Educational Administration: Theory and Practice
2024, 30(6), 1536-1542
ISSN: 2148-2403
https://kuey.net/

Research Article

Project-Based Teaching and Learning in Higher Education: Insights from Educators' Experiences

Nguyen Van Tuan*

*Hanoi University of Industry, Vietnam Email: nguyen.tuan@haui.edu.vn

Citation: Nguyen Van Tuan (2024), Project-Based Teaching and Learning in Higher Education: Insights from Educators' Experiences, *Educational Administration: Theory and Practice*, *30*(6), 1536-1542, Doi:. 10.53555/kuey.v30i6.5533

ARTICLE INFO

ABSTRACT

This study examines lecturers' attitudes and experiences regarding project-based learning (PBL) in mathematics education programs. Utilizing qualitative analysis of data from 9 lecturers teaching at four universities in Vietnam, the study unveils a nuanced landscape marked by both opportunities and challenges. The analysis showcases a spectrum of attitudes towards PBL, ranging from enthusiasm and optimism to skepticism and reservation. While many lecturers recognize PBL's potential benefits in fostering active learning and student engagement, others voice concerns about its practicality and feasibility within their teaching context. Positive experiences of lecturers in PBL highlight its efficacy in nurturing critical thinking, problem-solving skills, and collaborative learning among students. However, negative experiences shed light on logistical challenges linked to PBL implementation, such as time constraints, resource limitations, and the need for additional training and support. A comparison of positive and negative experiences underscores that while PBL presents numerous benefits, its effective implementation demands careful attention to logistical challenges and the provision of ample support and resources. These findings enrich the ongoing discussion on PBL in mathematics education programs and offer insights for stakeholders aiming to elevate teaching and learning quality in this field.

Keywords: Project-based learning, Mathematics education, Lecturers' attitudes, Student engagement, Qualitative analysis

1. Introduction

In the realm of higher education, particularly in advanced mathematics and engineering disciplines, the adoption of innovative pedagogical approaches has become increasingly prevalent. One such approach that has garnered significant attention is Project-Based Learning (PBL), which deviates from traditional lecture-based methods by emphasizing active, experiential learning through the completion of authentic projects. PBL holds particular promise in disciplines like advanced mathematics and engineering, where the application of theoretical concepts to real-world problems is paramount for students' future success.

Nguyen Van Tuan (2016) explores the integration of creative learning techniques within the framework of the Dirichlet principle, offering insights into how educators can engage students in solving complex problems through innovative pedagogy. Similarly, Nguyen Van Tuan and Tran Viet Cuong (2018) delve into the design of learning projects focusing on extreme values of two-variable functions, highlighting the potential of PBL to deepen students' understanding of mathematical concepts while fostering critical thinking and problem-solving skills.

Despite the growing recognition of PBL's benefits, educators face various challenges in its implementation, particularly in the context of advanced mathematics and engineering education. Nguyen Van Tuan and Tran Viet Cuong (2020) shed light on the current landscape of project-based teaching activities in universities in Hanoi, offering valuable insights into the practical realities and obstacles encountered by instructors.

Moreover, the efficacy of PBL in enhancing student learning outcomes is a subject of ongoing research and debate. Tran Viet Cuong and Nguyen Van Tuan (2021) present experimental research on the effectiveness of the PBL method in advanced mathematics for engineering students in Vietnam, contributing to a deeper understanding of its impact on student engagement, knowledge acquisition, and skill development.

In addition to the empirical studies within the field of mathematics and engineering education, insights from interdisciplinary research provide valuable perspectives on the application of PBL. For instance, Balkevicius,

Mazeikiene, and Svediene (2013) discuss the initial steps of project-based education in Lithuanian high schools, offering lessons that can be extrapolated to higher education contexts.

As educators navigate the complexities of integrating PBL into their teaching practices, the guidance provided by theoretical frameworks and pedagogical principles becomes indispensable. Drawing on seminal works such as Marshall and Rossman's (2011) "Designing Qualitative Research," educators can glean valuable insights into designing and implementing effective PBL experiences that align with the unique needs and goals of advanced mathematics and engineering education.

Furthermore, understanding the role of self-regulated learning (SRL) in the context of PBL is crucial for optimizing its effectiveness. Insights from research on SRL, such as Paris and Paris (2003) and Stefanou et al. (2013), offer valuable perspectives on how students can take ownership of their learning process within the framework of PBL, enhancing their autonomy, motivation, and metacognitive skills.

In summary, this introduction sets the stage for a comprehensive exploration of Project-Based Learning in advanced mathematics and engineering education. By synthesizing insights from empirical studies, interdisciplinary research, and pedagogical theory, this study aims to deepen our understanding of PBL's potential, challenges, and best practices in preparing students for success in complex, rapidly evolving professional landscapes.

2. Theoretical Framework

2.1. Concept and Theories Related to PBL in Education

PBL in education has emerged as a significant pedagogical approach aimed at fostering curiosity, creativity, and problem-solving skills among students through meaningful and real-world projects. According to Nguyen Van Tuan (2016), integrating this approach into teaching can create a stimulating learning environment conducive to the development of creative thinking in students.

Nguyen Van Tuan and Tran Viet Cuong (2018) proposed a project titled "Extreme of Two-variable Functions" designed for teaching advanced mathematics to engineering students. This project exemplifies how PBL can be tailored to specific academic disciplines to enhance student learning experiences. Furthermore, their work in 2020 delved into the current status of organizing project-based teaching activities in advanced mathematics for engineering students in universities in Hanoi, shedding light on the practical implementation of PBL in educational settings.

In the realm of mathematics education, Nguyen Van Tuan (2021) explored the organization of project-based teaching focusing on "Some applications of differential equations" for engineering students, providing insights into the application of PBL methodologies in teaching complex mathematical concepts.

Tran Viet Cuong and Nguyen Van Tuan (2021) conducted experimental research on the Project-Based Learning Method in Advanced Mathematics for Engineering Students in Vietnam. Their study contributes empirical evidence to the efficacy of PBL in enhancing the learning outcomes of engineering students.

Moreover, a doctoral dissertation by Nguyen Van Tuan (2021) from the Faculty of Education, Thai Nguyen University of Education, offers a comprehensive exploration of organizing project-based teaching specifically in advanced mathematics for engineering students, consolidating theoretical insights and practical applications of PBL.

Beyond specific mathematical contexts, the literature on PBL extends to various educational domains and contexts. For instance, Balkevicius, Mazeikiene, and Svediene (2013) investigated the initial steps of project-based education in Lithuanian high schools, highlighting the broader applicability and potential impact of PBL across different educational systems.

Additionally, studies such as those by Graziene (2012) and Kapusuz and Can (2014) explored the applicability and effectiveness of PBL in different educational contexts, providing valuable perspectives on the pedagogical principles underlying this approach.

In summary, the concept of PBL in education is grounded in fostering active, experiential learning through authentic projects, with a growing body of research highlighting its effectiveness in enhancing student engagement, problem-solving abilities, and overall learning outcomes across diverse academic disciplines and educational settings.

2.2. Previous Studies and Project-Based Teaching Methods

Numerous studies have investigated the implementation and effectiveness of project-based teaching methods across various disciplines and educational levels. Fernandes, Mesquita, Flores, and Lima (2014) conducted research focused on engaging students in learning through project-based education. Their findings emphasized the positive impact of project-based approaches on student motivation, participation, and learning outcomes.

Furthermore, Pietila and Virkkula (2011) explored the integration of therapy and practice based on project designs in secondary vocational education. Their work underscored the significance of project-based learning in promoting hands-on, experiential learning opportunities that bridge theory and practice.

The study by Roessingh and Chambers (2011) delved into project-based learning and pedagogy in teacher preparation programs. By examining the theoretical underpinnings and practical applications of PBL in

teacher education, they contributed insights into effective pedagogical strategies for preparing future educators.

Schreier (2012) provided valuable insights into qualitative content analysis, a methodology commonly employed in researching project-based teaching and learning. Understanding the qualitative aspects of PBL research is essential for capturing rich, nuanced data regarding student experiences, perceptions, and learning outcomes.

Additionally, Silverman (2011) offered methodological guidance on interpreting qualitative data, providing researchers with tools to analyze and make sense of the complex narratives and interactions inherent in project-based learning environments.

The work of Zhang and Hwang (2023) explored the effects of interaction between peer assessment and problem-solving tendencies on students' learning achievements and collaboration in mobile technology-supported project-based learning. This study shed light on the role of peer interaction and technology in facilitating collaborative learning experiences within project-based contexts.

Furthermore, Fontana, Milligan, Littlejohn, and Margaryan (2015) contributed to the understanding of self-regulated learning in the workplace, highlighting the importance of metacognitive processes in facilitating effective learning and performance in project-based environments.

Overall, previous studies have provided valuable insights into the theoretical foundations, methodological approaches, and practical implications of project-based teaching methods across diverse educational contexts. These studies collectively contribute to the growing body of knowledge aimed at enhancing teaching and learning practices through innovative pedagogical approaches.

3. Methodology

3.1. Participants

The sample consisted of 9 lecturers involved in the mathematics education program at Thai Nguyen University of Education and Hanoi University of Industry, National Academy of Educational Management. All participants hold Doctorates in Educational Science. Lecturers' teaching experience at the university ranges from 8 to 25 years.

3.2. Data Collection

A focused group discussion served as the data collection method, facilitating a comprehensive exploration of the advantages and disadvantages of PBL in higher education. Researchers posed questions such as: "What positive aspects do you observe in applying project-based learning in the mathematics education program?" and "Describe a scenario where you applied a specific project-based learning method and experienced success or failure, positive or negative emotions." The discussion, conducted in 2023, spanned 2 hours and 15 minutes.

3.3. Data Analysis

Qualitative content analysis was employed to discern how lecturers approach successful project-based teaching, elucidating their modes of reasoning and emotional responses. The analysis aimed to extract meaningful insights from the text.

4. Results

The findings presented in Table 1 offer a comprehensive overview of lecturers' experiences with project-based teaching. Through thematic analysis, both positive and negative aspects are elucidated, shedding light on crucial areas such as student competency development, collaboration dynamics between lecturers and students, and the professional growth of educators. This structured breakdown provides valuable insights into the nuanced challenges and successes encountered within the realm of project-based pedagogy.

Table 1. Experiences in Project-Based Teaching: Positive and Negative Aspects

Theme: Areas of Positive Experience	Theme: Areas of Negative Experience
Category	Category
Development of Students' Competencies	Lack of Students' Competencies
- Development of Students' Self-Dependence	- Unrealized and Unperceived Roles of Students in a Project Team
- Responsibility for the Expected Project Result	- Lack of Students' Social Competency
- Development of Social Competency of Students	- Lack of Students' Leadership Competency
Collaboration Between a Lecturer and a Student	Lack of Dialogue with Students

- Coaching of Lecturer	- Unrealized Role of Students Completing Task Assigned by a Lecturer
- Satisfaction with Students' Involvement into Project Activities	
Lecturer's Professional Development	Lack of Lecturer's Competencies
- Development of Meaningful Tasks to Students	- Lack of Lecturer's Managerial Competency
- Lecturer's Satisfaction with Improvement and Creation While Teaching with Students	- Lack of Lecturer's Didactic Competency

4.1. Expression of Lecturers' Attitudes towards Project-Based Learning

We conducted a qualitative analysis of lecturers' responses regarding their attitudes towards project-based learning (PBL). Through thematic analysis, several key themes emerged, reflecting the diverse perspectives and opinions of the lecturers.

One prominent theme was the perceived effectiveness of PBL in promoting active learning and student engagement. Many lecturers expressed positive attitudes towards PBL, highlighting its ability to cultivate critical thinking, problem-solving skills, and collaborative learning among students. Lecturer T.V. Cuong commented, "I believe that PBL encourages students to take ownership of their learning and fosters a deeper understanding of mathematical concepts through real-world applications."

Another prevalent theme centered on the perceived challenges and barriers to implementing PBL in the mathematics education program. Lecturers expressed concerns about the time and resource-intensive nature of PBL, as well as the need for additional training and support to effectively integrate PBL methodologies into their teaching practices. Lecturer T.T. Tinh remarked, "While I see the potential benefits of PBL, I also recognize the logistical challenges involved in designing and implementing meaningful projects within the constraints of our curriculum and available resources."

Overall, the analysis revealed a spectrum of attitudes towards PBL among lecturers, ranging from enthusiasm and optimism to skepticism and reservation. These findings underscore the importance of addressing the concerns and barriers identified by lecturers while also capitalizing on the perceived benefits of PBL to maximize its effectiveness in the mathematics education program.

4.2. Positive Experiences of Lecturers in Project-Based Teaching

In examining the positive experiences of lecturers in PBL, we conducted a qualitative analysis of their responses, unveiling several key themes that shed light on their perspectives.

One prominent theme highlighted the perceived benefits and advantages of PBL in enhancing student learning outcomes. Lecturers expressed satisfaction with the level of student engagement and active participation observed during PBL activities. They noted that PBL stimulated students' critical thinking abilities and encouraged them to apply theoretical knowledge to real-world scenarios. Lecturer T.H.Quang stated, "I have seen significant improvements in students' problem-solving skills and their ability to work collaboratively in project-based settings. PBL has undoubtedly enriched their learning experiences."

Additionally, lecturers appreciated the opportunity PBL provided for them to innovate and experiment with teaching methodologies. They valued the creative freedom to design and implement meaningful projects tailored to the needs and interests of their students. Lecturer L.T.Hieu remarked, "PBL has rejuvenated my teaching approach, allowing me to explore alternative ways of delivering content and fostering deeper connections with my students. It has been rewarding to witness their growth and development throughout the project-based learning process."

Overall, the analysis revealed a positive outlook among lecturers towards PBL, with many acknowledging its effectiveness in promoting student engagement, critical thinking, and collaboration. These findings underscore the value of incorporating PBL into the curriculum as a means of enriching the learning experiences of both students and lecturers alike.

4.3. Negative Experiences of Lecturers in Project-Based Teaching

Exploring the negative experiences of lecturers in PBL, we delved into their responses through qualitative analysis, unveiling distinct themes that elucidate their viewpoints.

One notable theme revolved around the challenges and obstacles encountered during the implementation of PBL. Lecturers expressed frustration with logistical issues such as time constraints and resource limitations, which hindered their ability to execute PBL effectively. They cited difficulties in designing and managing projects within the confines of the curriculum and available resources. For instance, Lecturer B.H.L lamented, "The logistical constraints of PBL often make it challenging to strike a balance between academic rigor and practical application. Limited time and resources impede our efforts to develop and implement meaningful projects that align with learning objectives."

Another prevalent theme centered on the perceived lack of student readiness and preparation for PBL. Lecturers noted instances where students struggled to adapt to the self-directed nature of PBL, lacking the necessary skills and motivation to engage fully in project-based activities. They expressed concerns about

students' ability to work collaboratively, manage their time effectively, and take ownership of their learning. Lecturer N.V.T remarked, "Some students seem overwhelmed by the autonomy and responsibility afforded by PBL, leading to a lack of engagement and productivity. It is challenging to motivate them to take initiative and drive their own learning process."

Overall, the analysis illuminated the various challenges and frustrations experienced by lecturers in implementing PBL, ranging from logistical constraints to student readiness issues. These findings underscore the importance of addressing these challenges through targeted support and professional development initiatives to enhance the effectiveness of PBL implementation in higher education settings.

4.4. Comparison of Positive and Negative Experiences

In comparing the positive and negative experiences of lecturers in PBL, we sought to discern patterns and contrasts that shed light on the overall effectiveness and challenges associated with PBL implementation.

One significant observation is the juxtaposition of enthusiasm and skepticism among lecturers regarding PBL. While many lecturers expressed optimism about the potential benefits of PBL in promoting active learning and student engagement, others voiced reservations about its practicality and feasibility within the constraints of their teaching context. This disparity highlights the nuanced nature of attitudes towards PBL and underscores the importance of addressing both positive and negative perspectives in designing effective pedagogical strategies.

Another notable difference lies in the perceived barriers and facilitators of PBL implementation. Lecturers identified logistical challenges such as time constraints and resource limitations as major obstacles to effective PBL implementation. However, they also acknowledged the importance of additional training and support in overcoming these challenges and maximizing the benefits of PBL. This duality underscores the need for targeted interventions and professional development initiatives to equip lecturers with the necessary skills and resources to implement PBL successfully.

Overall, the comparison of positive and negative experiences provides valuable insights into the complexities of PBL implementation in higher education settings. By acknowledging both the benefits and challenges of PBL, stakeholders can work collaboratively to develop strategies that capitalize on its strengths while addressing its limitations, ultimately enhancing the quality of teaching and learning in mathematics education programs.

5. Findings

The analysis of lecturers' attitudes and experiences towards PBL in mathematics education programs reveals a nuanced landscape characterized by both opportunities and challenges.

Firstly, a spectrum of attitudes towards PBL was observed among lecturers, ranging from enthusiasm and optimism to skepticism and reservation. While many acknowledged the potential benefits of PBL in promoting active learning and student engagement, others voiced concerns about its practicality and feasibility within the constraints of their teaching context.

Secondly, positive experiences of lecturers in PBL highlighted its effectiveness in fostering critical thinking, problem-solving skills, and collaborative learning among students. Lecturers noted the ability of PBL to cultivate deeper understanding of mathematical concepts through real-world applications, thereby enhancing student engagement and motivation.

However, negative experiences underscored the logistical challenges associated with PBL implementation, including time constraints, resource limitations, and the need for additional training and support. Lecturers expressed concerns about the complexity of designing and implementing meaningful projects within the constraints of their curriculum and available resources.

In comparing positive and negative experiences, it becomes evident that while PBL offers numerous benefits, its effective implementation requires careful consideration of logistical challenges and the provision of adequate support and resources. By addressing these concerns and leveraging the perceived benefits of PBL, stakeholders can work collaboratively to enhance the quality of teaching and learning in mathematics education programs.

6. Conclusion

In conclusion, our study sheds light on the attitudes and experiences of lecturers regarding PBL in mathematics education programs. Comparing with previous research, our findings reveal a nuanced landscape characterized by both opportunities and challenges.

On one hand, lecturers expressed a spectrum of attitudes towards PBL, ranging from enthusiasm and optimism to skepticism and reservation. This aligns with previous studies such as those conducted by Nguyen Van Tuan (2016), Nguyen Van Tuan and Tran Viet Cuong (2018, 2020), and Tran Viet Cuong and Nguyen Van Tuan (2021). These attitudes reflect the diverse perspectives and opinions of educators regarding the effectiveness and feasibility of PBL in promoting active learning and student engagement.

On the other hand, positive experiences of lecturers in PBL highlighted its effectiveness in fostering critical thinking, problem-solving skills, and collaborative learning among students. This finding resonates with the research conducted by Bitinas (2006), Graziene (2012), and Roessingh and Chambers (2011), which emphasized the benefits of PBL in enhancing student learning outcomes and motivation.

However, negative experiences underscored the logistical challenges associated with PBL implementation, including time constraints, resource limitations, and the need for additional training and support. These challenges are consistent with the findings of previous studies such as those conducted by Bell (2010), Chiazzese et al. (2019), and Marshall and Rossman (2011), which highlighted the practical barriers to effective PBL implementation.

In comparing positive and negative experiences, it becomes evident that while PBL offers numerous benefits, its effective implementation requires careful consideration of logistical challenges and the provision of adequate support and resources. This finding echoes the conclusions drawn by Chen and Yang (2019), Demir and Onal (2021), and Paris and Paris (2003), which emphasize the importance of addressing practical barriers and providing scaffolding to facilitate effective PBL implementation.

Overall, our study contributes to the ongoing discourse on PBL in mathematics education programs by providing empirical evidence of the attitudes and experiences of lecturers. By addressing the concerns and barriers identified by lecturers while also leveraging the perceived benefits of PBL, stakeholders can work collaboratively to enhance the quality of teaching and learning in mathematics education programs.

References

1. Balkevicius, M., Mazeikiene, A., & Svediene, S. (2013). The first steps of project-based education in Lithuanian high schools. *Procedia - Social and Behavioral Sciences, 83*, 483-492.
2. Bell, S. (2010). Project-Based Learning for the 21st Century: Skills for the Future. *The Clearing House A Journal of Educational Strategies, Issues and Ideas*.
3. Bitinas, B. (2006). Edukologinis tyrimas: sistema ir procesas [Educational Research: System and Process]. Vilnius: Kronta.
4. Chen, C. H., & Yang, Y. C. (2019). Revisiting the effects of project-based learning on students' academic achievement: A meta-analysis investigating moderators. *Educational Research Review, 26*, 71–81.
5. Chiazzese, G., et al. (2019). Educational robotics in primary school: Measuring the development of computational thinking skills with the bebras tasks. *Informatics*.
6. Demir, C. G., & Onal, N. (2021). The effect of technology-assisted and project-based learning approaches on students' attitudes towards mathematics and their academic achievement. *Education and Information Technologies, 26*(3), 3375–3397.
7. Fernandes, S., Mesquita, D., Flores, M. A., & Lima, R. M. (2014). Engaging students in learning: findings from a study of project-based education. *European Journal of Engineering Education, 39*(1), 55-67.
8. Fontana, R. P., Milligan, C., Littlejohn, A., & Margaryan, A. (2015). Measuring self-regulated learning in the workplace. *International Journal of Training and Development, 19*(1), 32–52.
9. Graziene, V. (2012). Applicability of Project Based Learning Approach in Final Thesis in Educology Studies. In Twenty Years for Sustainable Development: Learning from Each Other. ATEE Spring University. Vilnius: Klaipeda University, 2, 36-52.
10. Marshall, C., & Rossman, G. B. (2011). Designing qualitative research (5th ed.). Thousand Oaks, CA: Sage.
11. Nguyen Van Tuan, & Tran Viet Cuong. (2018). Designing the "Extreme of Two-variable Functions" learning project in teaching advanced mathematics for engineering students. *Education Journal, Ministry of Education and Training, Special Issue*, 194-197.
12. Nguyen Van Tuan, & Tran Viet Cuong. (2020). The current situation of organizing project-based teaching activities in teaching advanced mathematics for engineering students at universities in Hanoi. *Education Journal, Ministry of Education and Training, 472*, 44-49.
13. Nguyen Van Tuan. (2016). Teaching creative learning when teaching some problems applying the Dirichlet principle. *Journal of Educational Management, Academy of Educational Management, 85*, 33-35.
14. Nguyen Van Tuan. (2021). Organizing project-based teaching in advanced mathematics for engineering students [Doctoral dissertation, Faculty of Education, Thai Nguyen University of Education, Thai Nguyen University].
15. Nguyen Van Tuan. (2021). Organizing project-based teaching of "Some applications of differential equations" in teaching advanced mathematics for engineering students. *Education Journal, Ministry of Education and Training, February Issue 2*.
16. Paris, S. G., & Paris, A. H. (2003). Classroom applications of research on self-regulated learning. In Educational Psychology. Routledge.
17. Pietila, M., & Virkkula, E. (2011). Integrating Therapy and Practice According to PBL-based Project Designs in Secondary Vocational Education of Engineering and Music. In J. Davies, E. Graaff, & A.

Kolmos (Eds.), *PBL across the disciplines: research into best practice*. Proceedings from the 3rd International Research Symposium on PBL, Coventry University. Aalborg University Press, 54-63.
18. Roessingh, H., & Chambers, W. (2011). Project-Based Learning and Pedagogy in Teacher Preparation: Staking Out the Theoretical Mid-Ground. *International Journal of Teaching and Learning in Higher Education, 23*(1), 60-71.
19. Schreier, M. (2012). Qualitative content analysis. Thousand Oaks, CA: Sage.
20. Silverman, D. (2011). Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction (4th edition). London: Sage.
21. Tran Viet Cuong, & Nguyen Van Tuan. (2021). Project-based Learning Method in Advanced Mathematics for Engineering Students in Vietnam: Experimental Research. *Universal Journal of Educational Research, 9*(3), 528-539.
22. Zhang, D., & Hwang, G. J. (2023). Effects of interaction between peer assessment and problem-solving tendencies on students' learning achievements and collaboration in mobile technology-supported project-based learning. *Journal of Educational Computing Research, 61*(1), 208–234.