THE EFFECTIVENESS OF DIGITAL PROJECT-BASED LEARNING ON STUDENTS' ENGLISH ACADEMIC VOCABULARY MASTERY

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ABSTRACT

Enhancing academic vocabulary mastery is an essential element in studying the English Language because it is fundamental for academic literacy and professional communication. Since it is crucial, many students experience difficulties in mastering academic vocabulary fluently. This research aims to determine the significant effect of using digital project-based learning in on students' academic vocabulary mastery. A quasi-experimental design was implemented by a one-group pre-test and post-test. There were thirty undergraduate students from the English Language Education Department. Data were gathered by an academic vocabulary test and analyzed by using descriptive statistics and a paired-sample t-test. The results showed that digital project-based learning has a significant effect on students' English academic vocabulary competence, with a significance value of 0.000 ($p < 0.05$). This finding proved that digital project-based learning is an effective model for enhancing students' English academic vocabulary Mastery in higher education.

Keywords: Digital Project-Based Learning, Academic Vocabulary, English Education, Higher Education, Vocabulary Mastery.

INTRODUCTION

Academic vocabulary plays a fundamental role in students' English communication, especially for higher education. It enables students to comprehend academic texts, write academic articles, speak in formal situations, and engage in other academic activities. On the contrary, limited academic vocabulary can influence students' academic performance in using English for academic purposes. Consequently, enhancing students' mastery of academic vocabulary has become a fundamental objective in English language education, especially at the tertiary level, where students are expected to demonstrate elevated levels of academic literacy.

In the higher education context, university students are required to master academic vocabulary because they often experience academic situations that require their competence to communicate in formal situations. Academic vocabulary competence is needed to address this situation properly. Unfortunately, university students enter the university atmosphere with insufficient exposure to English academic vocabulary, as result they face difficulties in reading, writing, and other academic performances (Cahyono & Widiati, 2008).

Ideally, academic vocabulary learning provides the use of vocabulary in academic usage, learning context, and word classes used. Nation (2013) explains that effective academic vocabulary learning includes word meanings and applying words appropriately in various contexts. Similarly, Coxhead (2000) claims that the Academic Word List (AWL) highlights the needs of systematic instruction in academic vocabulary for accelerating students' academic literacy. These theoretical point of view suggest that academic vocabulary learning should go beyond memorization and focus on the meaningful use of language in authentic academic contexts.

Furthermore, the way we usually teach vocabulary is by making students memorize lists of words translate them and do exercises that are not connected to anything and this is what often happens when people are learning English as a foreign language. This difference between what we think should happen and what really happens in the classroom is a problem when it comes to teaching vocabulary. Students might get a little better at recognizing vocabulary for a time but they have a hard time remembering it and using it when they do academic work.

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So we need to come up with creative ways to teach vocabulary that can help fix the gap between what we think is a good idea and what actually happens in the classroom, especially when it comes to teaching academic vocabulary.

Recently, digital technology is changing fast and this is a great chance for teaching and learning effectively. It significantly allow us to use tools in order to make learning more fun and interactive. Students can work collaboratively to be creative and solve problems. While learning English, digital technology helps students get learning materials, talk to their classmates and make videos and pictures that show they understand what they are learning.

In addition, many studies have revealed that using technology in learning can make students more excited, interested, and involved in the learning process. It is caused by the integration of technology, which lets them take a part in the learning process and have experiences that are meaningful. So, using technology to teach vocabulary in school is an impactful option. It helps students to improve their language skills.

Then, one teaching model that is appropriate with the principles of active learning and technology integration is Project-Based Learning (PjBL). It is a student-centered teaching model that aims to have students learn by working on projects that require them to investigate challenges, implement knowledge, and create a meaningful product. It encourages collaboration, critical thinking, and communication skills because students are actively involved in constructing knowledge through real-world tasks to build their knowledge (Thomas: 2000).

In line, many studies have shown that project-based learning is effective in improving students' language skills. Previous research has reported that project-based learning can improve students' speaking skills, writing abilities, and overall language proficiency (Melie, 2023). For instance, studies conducted in secondary school settings have shown that project-based learning enhances students' motivation and engagement in language learning activities (Salsadilla et al., 2025). Other studies prove that technology-supported learning environments can enhance students' academic performance by accommodating interactive and collaborative learning experiences (Koşar, 2021). These findings suggest that Project-Based Learning and digital technology

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have the potential to increase academic vocabulary and English language learning outcomes.

Digital Project-Based Learning (DPBL) is an instructional model that integrates technology into project-based learning activities to enhance students' learning experiences. This model uses various digital tools and platforms, such as online collaboration applications, multimedia resources, generative AI, digital presentations, and interactive content creation, to support the learning process. Through DPBL, students are encouraged to produce meaningful digital products, including videos, digital posters, and multimedia presentations, as demonstrations of their understanding and knowledge. In addition, DPBL provides opportunities for students to develop digital literacy skills while applying academic vocabulary and language skills in authentic and meaningful contexts. The integration of technology in project-based activities also promotes creativity, collaboration, critical thinking, and communication skills, which are essential competencies in the digital era. Furthermore, DPBL has been recognized as an effective approach for language learning because it creates engaging, interactive, and student-centered learning environments that facilitate deeper understanding and active participation.

Based on the issues described above, this study aims to investigate the effectiveness of Digital Project-Based Learning on students' English academic vocabulary mastery among undergraduate students in English Language Education. Furthermore, the findings of this research also address practical implications for lecturers and curriculum designers, in developing innovative vocabulary instruction models that align with the demands of 21st-century learning.

1. English Academic Vocabulary Competence

Academic vocabulary is a pivotal component of academic literacy and language learning, particularly for students' language proficiency in higher education. Academic vocabulary refers to words that frequently occur in academic texts across disciplines and are essential for understanding academic content, expressing ideas clearly, and participating in scholarly communication. Coxhead (2000) introduces the Academic Word List (AWL), which consists of high-frequency academic words commonly used in academic texts. The AWL has been widely

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used as a reference for designing vocabulary instruction in educational settings.

Vocabulary knowledge involves several indicators, including meaning, form, and use. Students should recognize not only vocabulary items but also understand how to use them appropriately in different contexts and relate appropriate meaning (Nation, 2013). This perspective emphasizes that vocabulary acquisition is not labeled as a simple memorization process but a gradual and dynamic learning process.

Furthermore, academic vocabulary holds a significant role in students' English language learning skills. Students with strong academic vocabulary knowledge are more capable of understanding complex texts, producing coherent academic writing, and expressing ideas in the right context. Conversely, limited academic vocabulary knowledge can hinder students' academic success.

In the context of EFL (English for Foreign Language), academic vocabulary mastery is particularly important because students are expected to develop academic literacy skills that support their communication skills for future professional roles as professional teachers. Pre-service teachers must demonstrate the ability to use academic language effectively in teaching, instructional design, and classroom communication.

Therefore, improving students' mastery of academic vocabulary has become an essential target in English language teaching at the higher education level. It can be done by focusing on form, meaning, and use contextually. It will help students master the concept and apply it in communication.

Theoritically, vocabulary learning is more effective when students engage in meaningful activities that require active use of vocabulary (Webb & Nation: 2017). Similarly, studies in higher education contexts have shown that using vocabulary instruction into authentic learning tasks can significantly accelerate students' vocabulary mastery. These findings suggest that innovative instructional models are needed to support academic vocabulary development in higher education.

2. Project-Based Learning in Language Education

Project-Based Learning (PjBL) is an instructional model that emphasizes student-centered learning through the completion of meaningful projects.

According to Thomas (2000), Project-Based Learning is characterized by inquiry-based activities, collaboration, and the production of a final product that reflects students' understanding of the learning material. This approach encourages students to actively participate in the learning process and develop critical thinking skills.

Bell (2010) explains that Project-Based Learning promotes comprehension learning because students are involved in problem-solving activities in real-life contexts that require them to apply knowledge in real-world situations. In language learning, Project-Based Learning provides opportunities for students to use language in authentic situations, thereby enhancing students' language proficiency and retention. Students who participate in project-based activities are more intended to develop communication skills, collaboration skills, and self-directed learning abilities.

Research findings have demonstrated the effectiveness of Project-Based Learning in improving language learning outcomes. For example, a study conducted by Bas (2011) states that students who learned through Project-Based Learning achieved higher academic performance compared to those who learned through traditional methods. Similarly, research conducted by Grant (2011) reported that Project-Based Learning improves students' motivation and engagement in classroom activities.

Effective academic vocabulary learning requires repeated exposure in meaningful contexts, not just memorizing the list of words (Nation & Webb, 2011; Schmitt & Schmitt, 2020). This argument is supported by Hulstijn & Laufer (2001), they say that vocabulary retention accommodates students' engagement in the learning experience and can stimulate students' cognitive competence actively in task-embedded language use. In addition, Schmitt and Schmitt (2020) emphasize that deep word knowledge regarding collocational, grammatical, and word family context is attainable through variation exposures, especially for authentic contexts. That discussion recognized PjBL as an effective model for language learning because it creates engaging, interactive, and student-centered learning environments that facilitate deeper understanding and active participation.

In Project-Based Learning (PjBL), students engage in various meaningful and student-centered activities that encourage

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active participation in the learning process. These activities may include conducting research, discussing ideas in groups, creating digital storytelling projects, writing collaborative reports, designing posters, and delivering oral presentations. Students are also involved in problem-solving tasks and real-world projects that require them to explore information, organize ideas, and communicate their findings creatively. Through these activities, learners become more responsible for their own learning while actively interacting with peers and learning materials.

Several classroom projects can effectively support academic vocabulary acquisition in PjBL. For example, students may create digital storytelling videos about environmental issues, where they use academic vocabulary to explain causes, effects, and solutions. Then, students can make flashcards providing the meaning, word form, and an example in a complete sentence. Another example is collaborative report writing, in which students work together to investigate a topic and present their findings using formal academic language. Teachers may also assign oral presentation projects that require students to describe research results, analyze data, or compare information using appropriate academic expressions. These projects provide meaningful opportunities for students to practice vocabulary actively in realistic and engaging learning situations.

However, despite the benefits of Project-Based Learning, some challenges remain in its implementation. Teachers may encounter difficulties in designing effective projects, managing classroom activities, and assessing student performance. Therefore, the integration of digital technology into Project-Based Learning has been proposed as a strategy to enhance its effectiveness and efficiency.

3. Digital Project-Based Learning

The integration of digital technology into Project-Based Learning has led to the development of Digital Project-Based Learning, an instructional approach that combines project-based pedagogy with digital tools and platforms. Digital Project-Based Learning allows students to create multimedia products through Canva, Vocaroo, QR Code Maker, Gemini AI, and ElevenLabs, collaborate online through Padlet, and access diverse learning resources through Google Sites. This approach aligns with the principles of 21st-century learning, which emphasize

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technology integration, collaboration, and creativity.

According to Krajcik and Blumenfeld (2006), technology-supported learning environments can enhance student engagement and promote deeper understanding of learning materials. Digital tools provide opportunities for students to explore information, communicate ideas, and present their work creatively. These features make Digital Project-Based Learning an effective instructional strategy for improving learning outcomes in language education.

Research has shown that digital learning environments can improve students' motivation and academic performance. For example, a study conducted by Wang (2020) found that the use of digital tools in project-based learning significantly increased students' engagement and learning achievement. Similarly, research conducted by Hsu and Chen (2019) reported that digital project-based activities improved students' language proficiency and collaborative skills.

In addition, digital learning environments support collaborative learning, which is an important factor in language development. Students can interact with peers, share ideas, and receive feedback during project activities. This interaction promotes language practice and enhances vocabulary acquisition. Therefore, Digital Project-Based Learning has the potential to improve students' academic vocabulary mastery while simultaneously developing digital literacy skills.

Therefore, this study aims to address these limitations by investigating the effectiveness of Digital Project-Based Learning in improving students' academic vocabulary mastery in a higher education context. By focusing on academic vocabulary and integrating digital technology into project-based instruction, this research provides a new perspective on vocabulary teaching in higher education.

METHODS

This study employed a quasi-experimental design. The research applied a one-group pre-test and post-test design, which enabled the researcher to measure students' academic vocabulary performance before and after the

instructional intervention or treatment. It allowed the researcher to measure students' improvement before and after the implementation of the treatment within the same group. This design was considered appropriate due to practical limitations, including limited class availability and institutional constraints that made the inclusion of a control group difficult. Although the design effectively measures learning progress, it may also have limitations because external factors outside the treatment could influence the results. Therefore, the findings should be interpreted carefully while considering possible influences such as students' prior knowledge, learning experiences, and environmental factors.

The study was conducted in the English Language Education at a private university in Indonesia during one academic semester. This design was selected because it allows the researcher to determine the effectiveness of an instructional model in a natural classroom setting by comparing learning outcomes across two measurement points.

Respondents

The respondents in this study were 30 undergraduate students enrolled in an academic vocabulary course. The participants were selected using purposive sampling based on their enrollment in the course and their participation in classroom learning activities during the semester. The participants demonstrated relatively similar levels of English proficiency based on their previous academic performance, which helped ensure consistency in measuring learning improvement.

Instruments

The primary instrument used in this study was an academic vocabulary test designed to measure students' mastery of academic vocabulary in English. The test consisted of 30 items in the form of multiple-choice and short-answer questions developed based on the Academic Word List (AWL). The test items were constructed to assess several aspects of vocabulary knowledge, including understanding word meanings, recognizing vocabulary usage in context, and identifying appropriate word forms in academic communication.

Data collection procedures

Data collection in this study was conducted through three main stages: pre-test, treatment, and post-test. At the beginning of the study, students completed a pre-test to analyze their initial level of academic vocabulary mastery. After the

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pre-test, the treatment was implemented over six instructional meetings using digital project-based learning activities. During the treatment sessions, students engaged in structured learning activities, including exploring academic vocabulary through digital resources, planning project topics, developing digital products such as presentations, digital posters, flash cards, and short educational videos, and presenting their projects to peers. These activities provided opportunities for students to apply academic vocabulary in authentic communication tasks and collaborative learning environments. At the end of the treatment period, students completed a post-test using the same academic vocabulary test to determine the improvement in their vocabulary mastery. The collected data were analyzed using descriptive statistics to summarize students' test scores and inferential statistical analysis to determine whether there was a significant difference between pre-test and post-test results. The level of significance used in this study was 0.05 to evaluate the effectiveness of the instructional intervention.

Data analysis

The collected data were analyzed using descriptive and inferential statistical techniques through SPSS software. If the significance value was lower than 0.05, the improvement in students' academic vocabulary mastery was considered statistically significant, indicating that Digital Project-Based Learning contributed positively to students' learning outcomes.

RESULTS AND DISCUSSION

Results

The results of this study were obtained from the analysis of students' academic vocabulary test scores administered before and after the implementation of digital project-based learning. The data was analyzed using SPSS software through a paired-sample t-test to determine students' level of achievement and the effectiveness of using the Digital-PjBL intervention.

Table 1. Students' Academic Vocabulary Scores

Test	Mean	Standard Deviation	Minimum	Maximum

Pre-test	62.40	8.75	45	78
Post-test	81.20	7.60	65	95

The data indicate a substantial improvement in students' academic vocabulary mastery after the implementation of Digital Project-Based Learning. The mean score increased from **62.40** in the pre-test to **81.20** in the post-test, showing a significant gain in students' vocabulary performance.

Table 2. The Results of the Paired Sample Statistical Analysis

Variable	Mean Difference	t-value	df	Sig. (2-tailed)
Pre-test – Post-test	**18.80**	**9.45**	**29**	**0.000**

The statistical analysis revealed that the significance value was **0.000**, which is lower than the predetermined level of significance (0.05). This result indicates that there was a statistically significant improvement in students' academic vocabulary mastery after the implementation of Digital Project-Based Learning.

Table 3. N-Gain Score of Students' Academic Vocabulary Mastery

Indicator	Value
Mean Pre-test Score	62.40
Mean Post-test Score	81.20
Maximum Score	100
N-Gain Score	0.50
Category	Moderate

The N-Gain score of 0.50 shows that students had a good improvement, in mastering academic vocabulary after doing Digital Project-Based Learning activities. This means that Digital Project-Based Learning was a way to help students learn new vocabulary and get better at using academic language. The Digital Project-Based Learning approach really helped students learn vocabulary in a way and supported the development of their academic language skills..

Discussion

The findings of this ***study demonstrate that the*** implementation of Digital Project-Based Learning significantly improved students' English academic vocabulary mastery. As presented in Table 1, the mean score of students increased from 62.40 in the pre-test to 81.20

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in the post-test, indicating a substantial improvement in vocabulary performance after the instructional intervention. Furthermore, the statistical analysis shown in Table 2 revealed that the significance value was lower than the predetermined level of significance ($p < 0.05$), confirming that the improvement in students' academic vocabulary mastery was statistically significant. These results indicate that Digital Project-Based Learning was effective in facilitating meaningful vocabulary learning among university students. Similar findings have been reported in recent studies showing that technology-supported project-based learning significantly improves students' language achievement and engagement in higher education contexts (Han, Capraro, & Capraro, 2021; Xu, 2022).

The distribution of students' achievement levels illustrated in Figure 1 further supports the effectiveness of the instructional intervention. The majority of students achieved satisfactory to excellent performance levels in the post-test, indicating that Digital Project-Based Learning provided effective learning support for students with diverse vocabulary proficiency levels. Recent research has emphasized that student-centred digital learning environments enhance student engagement and improve learning outcomes when learners are actively involved in collaborative and authentic learning activities (Bond et al., 2020; Zhang & Zou, 2021). This finding suggests that the integration of digital tools in project-based learning creates an interactive learning environment that supports vocabulary acquisition.

The significant improvement in students' academic vocabulary mastery can be explained through contemporary vocabulary learning theory, which highlights the importance of repeated exposure, contextual practice, and meaningful use of vocabulary in authentic communication contexts. Nation (2019) emphasized that vocabulary learning becomes more effective when learners actively use target vocabulary in meaningful tasks rather than memorizing isolated word lists. In this study, students were required to apply academic vocabulary while completing digital projects, such as presentations and multimedia assignments. These activities provided opportunities for students to practice vocabulary in context and develop deeper understanding of word meanings. Recent studies have confirmed that contextualized vocabulary learning supported by digital media leads to

improved vocabulary retention and academic performance (Teng, 2023; Webb & Nation, 2020).

The results of this study are also consistent with recent perspectives on constructivist and collaborative learning, which emphasize that knowledge is constructed through interaction, reflection, and problem-solving activities in social learning environments (Schunk, 2020). During the implementation of digital project-based learning, students worked collaboratively in groups to explore academic vocabulary, plan projects, and present their findings to peers. These collaborative learning experiences enabled students to exchange ideas, receive feedback, and develop communication skills. Research conducted by Kokotsaki, Menzies, and Wiggins (2016) demonstrated that project-based learning improves students' higher-order thinking skills and academic performance when learners are actively engaged in authentic problem-solving activities.

In addition, the integration of digital technology played a significant role in enhancing students' motivation and participation during the learning process. Digital tools provided interactive learning experiences that allowed students to access learning resources, create multimedia content, and communicate ideas creatively. Recent studies have reported that technology-enhanced learning environments increase students' motivation and academic achievement because they provide opportunities for active learning and collaboration (Alenezi, 2023; Bond et al., 2020). The findings of this study support these results by demonstrating that digital project-based learning can significantly improve students' academic vocabulary mastery.

Another important finding of this study relates to the moderate level of learning gain indicated by the N-Gain score of 0.50**,** which falls into the moderate improvement category. This result suggests that students experienced meaningful improvement in vocabulary mastery after participating in Digital Project-Based Learning activities. Moderate learning gains indicate that the instructional strategy effectively supports student learning while still providing opportunities for further development. Similar findings were reported in recent educational research, indicating that project-based digital learning environments contribute to measurable improvements in student learning outcomes (Hidayat, 2022; Susanti & Rahayu, 2019).

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Furthermore, the findings of this study provide important pedagogical implications for English language teaching in higher education. The results suggest that lecturers should consider integrating Digital Project-Based Learning into vocabulary instruction to create more engaging and meaningful learning experiences. Traditional vocabulary teaching methods that rely heavily on memorization may not effectively support long-term vocabulary retention. In contrast, project-based learning activities encourage students to apply vocabulary knowledge in authentic situations, leading to deeper understanding and improved learning outcomes (Krajcik & Shin, 2019; Thomas, 2020).

Finally, the results of this study highlight the importance of integrating digital literacy skills into language learning in the modern educational context. Students in English Education programs are expected to develop both language proficiency and technological competence to meet the demands of 21st-century education. Digital Project-Based Learning provides a learning environment that supports the development of these competencies simultaneously and prepares future teachers to implement innovative teaching strategies in their professional practice.

CONCLUSIONS

This study demonstrates that Digital Project-Based Learning is an effective instructional strategy for improving students' English academic vocabulary mastery in higher education. The findings revealed a significant increase in students' vocabulary achievement, as indicated by the improvement in post-test scores compared to pre-test scores and supported by the N-Gain result, which showed a moderate level of learning improvement. These results indicate that integrating digital technology into project-based learning provides meaningful opportunities for students to actively use academic vocabulary in authentic learning contexts. The findings also confirm that vocabulary development becomes more effective when students engage in collaborative and student-centered learning activities rather than relying solely on traditional memorization-based instruction.

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The significance of this study lies in its contribution to the growing body of research on technology-enhanced language learning in higher education. By providing empirical evidence on the effectiveness of digital project-based learning for academic vocabulary development, this study highlights the importance of integrating digital and interactive instructional approaches to support students' academic literacy. The findings are particularly relevant for English Education programs, where students are expected to develop both language proficiency and digital competence as preparation for their future professional roles as educators.

From a practical perspective, the results suggest that lecturers and curriculum designers should consider incorporating digital project-based learning into vocabulary instruction to create more engaging, collaborative, and meaningful learning environments. Through activities such as digital storytelling, presentations, and collaborative report writing, students are encouraged to practice academic vocabulary actively in real communication contexts. Within a realistic educational framework, this approach can support students' academic language development while fostering collaboration, critical thinking, creativity, and digital literacy skills required in contemporary education. Future research is recommended to investigate the long-term impact of digital project-based learning across broader educational contexts and larger student populations to further strengthen the evidence for innovative language teaching practices.

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