



Research Output Journal of Education 3(3):51-56, 2024

ROJE Publications

PRINT ISSN: 1115-6139

<https://rojournals.org/roj-education/>

ONLINE ISSN: 1115-9324

The Impact of Project-Based Learning on Developing Critical Thinking and Problem-Solving Skills

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ABSTRACT

This essay explores the impact of Project-Based Learning (PBL) on the development of critical thinking and problem-solving skills among students. PBL is recognized as an effective instructional approach that fosters student engagement by simulating real-world scenarios, encouraging self-directed learning, and enhancing communication skills. The essay provides an overview of PBL, its principles, and how it motivates learners by integrating various disciplines and promoting a collaborative learning environment. Through the analysis of empirical studies, the essay demonstrates that PBL effectively cultivates critical thinking and problem-solving abilities by allowing students to apply theoretical knowledge to practical challenges. The essay concludes by emphasizing the importance of implementing PBL in educational settings to prepare students for the complexities of the 21st-century workforce.

Keywords: Project-Based Learning (PBL), Critical Thinking, Problem-Solving Skills, Educational Strategies, 21st Century Skills.

INTRODUCTION

This essay will be addressing the impact of project-based learning (PBL) on developing critical thinking and problem-solving skills in students. We will first define PBL and highlight how it aligns as a mature which is a more effective instructional method that is widely recognized to help with shaping the minds of students and future workforce. It stimulates confidence and self-learning as well as communication skills among students. In addition, PBL allows students to envisage the outcome of what they could possibly face in reality by developing their problem-solving and critical thinking skill sets. Students are encouraged and challenged, implementing discipline knowledge in order to brainstorm ideas capable of solving challenging engineering problems [1]. PBL is focused around project-based learning so we will set the scene by looking into project-based learning, its definition and how it can contribute to a motivating environment. Project-based learning is "a system of instruction that enables students to gain knowledge and skills by working for an extended period of time to investigate and respond to a real-world, engaging, and complex question, problem, or challenge". In one simple sentence, from such a long definition, we can uncover the goal sought from project-based learning which will answer the question as to why it is contributing to creating a more motivating learning environment. PBL empowers the students by developing an appreciation of ideas, skills, attitudes, work habits, and processes valued by the practitioners. Additionally, the students acquire an understanding and belief that "they can also use these abilities to solve problems using sound practices, traditional methods, and new approaches" [2].

BACKGROUND AND RATIONALE

Educational scholars and practitioners are continually seeking an innovative and constructive learning process that could foster their students' intellectual, personal, and social development by considering their critical thinking and problem-solving skills. A variety of teaching approaches and methods such as cooperative learning, integrated teaching approach, problem-based learning, project-based learning, and technology-based instruction have been suggested as possible ways to promote the redefined learning goals in the 21st century. Among these, project-based learning and its potential effect on learners'

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development of critical thinking and problem-solving skills have received great attention as confirmed by the number of longitudinal and qualitative studies on the matter [3].

In a recent policy report, the UK-based Partnership for 21st Century Skills has highlighted the importance of project-based learning as part of a cultivation effort in preparing a ready citizen and workforce for the digital age. Given the voluminous project-based learning literature, a number of analyses have argued that project-based learning engages students in a lifelong development process for their 21st century skills. The researchers' claims are grounded in statements that project-based learning, when adopted in the classroom, combines realistic practices with problem identification, investigation, decision-making, and social collaboration. They also emphasize that, in project-based educational settings, the learners are involved in self-assessment, which drastically improves their self-reflection capacity. As a result, in project-based working environments, learners develop essential problem-solving and higher-order thinking skills, including creative thinking, risk-taking, communication, cooperative learning, leadership, flexibility, time management, and problem identification and resolution [4].

UNDERSTANDING PROJECT-BASED LEARNING

Project-based learning (PBL) is a valuable and successful teaching strategy that has been running in educational institutes for many years. PBL can be understood as an approach that is designed by using the 5E method (Engagement, Exploration, Explanation, Elaboration, and Evaluation). It is believed that problem-based learning can be used to improve student quality across cognitive, psychomotor, and affective areas. It is largely understood as a teaching method that provides flexibility for students to explore their individual potentials. According to the literature and statement of education experts, PBL can be summarized as a teaching strategy that aids students to face real-life situations more flexibly and more wisely. A growing number of learning studies have analyzed the benefits of Project Based Learning (PBL) from the perspective of skill development (critical thinking and problem-solving) [5]. There is a great need to improve cognitive skills and develop meaningful applications in scientific fields with great practical community values. Conceptually, PBL reinforces students' critical thinking and reasoning through the exploration of topic-related scenarios. The teacher designs the projects or activities for the students, who will be responsible for their completion. From the literature review and analysis of the diverse theoretical promotion results, the study in this paper chose to investigate the development of skill components in terms of progress, acquisition, and improvements made by studying degree variables during the recommended practice. The AGDE methodology and survey instruments were used in this study to examine the study's hypotheses [6].

DEFINITION AND PRINCIPLES

Project-based learning (PBL), also known as project-based instruction, focuses on the development of learning activities that integrate different disciplines. Wiggins nominated, "assigning projects is not the same as an approach to teaching and learning" (p. 128). PBL incorporates the fundamental principles of teaching and learning which use content and competencies texts as equal partners and integrate the objectives in a problem-centered context. To strengthen this definition, we implemented a course of teaching and learning for the teacher who felt that beginners would benefit from the continuation of the previously defined PBL definition. Based on their feedback, we removed the course of teaching and learning, "an at the beginning" so the definition could work for this course [7]. The several features associated with PBL will be closely examined. These will test the association between effective PBL and the development of critical thinking and problem-solving abilities in the learner [8].

CRITICAL THINKING AND PROBLEM-SOLVING SKILLS

Critical thinking and problem-solving skills are mental processes that encourage students to use those abilities. They aid in the classification of ideas and activities for self-directed learning, clear reasoning of an idea, putting things together and seeing relationships, determining the importance of what has been studied, and evaluating the effect of what has been evaluated or proposed. The world is overwhelmed with unique elements that must be resolved, resulting in a need for professionals with problem-solving skills. Critical thinking and problem-solving abilities are lessons essential for this century and for the global economy based entirely on information. The development of critical thinking skills by the youth is a significant goal in global education policy [9]. The significance of critical thinking and problem-solving skills is also growing in higher education. A pedagogy that encourages learners to develop these abilities has become necessary. According to current knowledge, the usage of critical thinking lessons in school is advantageous not just in the practice of developing moral beings, but it also aids adults in resolving authentic challenges. In school, the application of the project-based learning strategy develops various high-order thinking abilities, such as problem-solving and critical thinking. Instantly, problem-based learning has improved in terms of students' critical thinking development and problem-solving abilities.

When learners have the opportunity to use what they have learned in theory to solve an authentic challenge, the project-based learning strategy becomes effective [10].

IMPORTANCE IN EDUCATION

The importance of critical thinking and problem-solving is significant for students in their future career. According to a survey done by the National Association of Colleges and Employers, the greatest gap in workplace skills is in critical thinking and applying knowledge in real-world settings. Professionals in every industry must be able to solve problems and make decisions with a variety of stakeholders while considering the impact on an increasingly globalized society [11]. Investigating the effect of project-based learning on the development of students' critical thinking and problem-solving skills in higher education has become important for both instructional and programmatic assessment. Students are no longer just "regurgitating" in assessments but are being asked to show evidence of their ability to critically appraise and solve problems within the context of the discipline being studied [12]. Many educational researchers have regarded project-based learning as an influential remedy in promoting students' critical thinking and problem-solving skills. Based on project-based learning literature review, it seems that there is no consensus in conceptualizing project-based learning. This can be best appreciated against the backdrop of links between project-based learning and such concepts as problem-based learning, research-based learning, work-based learning, and so on [13]. Gibbs reckoned that increasingly many academics were engaged in both coursework exercise and in a project. "There are, however, some differences between the two in ways of working and in what the students are trying to show." The common qualities of the project-based learning adopted by universities and listed by the QAA are briefly as follows: it requires learners to develop research and/or inquiry skills, it draws upon current information to produce recommendations, it extends problem-solving abilities and understanding by requiring vocational application of development and organizational studies, and it is to demonstrate students' research, business, and professional skills learned [14].

THE RELATIONSHIP BETWEEN PROJECT-BASED LEARNING AND CRITICAL THINKING

Critical thinking is a significant skill that all individuals should possess. It is essential to be able to think deeply in order to solve real-life problems that are complex. As a result, many researchers are concerned with improving the development of critical thinking in students. One important issue is the effects of project-based learning (PBL) on the development of students' critical thinking abilities. Due to this, it is essential to find the relationship between PBL and the development of critical thinking [15]. Building on these known scientific concepts, there are also some scientifically valued studies that have been conducted to examine the possible effect of project-based learning on the development of critical thinking and problem-solving skills in students. One research study used a semi-experimental study design and involved 49 7th grade students who were divided into two groups. The experimental and control groups consisted of 25 and 24 students. The findings of the study indicated that the project-based learning employed in the experimental group was effective in developing students' critical thinking disposition [16]. Another empirical study aimed to compare the differences between students who engaged in collaborative project-based learning and those who engaged in traditional teaching. The researchers involved a sample of 45 senior class undergraduate students from the Department of Gifted Education Programme of the Faculty of Education at a state university in Ankara for this purpose. The data were analyzed using the one-way MANCOVA test. The results indicated a statistically significant effect in favor of project-based learning in the development of problem-solving skills in interdisciplinary approaches [17, 18]. In conclusion, it can be clearly stated that project-based learning facilitates and improves the development of critical thinking skills in students as it guides them to approach knowledge more critically and encourages them to think critically.

RESEARCH STUDIES

Since this type of learning develops or enhances general skills fundamental to engineering work in any case, it can contribute to personal and professional development, regardless of the performance in undergraduate and hands-on activities. To better understand the relationships, this essay presents a literature review of research studies that have been conducted in the engineering degree field on the impact of project-based learning on the development of CT and PS abilities [19].

Several research studies have assessed how project-based learning impacts, among other competences, critical thinking abilities. Specifically, some studies have aimed to understand how teaching engineering, particularly by using project-based learning procedures, impact abilities related to learning and professional performance. Several other research studies on this specific topic have been conducted mainly covering undergraduate students. The research studies reviewed in this section found some empirical evidence that project-based learning is efficient in developing critical thinking and problem-solving skills

in engineering, nursing, and agronomy education. The project-based learning effectiveness was evaluated employing various assessment tools [20]. This type of study is aimed at analyzing the effects of new didactic propositions generally involving undergraduate students. For this, an investigation investigates first the critical thinking levels and/or project-based learning critical thinking development confirms the narrow relationship between technical and formal aspects. Two empirical researches included in this overview established the levels of critical thinking of students, such as engineering and agronomy, and then applied projects as active methodologies with the aim to increase critical thinking. They found a significant increase of critical thinking after implementing new teaching strategies. A survey conducted to medical school educators aimed to investigate their perceptions about problem-based learning in critical thinking development. The main findings suggested that critical thinking is valued as an education goal, but its development has been considered as a product of traditional teaching practices. Results from a similar study applied in civil engineering degree are also included [21].

STRATEGIES FOR IMPLEMENTING PROJECT-BASED LEARNING

Offering project-based learning can seem like an extraordinary endeavor, so much so that it can be difficult to know where to start. Although adopting this educational modality comes with various challenges, two points are generally agreed upon in the literature about strategies for implementing project-based learning – namely, teaching is fundamentally different and increasingly complex when the teacher designs a project that is to serve as the pedagogical axis of their class, and when student learning is to be evaluated through the final project. Because of this, the advice offered by leading researchers in the field is to support the teacher in designing a feasible and effective project. More specifically, teachers often need help in thinking about how to work through the complex task decomposition associated with the project, the defining of a sequence of tasks which is appropriate for student learning, and in obtaining practical advice as to how to assess student performance on such complex tasks [22]. How, then, can projects be developed to help students develop critical thinking and problem-solving skills? There are many ways to organize projects to serve this role. One straightforward approach is what might be called a "Wicked Problem" approach – that is, piling on as much complexity as possible and letting the students work through it. Tasks is essential. Educators may find its elements useful either conceptually or directly in their practice and aim to give students work that actually challenges them [23].

DESIGNING EFFECTIVE PROJECTS

Aside from the peers' model, several principles and methodologies should be employed when designing a successful project-based learning experience. To ensure that a project learning environment (PLE) consists of significant and memorable experiences, it has been suggested that worthwhile personal attention, high levels of student enthusiasm, and an acceptance of the responsibility to undertake and self-manage a major project are paramount. Among possible methodologies in using principles for effective project-based learning experience, there is a focus on either the process of problem-solving or problem-based learning resulting in a wider project-based learning model. For the purpose of developing critical thinking and problem-solving skills, the potential for complex and multiple critical applications of problem-based learning in the classroom is limited. Normal practical uses of problem-based learning in meaningful contribution to addressing this challenging aspect of direct brain injury rehabilitation will be on a need to individualize care and case manage them effectively. There is weak evidence that problem-based learning does improve a variety of health professional student outcomes, but insufficient research is available to exclude the possibility that performance is either improved or worsened by increased learning time. We believe that a more focused inclusion of closed head he in such exercises makes the results more PTI relevant to us in the field of brain injury in terms of the cognitive and survival populations. 5.1.1. The Selection of Projects in the Short-Term Assignment of Value Design and engineering programs cover many subjects, skills, and types of knowledge in one degree. Many of these areas are being revised to achieve deep, enduring understanding, and the resolution for the unfamiliar and non-routine problems in a field of study is often a test of critical thinking ability. The PFW model provides workshops for first-year students to develop rational and problem-solving abilities to a watertight, professional level through the development of problem-based learning and design-based learning projects. This paper explores how the PFW project teams select design project topics for the final formal-prototypical solution to be built in 5-20 weeks. It examines the challenges the students, faculty, and professional advisors collectively face in working with students. 210 multi-horse engineering and engineering technology students have participated in this PFW component since 2006.

CONCLUSION

Project-Based Learning (PBL) plays a crucial role in developing critical thinking and problem-solving skills in students by providing them with opportunities to engage in complex, real-world challenges. The

evidence presented in this essay highlights that PBL not only enhances academic performance but also prepares students for future professional environments by fostering essential skills such as creativity, communication, and collaboration. As education continues to evolve to meet the demands of the 21st century, the adoption of PBL as a core teaching strategy is imperative for equipping students with the tools they need to succeed in a rapidly changing world.

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CITATION: Wambui David Adeline. The Impact of Project-Based Learning on Developing Critical Thinking and Problem-Solving Skills. *Research Output Journal of Education*, 2024 3(3):51-56.