The Impact of Project-Based Learning on Student Content Knowledge in an Undergraduate, Teacher Preparation, Foundations of Education Course

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Abstract

This hypothesis-generating research study provided insight into the impact of project-based learning on student content knowledge in an undergraduate, teacher preparation, Foundations of Education Course. Two instructors and 44-students participated in this mixed methods study. Data were collected over the course of 14-weeks and consisted of instructor field notes, two student reflective surveys, and a single-point project rubric scored by the instructors; the philosophy of education rubric was also considered, as this end of semester assignment assessed content knowledge. Themes pertaining to pedagogy, learning, and community emerged from data analysis. Once triangulated, data revealed that project-based learning may facilitate a deep understanding of content knowledge, and supportive learning communities may be cultivated through productive academic struggle while engaged in project-based learning experiences.

Purpose of the Study

The purpose of this study was to determine the impact of project-based learning (PBL) on student knowledge acquisition and students' and researchers' perceptions of the use of PBL as a pedagogical tool. This hypothesis-generating study sought to discover the value of using PBL as a strategy in three undergraduate Foundations of Education courses in a teacher education program during the Spring 2019 semester. With the intent of adding to the quality of educational practices and student learning, this research study provided insight into the impact of PBL as a pedagogical approach that assisted student conceptual understandings.

Research Question

The following questions served as the catalyst for research:
- What are the benefits and drawbacks of using PBL as a pedagogical tool for learning?
- In what way does PBL impact student learning of course content?
- What are undergraduate teacher candidates' and the researchers' perceptions of PBL as a tool in the classroom?

Theoretical Framework

Project-based learning is based on constructivist learning theories by well-known educational theorists such as Dewey, Vygotsky, Piaget and Freire. Specifically, PBL has its roots in inquiry- based learning, a pedagogical method that stems from constructivism. Inquiry-based learning is active learning, and hence a student-centered approach that focuses on critical thinking, questioning, and problem-solving (Barron & Hammond, 2008). It is intended to involve students in a deeper level of learning than traditional approaches to learning, such as lecture. "The inquiry-based model is more consonant with key principles of how people learn, including the need for relevance; explicit development of metacognition, creativity, and the ability to transfer skills and knowledge; and direct attention to misunderstandings" (Lucas Education Research, 2017). One method of inquiry-based learning is Project Based Learning (PBL).

A student-centered pedagogy, PBL involves exploration of real-world problems and challenges in order for students to acquire a deeper level of learning. According to Thomas (2000), these projects often involve students in design, problem-solving, decision making and investigation over an extended period of time. Students are given autonomy by a teacher-facilitator, and the projects usually culminate in a presentation or realistic product. Research on project-based learning found that students who engaged in PBL learned more factual knowledge than those students engaged in traditional learning (as cited in Barron & Hammond, 2008).

The Buck Institute for Education, a leading researcher in the field of PBL, analyzed literature reviews, spanning 30 years from 1984 to 2017 and found that PBL can promote student learning in social studies and science and to a lesser degree in mathematics and literacy (Kingston, 2018). Another literature review conducted and published through Lucas Education Research and MDRC found that PBL's effectiveness in improving students' outcomes is "promising but not proven" (Condliffe et al., 2017, p. iii). Condliffe's working paper did find that PBL approaches have had positive effects on students' engagement, motivation, and self-efficacy (Condliffe et al., 2017).

Implementers of PBL should note that there are significant challenges to its successful implementation. Barron and Darling-Hammond (2008) share that PBL requires diligent planning, collaboration strategies to enhance small group interaction, and ongoing assessment through formative feedback. More research is needed to link PBL to improved student outcomes and to establish best practices for implementation at various grade levels.

Method

Participants

Participants included two instructors and 44-students enrolled in EDU 3600, a Foundations of Education class required for all teacher candidates. We, the professors of the course, sought to enhance student engagement, inquiry, and creativity through the use of PBL with the intent of solidifying student content knowledge. Dr. Craig created the Design-A-School PBL assignment and implemented it for one semester. Following this initial experience, Drs. Craig and Eckardt decided to look more deeply into the impact of PBL on student conceptual understandings the following semester. For this reason, we investigated the impact this project based assignment had on our pedagogical approach and on student content knowledge.

Students. Students were undergraduate childhood and adolescent pre-service teachers. A total of 44 students were divided into three sections. Dr. Craig taught two sections of the course; Dr. Eckardt taught one.

Course EDU 3600

A required course for teacher candidates, this Foundations of Education class presents an overview of historical, sociological, and philosophical influences that are the foundation of American education. Candidates demonstrate awareness of the interdependence of education and society, critically examine educational issues, and compose a personal philosophy of education.

Design-A-School Project Description

Working in small groups, this semester long project asked students to design a new elementary or secondary school using information learned throughout the course and constituted 20% of a student's grade. This PBL assignment required students to collaborate outside of the classroom when designing a school that incorporates best practices as well as content from EDU 3600, including culturally responsive teaching, history, diverse learners, philosophy, purpose, reform, technology, finance, and governance. The assignment consisted of an initial and ending reflection, four project updates, the creation of a school website and one other creative outcome, a group presentation, question and answer to an audience of educators, and completion of a mid-project and end of project survey.

The essential question guiding this assignment was: *How can we improve (elementary or secondary) schools to better meet the needs of a diverse population of 21st century learners?*

"Cognitive science indicates that we learn more effectively when we see how ideas are conceptually connected to one another, when our minds are fully engaged, and when the tasks we encounter are motivating because they are interesting and accessible" (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019, p. 19). This notion was the impetus behind the PBL assignment.

Data Sources

The research design for this mixed methods study was hypothesis generating. Gathered over the course of a semester, data included: researchers' field notes, student reflective surveys administered mid-semester and at the culmination of the project, the PBL single point rubric, and the philosophy of education rubric.

Field notes. We, the researchers, compiled field notes throughout the duration of the semester which pertained to assignment design and student progress. Data were analyzed and coded based on emerging themes and patterns.

Student reflective surveys. Students were asked to respond to the Reflective Survey twice during the semester. Surveys were administered anonymously during mid-project in October and at the end of the project in December. Reflection topics were not guided or influenced in an attempt to allow for authenticity. Reflective Surveys were analyzed for emerging themes.

Project-based learning single point rubric. Following instructors' assessments, the associate dean of the undergraduate program was asked to review all assignments to check for content knowledge and further interrater reliability.

Philosophy of education rubric. The philosophy of education rubric consists of five areas of assessment. Two of the five elements pertaining to content knowledge are pedagogy and theoretical connections; these were considered for data analysis. Performance levels are based on a four-point scale as follows: level 1 emerging, level 2 developing, level 3 meeting expectations, level 4 exceeding expectations.

Interrater Reliability

When analyzing data, themes of pedagogy, learning, and community emerged. We compared analyses to determine reliability and examined discrepancies if present. Following triangulation of data, researchers generated two hypotheses which may be applied to student learning and classroom culture. **Table 1** presents characteristics of each category.

Table 1

Categories	Characteristics
	Pedagogy, Learning, and Community evidenced in data
Pedagogy	Professors model use of PBL as instructional practice that might be evidenced in the elementary and/or adolescent classroom. Professors employ PBL to engage learners and foster inquiry.
Learning	Rubric scores on the philosophy of education pertaining to content and pedagogy reflected conceptual understanding. Student scores on the PBL rubric and survey responses indicated theoretical connections.
Community	Instructor field notes and student reflective responses highlighted collaboration, productive academic struggle, and learning through uncertainty and challenges.

Evidence and Analysis

Pedagogy

The instructional practice employed in this PBL demonstrates active learning and student engagement as the project involves hands-on creation of a school based on course content. Students work together in class and outside of class to research, design, and present a new school. When the project was first introduced, students were shown short video clips of PBL in use in elementary and secondary classrooms. Benefits of PBL were discussed, and students were encouraged to read research that supports PBL in K-12 classrooms.

This project included frequent check-ins between the instructor and the groups through four blog posts demonstrating their progress in meeting the project outcomes. For example, one group stated in their blog post,

We share a similar outlook on education and believe that every student is entitled to a quality education that brings out the best in him or her. We also embrace the principles of diversity and inclusion, and seek to create a welcoming environment that celebrates both our differences and our similarities. This philosophy will be the basis of our Mission statement, which will be completed in due time.

If the instructor noticed that groups were struggling, she would offer insights in the form of online feedback or meet with groups face-to-face. Blog updates and feedback from the instructor aimed to help alleviate student stress during their first time experiencing the freedom and decision making involved in PBL.

Instructor field notes kept the faculty members engaged in the semester-long process of the project. By noting their observations throughout the 14-weeks, instructors had the opportunity to reflect on their own assumptions about learning and make improvements for the use of the project in future semesters. Early in the project, Dr. Craig wrote in her field notes, "Group projects seem to conjure up negative feelings of, perhaps, bad past experiences working in groups. Consider allowing self-selection of groups rather than assigned groups; take a look at the research on this when time permits."

Students' written responses to the essential question at the beginning of the project and written reflection at the end of the project provided opportunities for students to consider their own school experiences from a student perspective and how they might use PBL in their future classrooms as a teacher. One student wrapped up her final reflective paper by stating, "Overall, I think project-based learning is a great tool to use in the classroom. This was the first time I was introduced to it, and I can honestly say I will use it in my classroom when I become a teacher."

Learning

Evidence of student learning presented itself through student reflective surveys and responses, philosophy of education rubrics, and the single-point Design-A-School rubric. On the philosophy of education rubric, 31% of students met expectations in the area of theoretical connections, and 62% exceeded expectations. Pertaining to pedagogical understandings, 31% of teacher candidates scored a level 3 while 55% of teacher candidates achieved a score of four points. Only two percent of students scored on the emerging level in the area of pedagogy, and seven percent of learners scored on the developing level in the area of theory.

In order to successfully complete the Design-A-School project, students were required to cover areas of pedagogy and theory as outlined in the required course readings. The Philosophy of Education paper is a benchmark assignment and due one month before the end of the semester. The Design-A-School project is the culminating activity at the end of the semester. All students received a perfect score on the Design-A-School project.

Moreover, a student commented on the final reflective response, "This course really helps me understand the meaning of education and it helps me create new and unique ways of helping me form my classroom for the future." This sentiment was supported when another student commented on the end of semester survey, "I did not understand initially that the project was designing a school based on our own philosophies. Once I understood the need to connect theory with practice to form a philosophy, the process became much easier."

Community

Neurologist and teacher, Judy Willis (2007) suggested a brain state of disequilibrium stimulates the amygdala which creates an ability to "transmit data efficiently from the sensory response centers to the patterning and memory regions of the brain. The hippocampus is primed to bring 'online' any previously stored related information that may connect with the new data to … restore equilibrium" (pp. 24-25). Teachers who stimulate disequilibrium-prompted curiosity might assist learners in achieving a brain-state conducive for learning (Willis, 2007). The notion of productive struggle echoes sentiments of disequilibrium. Referring to the role of teachers, Blackburn (2018) contends, "Rather than immediately helping students at the first sign of trouble, we should allow them to work through struggles independently before we offer assistance … for students to become independent learners, they must learn to persist in the face of challenge" (para. 2). The Design-A-School project had the ability to prompt disequilibrium through productive struggle.

Reflecting on the project, at the end of the semester one student responded, "I loved working together with the freedom to choose how we wanted to make our school." This sentiment was supported by another student who commented the project was, "… fun, engaging, and helped me think deeper about how I want to shape future generations. The group work of this project was such a great and rewarding learning experience that really brought everyone closer together." Student responses indicated productive academic struggle fostered a state of curiosity and collaboration.

Final survey results included a sense of community and learning through peer-to-peer inquiry and academic struggle. However, when the midsemester survey was administered a teacher candidate expressed confusion stating, "I really enjoy this project but I wish there was a little more instruction so we weren't so confused with what to do next, but the rubric is helping nicely." Perhaps the sentiment of confusion resulted from teacher instruction, a lack of clarity that the purpose of the project was designing a school based on their own philosophies, or it may have stemmed from students' discomfort learning to work creatively with peers under the support of teacher guidance rather than direct instruction.

Dr. Eckardt's field notes initially indicated, "Students seemed a little nervous and confused - especially about the technology integration. However, they were excited to meet group members and discuss their ideas." Dr. Craig's midsemester field notes echoed similar sentiments. However, her end of semester notes reflected supportive learning communities stating, "At the conclusion of the presentations, students demonstrated true collegiality by verbally congratulating each other, high fives, and pats on the back as gestures of a job well done. The groups appeared sincerely proud of themselves for a big accomplishment and most groups seemed like they had successfully bonded. One group indicated they were going to get Starbucks to celebrate!"

Midsemester, students were asked to evaluate the following statement: I think this project is encouraging me to think deeply; at that time, only 24.4% responded they strongly agreed. At the end of the semester, learners revisited this statement; this time, 50% of learners reported strongly agree. It is evidenced that supportive communities of learners were established through peer-to-peer productive academic struggle.

Hypotheses Generated

The hypotheses generated are as follows:

- PBL may facilitate a deep understanding of content knowledge.

- Supportive learning communities may be cultivated through productive academic struggle while engaged in project-based learning experiences.

Discussion

This student-centered, collaborative activity can serve as a model for other assignments in additional courses. The faculty have begun a dialogue to examine how they might include this form of pedagogy into future projects. This project transformed the traditionally lecture-based course into a scholarly, collegial investigation resulting in a presentation for administration and other faculty that demonstrated how students deepened their understandings of project based learning and the connection of theory and practice in this pedagogical process.

In order to share this project more widely, future exhibitions will take the form of a poster presentation to be viewed by peers and faculty from various departments throughout the college. It is hoped that this project will continue to impact the learning of course content while offering future teachers (and current faculty) a model of inquiry-based learning that they will emulate in their future work.

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