communicate their findings, and evaluate outcomes in meaningful ways. All of these skills are life skills students will use for their higher education and beyond.

Learning Behaviors

Motivation and engagement. Participants noted that student engagement is high while using PBL/PjBL in the classroom. One teacher shared, "My students are highly engaged thinkers now. They feel greater ownership of the projects that they are involved in, and exert more effort. I have seen the level of motivation increase as I have created a more autonomous classroom." The students expressed eagerness to continue to investigate their projects. One participant wrote,

> I have been amazed to find that my students beg to come to my room during their lunch periods to work on these projects because they want to do their very best. During mock trials for instance, I have seen students come to my room every day for a month to make sure they are prepared for trial.

The authenticity of the investigations established a strong commitment for the students. A third teacher described the engagement and motivation of the students involved in a community service project:

> It increased their engagement and motivation this semester. It gave them a meaningful way to connect the content to community service and make a difference. The students who gave talks at the elementary school were nervous beforehand, but they did a marvelous job and were so proud of themselves. The experience meant a lot to them.

Creativity. Teachers noted how designing interesting problems spurred their students' creativity. One teacher shared, "I believe that presenting loosely defined problems to students/groups to solve fosters creativity and develops cognitive questioning skills. Problem-based learning is challenging and engaging for students." One of the teachers talked about the importance of the field experience in increasing creativity, "My field experience gave me confidence to use PBL in my classrooms. Overall, I had a great experience with the field experience. I did not realize how much PBL boosted creativity in students until I participated in the field experience." The growth in creativity while engaged in PBL and PjBL is corroborated in a separate research project conducted by the authors in which they interviewed and observed children during the week of RTC on the topic of creativity (Bloom, Dole, & Kowalske, 2016).

Perseverance. In order to thoroughly investigate challenging topics, the teachers described their students investing time and energy in order to develop a deep understanding. One participant said that students had an "eagerness to use and compare multiple sources to acquire requisite background knowledge." Allowing students the opportunity to research topics through an open-ended approach gave students the space to work through trial and error. One participant shared that students became adept at "accepting the relative messiness of the problem, accepting the need to be content in finding convergences as signposts that they were on a *workable* path toward some unseen but likely satisfactory answer." Being able to move through the process of trial and error is an important skill that is necessary throughout a lifetime. One teacher described how her students acquired this. She said, "They have learned the value of patience and perseverance. PBL helps students to become life-long learners and teaches them necessary life skills that are transferrable to new situations."

Divergent thinking. One teacher described her students having "openness to hearing alternate interpretations/ideas within their groups at every stage of work." In addition, others described how their students used many thought processes to generate ideas and solutions. One said,

> My students have developed research skills. They have learned the interconnectedness of math, reading, social studies, and science. They have learned that in life there often isn't *one right answer.* They have learned to develop theories and how to support those theories with detailed evidence. They have learned to ask meaningful questions. They have learned to collaborate. They have learned to be persistent. They have learned to develop research-based solutions to problems. They are developing life skills that are transferable to new situations.

Learning Preferences

Autonomy. Teachers described how student choice and ownership over the experience became a contributing factor to its success. One teacher said, "They like the fact that they can make many choices in these projects, it gives them autonomy and range to demonstrate their curiosity and creativity." Allowing students to share ownership over their learning experiences gave the students an opportunity to establish ownership over the classroom experiences. One participant explained, "I have seen the level of motivation increase as I have created a more autonomous classroom." Another shared the connection between autonomy and intrinsic motivation. She said,

> Each year, I find myself striving to create units/lessons that are relevant, challenging, and engaging for my students. Problem-based learning successfully addresses each of these goals. In addition, I seek to increase the level of independence required of my students each year. They always perform to the level of my expectations so the more freedom I give the more intrinsically motivated they seem to be.

One teacher described the importance of students having ownership over the PBL experiences and the impact it has on the students. She wrote,

> Students take ownership, have developed their own rubrics after attaining a certain comfort level, love choice, and are engaged and motivated to complete the project. They have enjoyed and wanted to discuss their projects with others in front of the class, which helps their public speaking and self-esteem.

The teachers described how the various techniques contributed to autonomy. One participant discussed the importance of giving students ownership of assessing their final products. She shared,

> I use rubrics; most of the time the students are involved in designing the rubrics. I find that students are not only tougher in designing rubrics, they are also stricter graders! When I ask students to evaluate a project (the identity of the student author/writer/artist is not given) students make minute observations about the high and the low notes of a peer's project. Students are generally able to back up their analyses and evaluations by pointing out the flaws and weaknesses, student's apparent level of effort, and the brilliance and creativity!

Collaboration. Teachers described how students developed skills as both collaborators and leaders. PBL/PjBL brings forth the opportunity for authentic communication with a shared goal. One teacher described how students embraced this opportunity. She shared, "Students felt a sense of community. Teaching, talking, and reflecting on group dynamics and skills brought the classroom together as a team." Another participant described how the PBL experience allowed students to collaborate in real-world ways, promoting readiness for what they will encounter in the future. She said,

> PBL IS the future! When we think of 21st Century skills, helping our students becoming "career and college ready"—that is what PBL is all about. Working in teams, solving a problem, coming up with strategies, and then self-assessing are all ways we prepare our students for real-world performance and contributions.

Participants noted the impact on developing connections with others and the community. One said, "Without PBL my students would have never honored WWII veterans, talked with them, become friends with them, or understood the importance of sacrifice in a REAL setting with real people. It changes lives."

Discussion

The purpose of our study was to determine the effects of PBL and PjBL on the students of teachers who had completed RTC and brought PBL and PjBL back to their classrooms. While we did not have access to data in terms of test scores, the qualitative data we gathered documented important benefits of PBL and PjBL in terms of learners' attitudes and behaviors, as well as student learning preferences. In terms of learner attitudes, our research corroborates that of others suggesting that PBL and PjBL promote higher levels of student motivation and engagement among all types of learners (Belland, Ertmer, & Simons, 2006; Gallagher & Gallagher 2013; Jones et al., 2013; Zumbach, Kumpf, & Koch, 2004). Deci and Ryan (2008) identified autonomy, competence, and relatedness as keys to motivation.

Our data indicated strong student preference for both the autonomy and collaboration inherent in PBL and PjBL. With regard to practices that support autonomy, PBL and PjBL provide opportunities for student choice, self-regulated learning, and independent learning in every stage of the learning process. As the teachers in our study implemented PBL and PjBL in their own classrooms, they often felt the need to be more directive with regard to the problems and projects tackled in their classrooms but allowed for student choice and self-directed learning in many other ways, including letting students develop rubrics and timelines, allowing for choice in the learning process, and subsequently presenting problem/project outcomes.

With regard to relatedness, our data also indicated a student preference for collaboration. Having the opportunity to talk with and socialize with their peers and feeling a sense of community are important aspects of school for many students. PBL and PjBL allow teachers to take advantage of the power of social interaction enhanced by the pursuit of a common goal. With a sense that they are valued and respected members of a learning community, students are ready to learn, more likely to enjoy school, and less likely to engage in risky or inappropriate behavior (Centers for Disease Control and Prevention, 2009; Levine, 2003; Ozer, 2005, Stewart, 2003; Watson & Battistich, 2006).

A sense of competence as described by Deci and Ryan (2008), the third leg of self-determination theory, is enhanced when students have "aha" moments, the moments of deeper learning, and pride in a problem solved or project completed. The perseverance, opportunities for creative and divergent thinking, autonomy, and collaboration afforded by PBL and PjBL can prepare students for the challenges of the 21st Century.

Limitations and Future Research

One of the limitations of the research is that we did not conduct observations of students in classrooms in schools ourselves. Instead, we relied on the teachers' observations of their students in their own classrooms. However, teachers reported similar favorable outcomes among their own students in their own classrooms as those that we had observed among the students enrolled in RTC.

Another limitation of our study lies in the fact that we did not collect quantitative data with regard to student performance. Though many of the benefits of PBL/PjBL are difficult to quantify, in this age of accountability and high stakes assessment, future research with school age children, especially those in younger grades, should consider including quantitative data on student learning outcomes. Furthermore, the absence of a comparison group, although it was not our objective, did not allow us to compare direct teaching methods with PBL and PjBL. Despite these limitations, this study supports the findings of earlier research of the positive effects of PBL and PjBL on the learning and motivation of students.

Research is needed on the effects of PBL and PjBL on diverse groups of students, including culturally and linguistically diverse students, economically disadvantaged students, and students with special needs. While our study did not include demographic data on students, future studies should consider including it in order to get a better understanding of the effects of PBL/PjBL on various groups of students. The authors are currently conducting a study with teachers who recently completed the AIG program who teach in a school system with a high percentage of culturally and linguistically diverse as well as economically disadvantaged students. Demographic data is being collected in this study that should prove to be a valuable component of this research project.

Recent scholars have called for a new paradigm in education, one that emphasizes life skills that are important for success in the 21st century (Henshon, 2016; Ritchhart, 2015; Robinson & Aronica, 2015; Wagner, 2012, 2014; Wagner & Dintersmith, 2015; Zhao, 2012; Zhao et al., 2016). This new paradigm values and cultivates creativity and innovation, entrepreneurship, autonomy, motivation, collaboration and social skills, critical thinking, and problem solving. Our study adds to the research base that suggests problem-based and project-based learning are valuable teaching methods for learning these 21st century skills, behaviors, and attitudes.

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