Formatif: Jurnal Ilmiah Pendidikan MIPA, September 2023, 13 (2), 295-304
http://dx.doi.org/10.30998/formatif.v13i2.19785
p-ISSN: 2088-351Xe-ISSN: 2502-5457
Accredited (S2) by Ministry of Research and Technology of Indonesia No. 148/M/KPT/2020
Available online at https://journal.lppmunindra.ac.id/index.php/Formatif/index

The Effect of Project-Based Learning through Blended Learning on Students' Learning Achievement of English for Mathematics

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Abstract

The implementation of effective teaching-learning is pivotal in enhancing student's learning outcomes and teaching performance. One such model that holds promise is project-based learning (PjBL). This research employed a pre-experimental, one-shot case study design to investigate the impact of PjBL on student's achievement. Participants were selected using purposive sampling, 29 students from the English for Mathematics class at Universitas Borneo Tarakan for the academic year 2022/2023. Data collection relied on post-test instruments, subsequently analyzed using the one-sample t-test. The findings reveal a significant result of 7.489 ($p < .001$) in comparison to the critical value of 2.048 ($\alpha = .05$), underscore the noteworthy disparities in student achievements. Thus, it can be deduced that the integration of the PjBL has a substantial influence on elevating student performance in English for Mathematics classes. This research emphasizes the positive effects of PjBL and its role in fostering enhanced academic accomplishments within the context of Universitas Borneo Tarakan.

Keywords: Project-Based Learning, Teaching Performance, English for Mathematics

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How to Cite: Rafiqa, S., Ridwan, R., & Simamora, R.E. (2023). The effect of project-based learning through blended learning on students' learning achievement of English for mathematics. *Formatif: Jurnal Ilmiah Pendidikan MIPA, 13* (2): 295-304. http://dx.doi.org/10.30998/formatif.v13i2.19785

INTRODUCTION

The endeavor to master English for Mathematics within a university setting diverges markedly from the approach taken in international schools. Here, the emphasis broadens beyond mere proficiency in English Mathematics, encompassing pedagogical skills requisite for imparting this knowledge to prospective students. Universitas Borneo Tarakan's curriculum for English for Mathematics introduces a dynamic blend of interactive learning and information and communication technology, nurturing students' competence in teaching mathematics using English as the instructional medium. Through the creation and execution of straightforward English for Mathematics learning scenarios, students gain hands-on experience, equipping them to synthesize instructional methodologies. At its core, this study delves into the impact of the project-based learning model on student achievements within the English for Mathematics classes at Universitas Borneo Tarakan.

Project-based learning (PjBL) emerges as an immersive, student-centric pedagogical approach that galvanizes learners to independently explore solutions to real-world challenges (Kundu & Perwez, 2022; Laur, 2021; Trostel, 2023; Silva et al, 2019). Rooted in tangible problems, PjBL initiates a sequence of tasks wherein students employ pre-existing knowledge and skills from their subject area to devise innovative solutions. With a defined timeline, the project culminates in a comprehensive report or an oral presentation, replacing traditional lectures with active mentorship and guidance from

educators. Substantial research attests to the efficacy of PJBL in fostering holistic student engagement and enhancing communication and teamwork proficiencies (Helle et al., 2006; Kokotsaki D et al., 2016; Sauter et al., 2022).

This approach further hones essential soft skills, a growing priority in contemporary education, during the project's reporting and presentation phase. As students present their findings, they refine their aptitude for delivering compelling presentations – an invaluable aspect of effective teaching. Active cognitive engagement, including a critical assessment of project strengths and weaknesses, formulation of relevant queries, inference drawing, and anticipation of future developments, underscores the PjBL's efficacy. Regardless of achieving initial project objectives, this participatory process signifies the success of the PjBL methodology (Sauter et al., 2022). The role of mentors and interactive classroom discussions play a pivotal role in nurturing these learning outcomes, marking a departure from conventional approaches and aligning with knowledge acquisition principles (Phyllis C. Blumenfeld et al., 2011). Consequently, PjBL has emerged as a pedagogical approach akin to teacher education, prioritizing experiential learning and preparing educators for practical instruction (Almulla, 2020; Grossman et al., 2019).

Indonesia has witnessed a proliferation of PjBL initiatives and studies within its university landscape. Notably, these endeavors have demonstrated PJBL's efficacy in cultivating life skills (Sucilestari & Arizona, 2018), academic performance (A. Purwanto et al., 2021; Lona, 2019), motivation (Anggraeni, 2022), and creativity (Deni & Asiyah, 2019). In light of this backdrop, this research aims to assess students' achievements under the PjBL framework, with a specific focus on teaching performance aligned with evaluative criteria. It seeks to extend the understanding of PjBL's influence on English for Mathematics achievements through its impact on teaching performance, opening avenues for multifaceted educational enhancement.

Despite the growing interest in PjBL as an effective pedagogical approach and the increasing adoption of blended learning environments (Marsiti et al., 2023), there remains a research gap regarding the implementation of PjBL within the context of mathematics blended learning in the university setting, specifically in the English for Mathematics course. While there is existing research that explores the benefits of PjBL and blended learning separately, there is limited inquiry into how these two methods intersect and synergize to enhance student learning outcomes in mathematics education.

This research gap highlights the need to investigate the integration of PjBL strategies within a blended learning environment in the English for Mathematics course. By exploring the design, execution, and assessment of PjBL activities in this context, researchers can contribute to a deeper understanding of how these two educational approaches can complement each other to foster student engagement, critical thinking, and language development while learning mathematics. Additionally, an examination of potential challenges, strategies for successful implementation, and the impact on student achievement within this specific course setting can provide valuable insights for educators, curriculum designers, and educational policymakers seeking to optimize teaching and learning experiences.

METHODS

This research employed a pre-experimental approach utilizing a one-shot case study design. In this design, a single group received the treatment, followed by a posttest to evaluate the outcomes, thereby allowing the observation of changes resulting from the treatment (Pujiyanti et al., 2021; Warniasih & Nuryani, 2018). Given the absence of a

control group, this design primarily focused on assessing the effect of the treatment on the dependent variable (Fraenkel et al., 2023; Gay et al., 2012). The schematic representation of the one-shot case study design is provided in Table 1.

Table 1. One-Shot Case Study Design

X	O
Treatment	Posttest (Dependent Variable)

The research involved a cohort of 29 students, consisting of eight males (34.50%) and 19 females (65.50%), who were enrolled in the English for Mathematics class at Universitas Borneo Tarakan. These students were in their second year of study. In advance of commencing the study, the participants were provided with consent letters by the researchers, detailing their inclusion in a project focused on the implementation of PjBL within the context of English for Mathematics. Subsequently, the participants provided their voluntary agreement to partake in the study. The research methodology employed PjBL as the central instructional approach, with a specific emphasis on crafting and presenting a straightforward learning scenario in English. To evaluate the hypotheses, a one-sample t-test was administered. The utilization of a one-sample t-test permits a comparison of a solitary independent variable.

This research was conducted in the Department of Mathematics Education, Faculty of Education and Teaching (FKIP), at Borneo Tarakan University, one of the state universities in North Kalimantan, Indonesia. The course in this study, English for Mathematics, was carried out using blended learning, which combines face-to-face and online learning. Within this course, students faced two challenging group projects: 1) designing a Mathematics lesson plan (LP) presented in a PowerPoint format, and 2) creating a micro-teaching video following the LP guidelines, uploaded to YouTube. Furthermore, there were similar individual projects: 1) creating an LP for teaching a Mathematics topic, and 2) producing a micro-teaching video based on the LP, also uploaded to YouTube.

The resulting products, LP, and instructional videos were assessed considering: (1) *Fluency and Coherence,* students' ability to speak fluently and coherently, organizing their thoughts logically while explaining the learning materials; (2) *Lexical Resource* (*vocabulary*), their ability to demonstrate a range of accurate mathematical vocabulary when explaining concepts; (3) *Pronunciation*, how well students pronounced the materials to ensure they were understandable by the audience; (4) *Task Appropriateness*, students' capacity to produce instructional videos suitable for school students, with mathematically accurate content and pedagogical approaches aligned with sound teaching principles; and (5) *Creativity*, their capability to generate engaging, non-plagiarized, and innovative LP and instructional videos.

Tasks and assessment rubrics used in this evaluation were validated by experts within the department. The processed data in this study originated from the assessment of both group and individual project tasks.

RESULTS & DISCUSSION

Results

Table 2 illustrates the outcomes of students' learning achievements in the English for Mathematics course within the Mathematics Education Department of FKIP at

Universitas Borneo Tarakan after instruction using PjBL. For a traditional depiction of the distribution, showcasing the percentage of students' achievements in various score categories, please refer to Table 3.

Table 2. The result of Students' Learning Achievement of English for Mathematics

No.	Student Code	Score	Category	No.	Student Code	Score	Category
1	Std_01	64.35	C	16	Std_16	82.10	A
2	Std_02	75.84	AB	17	Std_17	77.10	AB
3	Std_03	76.95	AB	18	Std_18	87.45	A
4	Std_04	75.00	AB	19	Std_19	75.30	AB
5	Std_05	66.30	BC	20	Std_20	69.85	BC
6	Std_06	91.15	A	21	Std_21	75.75	AB
7	Std_07	85.60	A	22	Std_22	91.80	A
8	Std_08	88.15	A	23	Std_23	89.35	A
9	Std_09	86.80	A	24	Std_24	80.05	A
10	Std_10	83.35	A	25	Std_25	85.60	A
11	Std_11	81.20	A	26	Std_26	86.00	A
12	Std_12	78.75	AB	27	Std_27	71.00	B
13	Std_13	79.85	AB	28	Std_28	85.75	A
14	Std_14	78.65	AB	29	Std_29	81.50	A
15	Std_15	71.30	B				

Table 3. The Percentage of Students' Learning Achievement of English for Mathematics

No.	Category	Predicate	Interval	Frequency	Percentage (%)
1	A	Very Good	> = 80	15	51.72
2	AB	Good-Very Good	75 – 79	9	31.03
3	B	Good	70 – 74	2	6.90
4	BC	Fair-Good	65 – 69	2	6.90
5	C	Fair	60 – 64	1	3.45
6	CD	Poor-Fair	55 – 59	0	0
7	D	Poor	40 – 54	0	0
8	E	Very Poor	< 40	0	0
	Total			29	100

Table 3 outlines the distribution of students' scores in the English for Mathematics course. The preeminent proportion of students (15 out of 29) achieved the classification of "Very Good" followed by 9 students who attained scores in the "Good-Very Good" range. A smaller number of students received scores of "Good", "Fair-Good", and "Fair" while no students' scores fell within the categories of "Poor-Fair", "Poor", and "Very Poor."

After data collection, the analysis focuses on evaluating students' learning achievements in English for Mathematics. Initially, an assumption test is conducted, specifically a normality test employing the Shapiro-Wilk test, facilitated by the SPSS software for Windows. The obtained significance value for students' learning

achievements surpass the predetermined significance level ($0.608 > .05$). Given that the significance value exceeded .05, it can be concluded that the data exhibited a normal distribution. Refer to Table 4 for a presentation of the outcomes of the normality test.

Table 4. The result of Tests of Normality

	Shapiro-Wilk		
	Statistic	df	Sig.
English for Mathematics Achievement	.972	29	.608

Furthermore, hypothesis testing is performed to ascertain the efficacy of the project-based learning approach on students' achievements in the English for Mathematics course. The statistical summary of students' learning achievements is provided in Table 5, while the outcome of the hypothesis testing, conducted via a one-sample t-test, is presented in Table 6.

Table 5. Description of One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
English for Mathematics Achievement	29	80.063	7.235	1.343

The data reveals that the average score of students' learning achievements amounted to 80.068, indicating that the students attained scores within the "Very Good" range.

Table 6. The result of the One-Sample T-Test

	Test Value = 70.00					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
English for Mathematics Achievement	7.489	28	.000	10.063	7.311	12.815

Utilizing the One-Sample t-test, a two-tailed significance value of .000 is computed. This value is subsequently compared against the predetermined significance level of .05. Given that .000 is smaller than .005, the outcome signified the rejection of the Null Hypothesis (H_0) in favor of accepting the Alternative Hypothesis (H_a). Consequently, it can be deduced that the mean score of students' learning achievements in the English for Mathematics course surpass a score of 70.00. Thus, it can be affirmed that the mean score of students' learning achievements not only reached but also exceeded the "Good" category.

Discussion

The results of this research reaffirm the effectiveness of PjBL in improving learning outcomes, as can be found in all areas of education, including Mathematics, Science, engineering, medical, and professional education (Boaler et al., 2022). PjBL enhances student collaboration (Owen & Hite, 2022; Triana, Anggraito, & Ridlo, 2020; Baser, Ozden, & Karrarslan, 2017; Juuti et al, 2021), thus increasing their motivation to learn. Moreover, this pedagogical approach boosts students' activity in exploring the content they are learning. In recent years, the integration of PjBL has gained substantial recognition for its positive impact on student performance across various educational contexts. The research conducted by Jiang et al. (2023) stated that the integrated approach of English and mathematics learning was more effective for learners with higher expertise, whereas the separated learning condition of English and mathematics was more advantageous for learners with lower expertise. In this research, both high-expertise and low-expertise students learn together, whether in content where English and Mathematics are integrated or in content where English and Mathematics are taught separately.

Research shows PjBL's effectiveness in boosting student achievements, especially in challenging subjects. Studies reveal the multifaceted benefits of integrating PjBL into education. Uyen et al. (2023) conduct a systematic review on online PjBL adoption in teacher education, finding that even online, PjBL enhances pre-service teachers' knowledge, skills, and attitudes. Despite technical challenges, it thrived during the pandemic's shift to online learning. Expanding on this, Uden et al. (2023) craft STEM-PjBL, merging neuroscience with teaching. They test it by teaching Physics in Malaysia and South Korea. The STEM-PjBL group, compared to the traditional approach, embraced more positive shifts in their beliefs about physics, showing how cognitive science amplifies learning engagement, even in abstract subjects.

Nuraini et al. (2023) take the integration of PjBL further by combining it with a STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach to foster science literacy among high school students. Their study develops and validates a PjBL model with a STEAM approach for teaching ecosystem materials. The results indicate the practicality and effectiveness of the developed model in improving students' science literacy abilities. This research underscores the potential of combining innovative teaching approaches to address complex educational goals, such as enhancing science literacy. In line with these findings, Baidal-Bustamante et al. (2023) proposed an innovative approach, combining the STEAM model and PjBL referred to as STEAM-PjBL. This approach aims to tackle students' challenges in understanding Pascal's principle. Through an experimental design involving control and experimental groups, the study points out that the STEAM-PjBL approach enhances the teaching-learning process and maintains students' motivation during lectures. This exemplifies how the fusion of PjBL and STEAM can yield positive outcomes in knowledge acquisition and student’s engagement.

Finally, Zenkov et al. (2023) suggest that pre-service teachers' identification with pedagogical practices aligned with their teaching identities can be nurtured through experiences in school-university partnerships. This insight further supports the notion that practical, real-world experiences can play a pivotal role in shaping teachers' instructional approaches and identities. Collectively, these studies underscore the transformative potential of PjBL and its variations, particularly when combined with innovative approaches such as STEAM and neuroscience principles. These findings provide valuable insights for educators seeking effective strategies to enhance student learning outcomes and engagement across diverse subjects and educational levels.

The research findings are based on a specific sample of 29 students from the English for Mathematics course at Universitas Borneo Tarakan, potentially limiting generalizability. The research employs a pre-experimental, one-shot case study design, which may not fully capture complexities in different contexts. Purposive sampling might have introduced bias, affecting the representation of student's profiles and abilities (Creswell & Poth, 2018). The study focuses mainly on PjBL's impact, potentially overlooking other factors like learning preferences and socio-economic status.

Our research, which focuses on English for Mathematics classes, aligned with several other studies that explored the benefits of project-based learning (PjBL) in different educational contexts. Specifically, our study demonstrates a significant improvement in student's achievement through the integration of PjBL. This finding is consistent with Nilsook et al.'s (2021) framework for PjBL management in vocational education, which emphasizes the development of attributes like creativity, critical thinking, and effective communication.

In addition, Saduakassova et al. (2023) introduce PjBL in a Mathematics classroom and report an increase in student's responsibility, collaboration, and teamwork skills—all of which contributed to the development of 21st-century abilities. Furthermore, (Syakur et al., 2020) investigate PjBL's impact on English learning outcomes, revealing a significant improvement in student's performance and emphasizing the importance of creative thinking and problem-solving. Similarly, Ennis et al. (2022) compare PjBL with traditional teaching methods in an intensive English course and observed positive participant attitudes toward PjBL, highlighting its potential in language education. These studies collectively underscore the effectiveness of PjBL in enhancing student's outcomes and skills development across various educational settings, including Mathematics, vocational education, and language instruction.

Future studies could include a larger, diverse sample from various classes to enhance generalizability. Longitudinal studies could provide insights into PjBL's lasting impact on student's performance. Comparative studies could offer a comprehensive assessment of PjBL's benefits and drawbacks. Exploring additional factors like motivation through multivariable analyses could clarify PjBL's effectiveness. Replicating the study across settings and subjects could validate the findings' robustness. Incorporating qualitative data alongside quantitative findings could provide deeper insights (Creswell & Creswell, 2017). Addressing these limitations and pursuing recommendations could enrich understanding of PjBL's role in student's achievement, guiding effective teaching strategies.

CONCLUSION

Based on the outcomes of the conducted data analysis, the research findings lead to the conclusion that project-based learning exerts a significant influence on the attainment of achievements in the English for Mathematics course. The utilization of project-based learning, serving as both a pedagogical strategy and a medium for teaching performance, emerges as an effective means to enhance students' performance in the learning process of English for Mathematics. This approach serves as a potent tool to facilitate students' engagement and accomplishment within the realm of English for Mathematics education.

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