



Contents lists available at Journal Global Econedu

Journal of Educational and Learning Studies

ISSN: 2655-2760 (Print) ISSN: 2655-2779 (Electronic)

Journal homepage: <http://jurnal.globeconedu.org/index.php/jels>



Student perceptions of project-based learning with a deep learning approach in vocational education

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Article Info

Article history:

Received Apr 24th, 2026
Revised May 29th, 2026
Accepted Jun 30th, 2026

Keywords:

Project-based learning;
Deep learning;
Student engagement;
Digital archiving skills.

ABSTRACT

This study aimed to examine the effects of Project-Based Learning integrated with a Deep Learning approach on student engagement and digital archiving skills among vocational students based on their perceptions. A quantitative survey with an explanatory design was employed. The participants were 117 Office Management students at SMK Negeri 1 Painan selected through purposive sampling. Data were collected using validated and reliable questionnaires and analyzed using descriptive statistics and simple linear regression. Project-Based Learning with a Deep Learning approach significantly influenced student engagement ($\beta = 0.963$, $t = 38.360$, $p < 0.001$) and digital archiving skills ($\beta = 0.851$, $t = 17.365$, $p < 0.001$). Meaningful and contextual project-based learning is positively associated with higher student engagement and stronger perceived digital archiving competencies in vocational education.



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Introduction

Education plays a strategic role in preparing human resources who possess knowledge, skills, and adaptive capacities to respond to increasingly dynamic social and industrial changes (Albab, 2021; [Depdiknas], 2003). In vocational education, this responsibility extends beyond knowledge acquisition to developing graduates who are productive, technologically competent, and ready to meet workplace demands (Della Prameswary et al., 2023; Utomo, 2021). Consequently, Vocational High Schools (SMKs) are expected to provide learning experiences that facilitate authentic skill development and foster competencies relevant to contemporary occupational contexts (Directorate General of Vocational Education, 2020).

Despite their strategic role, vocational schools continue to face persistent challenges related to the mismatch between graduate competencies and industry expectations, particularly in digital capabilities and workplace adaptability (Agustian et al., 2024; BBPPMPV BMTI, 2025). The acceleration of digital transformation requires vocational graduates not only to possess technical knowledge but also to demonstrate digital literacy, problem-solving abilities, collaboration, and self-directed learning skills. These conditions indicate the need for instructional approaches that promote meaningful learning experiences and active student participation while simultaneously strengthening vocational competencies.

One vocational specialization substantially influenced by digital transformation is Office Management, where administrative activities have progressively shifted from paper-based procedures to digital information management systems (Arwildayanto, 2021). Contemporary office environments require graduates who are capable of managing electronic records, operating office applications, and ensuring information retrieval and

security through digital archiving systems (Mursyidah et al., 2024; Risamasu et al., 2025). Consequently, digital archiving competence has become an essential skill that vocational institutions must systematically develop to ensure graduates' professional readiness and employability.

Preliminary observations conducted in the Office Management Department of SMK Negeri 1 Painan revealed that archiving instruction remains predominantly focused on manual filing, document classification, and conventional record-management practices. Although these competencies remain relevant, they no longer adequately represent the digital competencies required in modern workplaces (Jaya et al., 2024). Furthermore, students demonstrated varying levels of technological readiness, with many encountering digital archiving applications and office software for the first time upon entering vocational education. These conditions suggest that instructional practices have not fully accommodated differences in students' readiness, learning environments, and access to digital technologies (Prasetyo & Haryanto, 2025).

Classroom observations further indicated that although Project-Based Learning (PjBL) had been formally adopted in instructional planning, its implementation frequently remained teacher-centered and did not consistently reflect the inquiry, collaboration, and authentic problem-solving principles underlying the model. As a result, students tended to wait for instructions, participate minimally in classroom activities, and exhibit limited initiative during learning processes. Previous studies have shown that teacher-centered instruction is associated with lower participation, reduced intrinsic motivation, and inadequate preparation for authentic workplace demands (Hermanto et al., 2024). Moreover, interactive learning environments and meaningful teacher support have been reported to positively influence student engagement and academic achievement, whereas limited interaction and feedback often contribute to student disengagement (Zhou & Wu, 2023).

The issue of student engagement was confirmed through classroom observations involving 117 students from four Office Management classes. As presented in Table 1, student engagement levels ranged from low to moderate across behavioral, affective, cognitive, social, and self-regulation dimensions. Behavioral engagement varied between 30% and 58%, while cognitive engagement ranged from 40% to 55%. Although social and affective engagement demonstrated relatively higher percentages, persistence and self-regulation remained limited, ranging between 40% and 50%. These findings suggest that students have not yet been fully involved in learning activities, particularly in aspects requiring active participation, critical thinking, and independent learning regulation.

Table 1. Student Engagement Observation Results in Office Management Classes

Class	Number of Students	Behavioral Engagement (%)	Affective Engagement (%)	Cognitive Engagement (%)	Social Engagement (%)	Persistence and Self-Regulation (%)
X MP1	28	50	57	50	40	40
X MP2	30	55	40	40	40	50
XI MP1	30	30	40	40	60	45
XI MP2	29	58	60	55	50	50
Total	117	48.25	49.25	46.25	47.50	46.25

The consequences of low engagement are reflected in students' academic achievement. Final semester examination data on digital archiving competencies indicated that only 50 out of 117 students (42.74%) achieved mastery learning, while 67 students (57.26%) failed to meet the expected competency standards. As shown in Table 2, learning mastery rates remained relatively low across all classes, particularly in X MP2 and XI MP1. These findings suggest that current instructional practices have not effectively facilitated the integration of conceptual understanding and practical competence in digital archiving. Such conditions are concerning because student engagement has been widely recognized as a multidimensional construct encompassing behavioral, emotional, and cognitive participation, all of which significantly influence learning outcomes (Bond et al., 2020; Schindler et al., 2023). Furthermore, low engagement and weak self-regulated learning have been associated with reduced academic performance and limited persistence in completing complex tasks (Xie et al., 2022; Panadero et al., 2022).

Previous studies have shown that lecture-dominated instruction negatively affects student engagement and critical thinking (Sutanto & Wibowo, 2021; Huang et al., 2023), whereas Project-Based Learning (PjBL) improves engagement, motivation, collaboration, and practical competencies (Wandi et al., 2023; Gutiérrez-González et al., 2024). The integration of PjBL and a Deep Learning approach has recently gained attention because it combines authentic problem solving with conceptual understanding and reflective learning (Biggs & Tang, 2011; Kementerian Pendidikan Dasar dan Menengah, 2024; Krajcik & Blumenfeld, 2021). Emerging evidence indicates that this approach enhances student engagement and digital competencies, including digital

archiving skills (Habók et al., 2021; Nurazizah et al., 2025; Xiong et al., 2025). However, empirical evidence in vocational education remains limited. Therefore, this study examines the effects of this integrated approach on student engagement and digital archiving skills among Office Management students, contributing to vocational education research in the digital era.

Table 2. Final Semester Examination Results in Digital Archiving

Class	Number of Students	Students Achieving Mastery	Mastery (%)	Students Not Achieving Mastery	Not Mastery (%)
X MP1	28	13	11.11	15	12.82
X MP2	30	12	10.26	18	15.38
XI MP1	30	11	9.40	19	16.24
XI MP2	29	14	11.97	15	12.82
Total	117	50	42.74	67	57.26

Method

This study employed a quantitative survey using an explanatory design to examine the relationships between students' perceptions of Project-Based Learning (PjBL) integrated with a Deep Learning approach, student engagement, and digital archiving skills. Because the study used cross-sectional perception data, the findings were interpreted as associative relationships rather than causal effects.

The population comprised 174 students enrolled in the Office Management program at SMK Negeri 1 Painan across Grades X, XI, and XII. Purposive sampling was employed to select participants who had received instruction on digital archiving materials in accordance with the curriculum. Grade XII students were excluded because they had completed the digital archiving course and were undertaking workplace learning activities outside the school. Consequently, the final sample consisted of 117 Grade X and Grade XI students.

Data were collected using structured questionnaires measuring three constructs: perceptions of the implementation of PjBL with a Deep Learning approach, student engagement, and digital archiving skills. The questionnaire items were developed based on relevant theoretical frameworks and employed a five-point Likert scale. Instrument quality was evaluated through item-total correlation analysis and Cronbach's Alpha reliability testing, and classroom observations were conducted to provide contextual support for interpreting the findings. Data were analyzed using IBM SPSS through descriptive statistics, the Kolmogorov-Smirnov normality test, and simple linear regression analysis to examine the associations between the independent and dependent variables.

Results and Discussions

Assumption Testing

Based on the results of the normality test, the Asymp. Sig. value was found to be lower than 0.05, indicating that the research data were not fully normally distributed. However, the sample size used in this study was relatively large ($n = 117$). Therefore, according to the Central Limit Theorem, the data were considered suitable for further analysis using parametric statistical techniques.

Simple Linear Regression Analysis

Effect of Project-Based Learning with a Deep Learning Approach on Student Engagement

Table 3. Simple Linear Regression Results of Project-Based Learning with a Deep Learning Approach on Student Engagement

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
Constant	2.428	1.562		1.554	0.123
Project-Based Learning with Deep Learning Approach (X)	0.965	0.025	0.963	38.360	0.000

Dependent Variable: Student Engagement (Y1) | Source: Processed Primary Data, 2026

The results of the linear regression analysis indicate that students' perceptions of the implementation of Project-Based Learning with a Deep Learning approach have a positive and statistically significant effect on student engagement. The regression coefficient was $B = 0.965$, with a standardized beta coefficient of $\beta = 0.963$ and a significance value of $p = 0.000$ ($p < 0.05$). These findings suggest that more positive student perceptions of the implementation of Project-Based Learning with a Deep Learning approach are associated with higher levels of student engagement.

The very high standardized beta coefficient indicates that students' perceptions of the learning model contribute substantially to explaining variations in student engagement. Therefore, the hypothesis stating that students' perceptions of the implementation of Project-Based Learning with a Deep Learning approach significantly influence student engagement is accepted.

Effect of Project-Based Learning with a Deep Learning Approach on Digital Archiving Skills

Table 4. Simple Linear Regression Results of Project-Based Learning with a Deep Learning Approach on Digital Archiving Skills

Model	Unstandardized Coefficients (B)	Std. Error	Standardized Coefficients (Beta)	t	Sig.
Constant	10.522	3.002		3.505	0.001
Project-Based Learning with Deep Learning Approach (X)	0.840	0.048	0.851	17.365	0.000

Dependent Variable: Digital Archiving Skills (Y2) | Source: Processed Primary Data, 2026

The linear regression analysis also revealed that students' perceptions of the implementation of Project-Based Learning with a Deep Learning approach have a positive and statistically significant effect on students' digital archiving skills. This result is evidenced by a regression coefficient of $B = 0.840$, a standardized beta coefficient of $\beta = 0.851$, and a significance value of $p = 0.000$ ($p < 0.05$). To facilitate the interpretation of the regression results, the standardized beta coefficients for student engagement and digital archiving skills are visually presented in Figure 1.

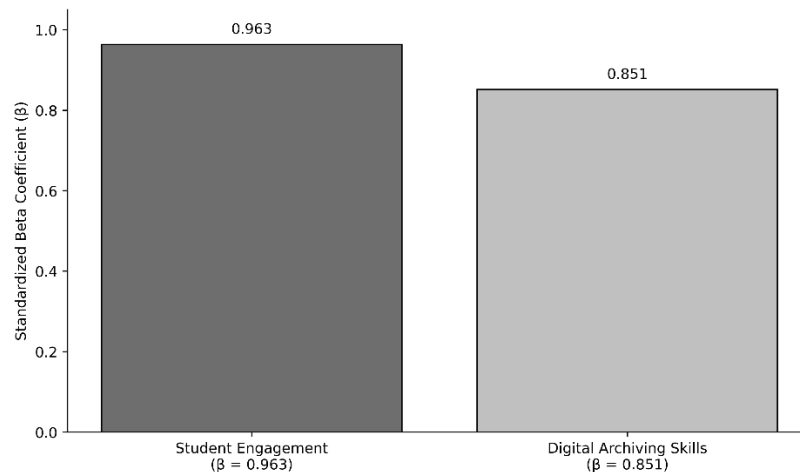


Figure 1. Standardized Beta Coefficients of the Regression Model

The findings of this study demonstrate that students' perceptions of the implementation of Project-Based Learning (PjBL) integrated with a Deep Learning approach have a positive and significant effect on student engagement. The regression analysis revealed a strong relationship between the learning model and student engagement, as indicated by a standardized beta coefficient of $\beta = 0.963$ ($p < 0.05$). This result suggests that student engagement is not solely determined by instructional activities themselves but is strongly influenced by how students perceive the quality, relevance, and meaningfulness of their learning experiences. These findings are consistent with those reported by Habók et al. (2021) and Novalia et al. (2025), who found that positive perceptions of project-based instructional designs are closely associated with increased multidimensional student engagement.

In vocational education, student engagement plays a pivotal role because learning outcomes depend not only on knowledge acquisition but also on active participation in authentic skill-development processes. When

students perceive PjBL as providing opportunities for collaboration, problem-solving, and project completion related to real workplace contexts, their behavioral engagement increases through greater participation in discussions, stronger commitment to completing tasks, and more intensive collaboration with peers. At the same time, cognitive engagement develops through deeper information processing, while emotional engagement is reflected in students' enthusiasm, interest, and sense of ownership toward learning activities. These findings support previous studies highlighting the positive relationship between interactive learning environments, teacher support, and student engagement (Zhou & Wu, 2023; Gutiérrez-González et al., 2024).

From a theoretical perspective, the present findings reinforce the conceptualization of student engagement as a multidimensional construct encompassing behavioral, emotional, and cognitive dimensions. According to Fredricks et al. (2004) and the more recent framework proposed by Assefa et al. (2025), engagement is shaped by the quality of students' interactions with their learning environment. The integration of PjBL and Deep Learning creates meaningful learning experiences that require critical reflection, authentic problem-solving, and connections between theoretical knowledge and practical applications. Such experiences strengthen students' cognitive investment and emotional attachment to learning. Similar conclusions were reported by Halil et al. (2024) and Syamsuddin (2025), who demonstrated that authentic problem-solving and reflective learning activities contribute significantly to sustained student engagement.

These findings can also be interpreted through the lens of social constructivism, which emphasizes that meaningful learning occurs when learners actively construct knowledge through social interaction and authentic experiences (Vygotsky, 1978). Project-Based Learning enables students to engage with real-world projects, while the Deep Learning approach encourages them to understand underlying concepts, evaluate decisions critically, and reflect on their learning processes. Consequently, students become active participants rather than passive recipients of information. This interpretation is supported by recent studies conducted by Nurazizah et al. (2025) and Putra et al. (2025), which found that the integration of PjBL and Deep Learning consistently produces higher levels of engagement among vocational students compared with conventional instructional approaches.

The study also revealed that students' perceptions of the implementation of Project-Based Learning with a Deep Learning approach significantly influence digital archiving skills, as indicated by a standardized beta coefficient of $\beta = 0.851$ ($p < 0.05$). This finding suggests that the development of vocational competencies is influenced not only by curriculum content but also by the quality of learning experiences perceived by students. In digital archiving education, students are required to manage electronic documents, operate office applications, and understand procedures for classification, storage, retrieval, and information security. When students perceive project-based learning activities as meaningful and relevant to professional practice, they are more likely to develop the competencies required for effective digital archiving. These findings are in line with Chen et al. (2025) and Liu et al. (2025), who reported that positive perceptions of project-based learning contribute directly to the enhancement of students' digital skills.

The effectiveness of the integrated PjBL and Deep Learning approach in developing digital archiving skills can be explained through Experiential Learning Theory (Kolb, 1984). This theory proposes that learning occurs through a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. In the present study, project-based activities provided students with authentic experiences in managing digital archives, while Deep Learning encouraged reflection and conceptual understanding of archival procedures. Through this process, students developed not only technical competencies but also responsibility, accuracy, and independent problem-solving abilities. These findings support the work of Chemerys et al. (2022), Feriyanto (2024), and Hasanah (2025), who emphasized the importance of reflective and experience-based learning in developing vocational and digital competencies.

Furthermore, the results corroborate previous studies indicating that technology-supported project-based learning effectively improves digital literacy and information management skills among vocational students (Eliana et al., 2016; Azmi et al., 2022; Wahyuni & Sarosa, 2017). Unlike traditional instructional approaches that focus primarily on procedural mastery, the integration of PjBL and Deep Learning enables students to understand the rationale behind digital archiving processes while simultaneously applying them in authentic contexts. Consequently, students not only acquire operational skills but also develop critical thinking, reflective capacity, and workplace readiness. Overall, these findings suggest that meaningful, contextual, and student-centered learning environments are essential for enhancing both student engagement and digital archiving competencies in vocational education. Therefore, the integration of Project-Based Learning and Deep Learning represents a promising pedagogical strategy for preparing vocational students to meet the challenges of increasingly digitalized workplace environments.

Conclusions

Based on the findings obtained from 117 Office Management students at SMK Negeri 1 Painan, it can be concluded that the implementation of Project-Based Learning integrated with a Deep Learning approach has a positive and significant effect on both student engagement and digital archiving skills. The results indicate that meaningful, contextual, and reflective project-based learning encourages students to participate more actively in the learning process while simultaneously enhancing their ability to manage digital archives effectively. These findings suggest that integrating Project-Based Learning and Deep Learning constitutes an effective instructional strategy for vocational education, as it not only promotes students' cognitive and emotional engagement but also strengthens essential digital competencies required in contemporary office environments.

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