Project-Based Learning and Teacher Self Efficacy

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Public K-12 educational institutions are being challenged to prepare students to be college and career ready after high school. In order for public K-12 institutions in the 21st century to appropriately prepare students for colleges and careers after high school, it is essential to understand how students learn and what cognitive learning concepts and instructional strategies yield targeted learning outcomes. Project Based Learning (PBL) is an instructional approach that incorporates an array of cognitive learning concepts and instructional strategies that emphasize 21st century skills. It is essential to identify the various and individual components of this instructional approach and how each component impacts student achievement. Additionally, due to the numerous and various combinations of instructional strategies that are needed to implement this instructional approach with fidelity, teacher self-efficacy of PBL is an important concept that needs explored in order to assess the extent of the implementation of PBL. An analysis of the components, successes, and implications of PBL along with the components and importance of teacher self-efficacy will be outlined in the subsequent sections of this article. In order to fully understand the conceptual framework(s) of PBL, the components, impacts, and effects of Project Based Learning (PBL) as well as teacher self-efficacy need to be explored.

21st Century Skills

Public K-12 educational institutions in the 21st century emphasize the importance of communication, collaborative, and interpersonal skills. These 21st century skills are a product of students and teachers implementing PBL. Possession of these skills is essential for students to be successful in college and careers beyond high school to become productive, contributing, and global citizens. In a review of the literature on 21st century skills, Dibenedetto and Meyers (2016) described a conceptual framework for 21st century skills. The framework contained nine categories that were identified as follows: learning skills, life skills, career skills, social skills, knowledge competencies, incidental learning skills, dispositions, experiences, and interdisciplinary topics (Dibenedetto & Meyers, 2016). These construct categories establish a foundation for applying 21st century skills in various contexts. DiCicco (2016) conducted a study at a high school in Pennsylvania that undertook a reform initiative to integrate teaching about the world into its curricular offerings. DiCicco indicated that test based accountability and alignment to standards can impede efforts to broaden the curriculum in the interest of knowledgeable, responsible, and critically minded global citizens. Reinforcing DiCicco's claim that test based accountability and alignment to standards can impede broadening the curriculum, Markham (2012) indicated that teaching to the test makes the PBL approach difficult or impossible. When implementing PBL in the 21st century accountability policy arena, teachers need to be creative and adapt their PBL lessons to meet federal, state, and local standards.

Project Based Learning (PBL)

Due to the various and ambiguous descriptions of Project Based Learning (PBL), it is critical to establish a working definition of this instructional approach. Markham (2012) described PBL as "an inquiry based process designed around important questions or problems that need to be answered or solved" (p.13). The term *project* can be interpreted in various ways and to various extents. Given Markham's description of PBL as an inquiry-based process used to solve a problem, the *project* or the means of solving the problem can lead to an end result or product. Various projects can require different approaches and tasks to complete the end product or solve the problem. Table 1 identifies various authors and researchers along with their description(s) of PBL. As is evident from these descriptions, PBL can be interpreted in various ways and forms. These various descriptions of PBL create a challenge for researchers and practitioners to delineate a working and functional definition of PBL.

Table 1

Components of PBL by Author

Bell (2010) Student driven, teacher facilitated approach to learning
Kovalyova, Soboleva, KerimKulov (2016) Students explore real world problems and challenges simultaneously developing cross curriculum skills while working in small collaborative groups and individually
Galvan & Corondao (2014) An instructional strategy in which students work in collaborative groups over a period of time to create a concrete and substantial product
Catapano & Gray (2015) Child directed, inquiry based learning
Buck Institute (2016) "A teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an engaging and complex question, problem, or challenge" (Buck Institute Website, 2016)
Mills (2009) Through the completion of authentic tasks, students develop an end product
De Oliveira, Fischer, Parisoto (2015) Didactic method that is known to increase students engagement and foster skills
Tseng, Chang, Lo, Chan (2013) Approach that focuses on organizing self learning in an empirical project through practical activities, interactive discussions, and independent or team operation.

Buck Institute Components of PBL

For the purpose of this article, the Buck Institute (2016) description of PBL will be utilized. Based on the Buck Institute, there are eight components of PBL. These eight components are *key knowledge, understanding, and success skills*, *creating a challenging problem or question*, *sustained inquiry, authenticity, student voice and choice, reflection, critique and revision, and creating a public product* (Buck Institute, 2016). These characteristics provide an essential framework and working description for understanding the intricacies of PBL.

The aforementioned eight components of PBL provide an outline and working description of the instructional approach. Many of these components are cited and indicated in the literature to an extent. Although a specific study was not conducted, Moylan (2008) indicated that PBL "engages the students allowing them to learn in all six levels of "Blooms Taxonomy" (1956), which are (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation" (p.288). These cognitive learning concepts are the essential foundations of cognition and student engagement when implementing effective instructional strategies in the education profession. The subsequent sections outline the essential components of PBL. In addition to the aforementioned Buck Institute (2016) description of PBL, I have included Markham's (2012) descriptions and my own personal interpretation of the essential components of the PBL instructional approach.

Challenging problem or question. The PBL process begins with an essential or substantial question based on a real world problem. The question(s) sets the stage for the collaboration and becomes the driving force behind the inquiry. Markham (2012) indicated "in order to stimulate critical analysis and problem solving, the questions must be open-ended and the problems must have more than one solution"(p.13). These questions and problems must be open ended to promote discussion, collaboration, and critical thinking among group members throughout the inquiry process. Markham indicated "throughout the process, students are compelled to acquire core knowledge and other information necessary to answer the questions or solve the problems" (p.13). Given that certain investigations can be lengthy in nature, the PBL inquiry process can be time consuming and require the use of numerous resources.

Sustained inquiry. The core component of PBL is the inquiry approach to learning. Avsec and Kocijancic (2016) described an inquiry-based approach as using meaningful tasks, cases, projects, and research to situate learning. Additionally, Ji-Wei Wu, Tseng, and Gwo-Jen (2015) indicated that inquiry based learning (IBL) is an effective approach for promoting active learning. Active learning is a key component of effective teaching. Teachers and school leaders need to create environments of active learning, which in turn can

positively impact student achievement. Maxwell, Lambeth, and Cox (2015) indicated "IBL is seen as a system of learning that supports the development of student's problem solving and critical thinking skills, which is important for them in everyday activities" (p.3). Problem solving and critical thinking skills are considered 21st century skills, thus reinforcing the notion that PBL emphasizes 21st century skills. Markham (2012) indicated that, "a learner centered, inquiry based process results in better retention, more in depth knowledge, and expanded curiosity" (p.13). Due to the in depth thought process, critical thinking, and problem solving of an inquiry based activity, it can lead to deeper and lasting learning of a topic or concept.

Authentic learning. Authentic learning places emphasis on applied and real life experiences and situations. Susiyawati, Ibrahim, Atweh, and Rahayu (2015) conducted a study with 25 bachelor degree students in an authentic task. The results suggested that the authentic task had positive impact on student's performance. One of the aspects of PBL is the emphasis that is placed on assessing the end product based on the rubric performance criteria in a specific context. Given that students' prior knowledge of real life experiences differ by individual and are contextually based, the impact of authentic learning on student achievement will be different in each situation.

Student choice and voice. A key component of PBL is student choice and voice of a real life problem or question that is relevant and applicable to their daily lives. Student choice and voice are components of differentiated instructional strategies. Tomlinson (2004) described differentiation as "what a student learns, how he/she learns it, and how the student demonstrates what he/she has learned is a match for that student's readiness level, interests, and preferred mode of learning" (p.188). Differentiation can be interpreted in many ways and in many different contexts. Many of the components of PBL are based on differentiated instructional strategies. The concepts of differentiated instructional strategies in relation to PBL are comparable in terms of choice of what they learn, how they learn it, and how they demonstrate what they have learned. Effective teachers base their instruction on student interest and student choice, however in the current accountability movement, there are certain non negotiable(s) of what a student is required to learn versus what a student wants to learn. Lane et al. (2015) conducted a study focused on two instructional choices with two students, one boy and one girl, who needed more intensive supports in the classroom. Lane et al. found a functional relation between choice conditions and increases in academic engaged time and decreases in disruptive behavior for one student, but not the other. When implementing a PBL activity, teachers need to be mindful of the various forms of student engagement and individual contributions to the group then adjust the PBL lesson when necessary.

Problem solving learning. Problem based learning is an inquiry-based approach used for students to investigate an issue that is relevant to their lives. Agbeh (2014) described problem based learning (PBL) as an instructional approach that is based on constructivism theory of learning where students work in groups to find a solution to an ill structured or complex problem. In the 21st century accountability policy arena, this approach can be a time consuming process and create obstacles for implementing PBL with fidelity. However, when planned appropriately and aligned with standards, PBL can yield positive results. Agbeh conducted a study with twenty students in a Midwest University Hospitality class and found that PBL had a positive impact on problem solving skills and an improvement in attitudes about PBL. When students problem solve they are forced to think outside the box, utilize critical thinking skills, and create a solution that is conducive to that specific context or problem. Yu, Fan, Lin (2015) conducted a study that involved 103 eighth grade students over a 14 week period that involved watching detective films, constructing a context simulation (or context based problem activity), and introducing a project design to enable students to construct a complete problem solving process. The results indicated that context simulation (or context based problem) activities are beneficial for cultivating student's abilities to establish and analyze questions and create solutions (Yu et al., 2015). If time is a concern, the teacher can create the conditions in which students can find solutions to a problem based on certain aspects of the curriculum.

Cooperative learning. Given that PBL is a collaborative process, it is essential to understand the components and impacts of cooperative learning. Cooperative learning is designed to involve all members of a group. Within each group, each member should be assigned a specific task, rather than all group members engaged in the same task. Once each member is assigned a specific task, the *cooperative* aspect of the PBL process becomes the focus. When implementing PBL, Markham (2012) indicated that students are expected to master key "soft skills" such as communication and collaboration. Genc (2016)

indicated that when a cooperative learning task is assigned, the tasks and responsibilities of the members of the group have to be well defined and delimited. Genc conducted a cooperative learning study with 135 sixth grade students and found that students in the experimental group have meaningfully increased student achievement in comparison to the control group. Engaging in cooperative learning tasks, students are provided an opportunity to learn and enhance their interpersonal and communication skills. Interpersonal and communication skills can be considered 21st century skills, which are essential aspects of implementing PBL. Cooperative learning activities yield an emphasis on 21st century skills, thus essentially reinforcing key concepts and components of PBL.

Feedback. Throughout the PBL process, teachers and students should be constantly communicating. Feedback loops and transparency in communication should be established and maintained throughout the inquiry process. Teachers should be providing feedback to students and students should be providing feedback to the teacher as to the progress and next steps of the project. Formative feedback throughout the PBL process is essential to the success of the project. Ion, Barrera-Corominas, and Tomas-Folch (2016) conducted a study that aimed to analyze the type of peer feedback that students provide in peer assessment groups in group projects and to investigate student perceptions towards peer assessment for the improvement of the learning process. The results found that the feedback received helped them to better develop the task and support them in their learning (Ion, et al., 2016). Ongoing, formative feedback facilitates the inquiry process and is an essential aspect of the PBL approach.

Public product. Creating a product can be an enjoyable task for a student. Throughout the PBL process, students have autonomy when creating the end result, solving a problem, and/or creating a product. The solution to the problem can be in the form of a product such as an electronic presentation, tangible object, or any other means of coming to a conclusion. The process, materials, and resources used throughout the inquiry can influence the end result or solution to the problem. Reinforcing the PBL component of student choice and voice, students have the opportunity to utilize resources outside of the classroom to solve a problem or create the end product. Essentially, the PBL process can be an enjoyable experience for students who like to choose their methods of learning, create products, and work together.

Student Successes of PBL in the K-12 Setting

Recent studies have indicated that PBL is an effective instructional approach. Sahin and Top (2015) investigated a new STEM (Science, Technology, Engineering, Mathematics) PBL teaching approach that incorporated a full curriculum and PBL projects for all core subjects, regular teacher trainings, and aligned with multiple state standards. The study identified two categories of student benefits; academic and 21st century skills (Sahin & Top, 2015). Baker and White (2003) conducted a study wherein two versions of a two-week PBL unit were developed, implemented, and assessed along with a collaborative GIS or paper maps to support data analysis activities in an eighth grade science Earth Science unit. The study found improvements in attitudes toward technology, self-efficacy toward science, and modest and significant improvements for geographic data analysis for students who used the GIS (Baker & White, 2003). When students engage in the PBL process, opportunities are created for collaboration and interaction among peers. These interactions can create an environment of teamwork, thus yielding the possibility of increases in student achievement. Holmes and Hwang (2016) conducted a study to assess the implementation process of PBL, both academically and motivationally, in secondary mathematics curriculum. The results indicated that at risk and minority students benefited from PBL in learning mathematics and the typical performance gaps diminished (Holmes & Hwang, 2016). Given the collaborative nature and teamwork aspect of PBL, opportunities are created for students to engage in active learning activities, work together, and make learning fun. Table 2 indicates the types and data sources of the aforementioned studies that describe the student successes of PBL in the K-12 setting.

Table 2

Author	Type of Study/Data Sources
Baker and White (2003)	Quasi-Experimental, Pre-test, treatment, and post-test
Holmes and Wang (2016)	Mixed Method, Standardized test scores, online surveys, classroom observations, and student interviews
Sahin and Top (2015)	Qualitative Theoretical sampling, Interviews

Teacher Implementation of PBL in the K-12 setting

The various components of PBL and their impacts on student achievement are influenced by how the teacher creates the conditions and prepares for a PBL activity. Han, Yalvac, Capraro, and Capraro (2015) conducted a study to explore teachers understanding and implementation of STEM PBL activities. The results of the study indicated that teacher's understandings of PBL can not guarantee the quality of implementation of STEM PBL (Han et. al). Classroom teacher buy in, appropriate and effective professional development, and a high level of teacher self-efficacy of implementing PBL are critical aspects for teachers to implement PBL with fidelity. Additionally, Han et al. concluded that students content achievement, beliefs, self-efficacy, and motivation can be negatively influenced if teachers poorly implement PBL's. Reinforcing the importance of the teacher's role in PBL, Grant (2011) conducted a PBL study with an eighth grade geography class in the Southeastern United States and indicated that teacher expectations and project requirements can significantly impact how students craft projects and how student learning is assessed. In order for teachers to implement PBL with fidelity, appropriate professional development needs to be provided along with an attainment of a significant level of teacher buy in, and a high level of self-efficacy that results in a common understanding of the implementation expectation.

Teacher Role in PBL

The role of the teacher in the PBL process is critical. The teacher establishes the environment in which students can openly express their concerns about real life issues and problems that directly influence their lives. Markham (2012) explored the role of the teacher as a coach. The teacher acts as a facilitator and guides the students through the inquiry process. Markham described the chief responsibility of the teacher is to train students in the *how of learning* and hold them accountable to put forth their best effort. Additionally, Markham indicated that the most crucial task of the teacher is to help students work as a team. In PBL, the teacher must create a supportive and collaborative environment that fosters high expectations.

Teacher Self Efficacy

The ability of a teacher to plan, implement, and evaluate a PBL lesson is based on the teacher's pedagogy and knowledge of curriculum and instruction. Teacher self-efficacy is an important factor that can influence how a teacher plans, implements, and evaluates a PBL lesson. Tschannen-Moran and McMaster (2009) described self-efficacy as "a future oriented belief about the level of competence a persons expects he or she will display in a given situation" (p.229). Bandura (as cited in Tschannen-Moran and McMaster, 2009) identified various components of self-efficacy as being verbal persuasion, vicarious experience, mastery experience, physiological and affective states, and analysis of the teacher task. Given that self-efficacy is based on observations, real life experiences, and perceptions, it is important to ensure that there is a common understanding of the intricacies of PBL. In reference to the components of self-efficacy, Tschannen-Moran and McMaster found in their study of self-efficacy in relation to implementing a new instructional strategy that there were no gains in teacher self-efficacy for those who were in the lecture-only group, mixed gains and losses in self-efficacy among those in the lecture plus demonstration group and the lecture, demonstration, and practice group, and substantial gains in self-efficacy only in the treatment condition that included follow-up coaching. This study has prompted further studies into the complexities of the relationship of teacher self-efficacy and implementing a new instructional strategy (Tschannen-Moran & McMaster, 2009).

Due to the magnitude of instructional strategies and cognitive learning concepts along with the structured approach that accompanies PBL, it is important that the teacher possesses a high level of understanding in implementing effective instructional pedagogical skills along with a solid understanding of curriculum and instruction. Shoulders and Krei (2015) conducted a study with rural high school teachers in Tennessee and Indiana. The results indicated that teachers with 15 years or more of teaching experience seem more efficacious in classroom management and instructional practices, but did not show the same significance in their self-efficacy for student engagement (Shoulders & Krei, 2015). Given the complexities and biases of self-efficacy, further studies are needed to examine its impact on teachers implementing PBL.

Impediments to Implementing PBL

In order to implement PBL with fidelity, teachers and students need to be fully aware of the time and magnitude of the approach, specifically in the accountability driven policy environment of the 21st century. Given that PBL can be a lengthy process, it may take more time than expected to properly and

thoroughly investigate a topic or problem. In the current accountability movement and the emphasis that is placed on standardized testing, implementation of PBL can be a challenge. Vega and Brown (2013) conducted a study with 15 middle school leaders implementing PBL. The leaders interviewed indicated struggles with implementing PBL authentically while meeting the curricular and assessment demands of the curriculum (Vega & Brown, 2013). Vega and Brown indicated "as indicated by all interviewed, stress and confusion arose when having to meet the demands of the campus and the ongoing demands of the district created by district wide benchmarking" (p.26). The current accountability policy arena of the 21st century and its impact on classroom instructional practices can restrict and detract from teachers implementing PBL in their classrooms. The focus of teachers could be on teaching the essential standards that are tested at the end of the course, rather than planning an in depth inquiry based activity.

Limitations and Recommendations for Future Research on PBL

Recent studies have shown that PBL has a positive impact on student achievement and learning outcomes. Avsec and Kocijancic (2016) indicated the quantitative evidence in terms of knowledge acquisition, problem solving, developing critical thinking skills, and decision-making capabilities are still lacking. The quantitative studies needed could possibly measure the effectiveness and impacts of the PBL approach in relation to traditional instructional approaches using a pre and post assessment. Additionally, recent studies have researched PBL with STEM curriculums (Han, et al., 2015; Sahin & Top, 2015; Tseng, et al., 2013;). Additional studies are needed in traditional courses or programs where students are typically required to successfully complete the course for graduation or complete an end of course assessment that determines knowledge attained of the curriculum.

Given that PBL incorporates numerous and various instructional strategies and cognitive learning concepts, it is imperative that the impacts of PBL be explored in various contexts and subject areas. Through exploring PBL through various lenses and/or paradigms, research methodologies, and contexts, we will be able to contribute to the literature on the intricacies, effectiveness, and impact of PBL on student achievement.

Conclusion

In order to fully understand the fidelity implementation, impacts, and effects of Project Based Learning (PBL), the components, intricacies, and conceptual framework(s) of PBL and teacher self-efficacy need to be explored. Implementing Project Based Learning (PBL) with fidelity as an instructional approach requires the teacher to be knowledgeable of the approach, highly skilled in curriculum and instruction, and possess a high level of teacher self-efficacy. When implemented with fidelity, the vast components and expectations of PBL can positively impact student achievement. Based on the aforementioned references of PBL, it is evident that PBL yields positive student achievement outcomes. Additionally, PBL can be an enjoyable experience for students and teachers due to the impact that it has on creating an active learning environment, the collaborative nature of the inquiry process, and the acquisition of the in depth knowledge that results from the instructional approach. In order for students to experience deep learning, the teacher needs to possess a high level of self-efficacy in relation to PBL.

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