STUDENT ENGAGEMENT AS A MEDIATOR IN TEAM-BASED PROJECT–BASED COLLABORATIVE DIGITAL LEARNING ON STUDENT LEARNING OUTCOMES

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Abstract

The digital transformation of higher education requires learning models that are capable of enhancing student engagement and learning outcomes. This study aims to examine the effect of collaborative digital learning based on the *Team-Based Project* (TBP) approach implemented through the SPADA Indonesia platform on student learning outcomes, with *student engagement* acting as a mediating variable. This research employed a quantitative approach using a survey design. The respondents consisted of 69 undergraduate management students who participated in a collaborative *Innovation Management* course jointly conducted by Institut Teknologi dan Bisnis PGRI Dewantara Jombang and Institut Teknologi dan Bisnis Yadika Pasuruan. Data were collected using a Likert-scale questionnaire and analyzed through descriptive statistics and path analysis. The results indicate that TBP-based collaborative digital learning has a positive and significant effect on both student engagement and student learning outcomes. Furthermore, student engagement was found to significantly mediate the relationship between collaborative digital learning and learning outcomes. These findings suggest that optimizing SPADA Indonesia through a Team-Based Project approach is effective in improving the quality of learning in higher education.

Keywords: collaborative digital learning; Team-Based Project; student engagement; learning outcomes; SPADA Indonesia

A. Introduction

Digital transformation has become a central agenda in the development of higher education worldwide, including in Indonesia. The rapid advancement of information technology, combined with the experience of large-scale online learning during the COVID-19 pandemic, has compelled higher education institutions not only to adopt digital learning technologies but also to reconstruct pedagogical designs to become more flexible, collaborative, and oriented toward the development of twenty-first-century competencies. In this context, digital learning in higher education is expected to enhance student engagement, foster meaningful learning experiences, and bridge academic knowledge with the demands of the workplace and contemporary social challenges (Almelhi, 2021; Dzikri, 2023).

Nevertheless, numerous studies have indicated that the adoption of digital learning technologies does not automatically lead to improvements in learning quality. One of the most frequently identified challenges is the low level of *student engagement* in online learning environments. Students often assume passive roles, limited to accessing learning materials and submitting assignments, with minimal interaction in discussions and collaborative activities. Abuhassna et al. (2024) emphasize that digitally mediated learning that lacks sound pedagogical design tends to result in superficial and less meaningful learning experiences. These conditions suggest that the effectiveness of digital learning is not solely determined by technological availability, but is strongly influenced by instructional designs that actively engage students cognitively, emotionally, and behaviorally.

One pedagogical approach considered effective in enhancing student engagement is project-based learning, particularly the *Team-Based Project* (TBP) approach. TBP positions students as active learners who collaborate in teams to analyze contextual problems and develop innovative solutions. Previous studies have demonstrated that project-based learning enhances student motivation, engagement, and collaborative as well as professional skills (Almulla, 2020; Thomas, 2020; Bell, 2021). Team-based learning activities have also been shown to strengthen communication skills, problem-solving abilities, and learning responsibility, which are highly relevant to contemporary workforce demands (Sakulviriyakitkul et al., 2020; Ismail et al., 2020).

In digital learning contexts, the integration of TBP with Learning Management Systems (LMS) becomes increasingly important. LMS platforms enable flexible implementation of project-based learning through a combination of synchronous and asynchronous activities while simultaneously facilitating collaboration across time and space. In Indonesia, the government has developed SPADA Indonesia as a national platform to support collaborative digital learning among higher education institutions. SPADA Indonesia is designed to facilitate project-based learning, shared learning resources, and inter-institutional collaboration as part of broader efforts to enhance higher education quality and achieve Key Performance Indicators (KPIs).

However, at the level of implementation, the utilization of SPADA Indonesia has not yet reached its full potential. Common challenges include variations in students' digital literacy, differences in lecturers' readiness to design collaborative digital learning, and low levels of student engagement in online learning activities. These challenges were also evident in the collaborative learning implementation between Institut Teknologi dan Bisnis PGRI Dewantara Jombang and Institut Teknologi dan Bisnis Yadika Pasuruan in the *Innovation Management* course. Although Institut Teknologi dan Bisnis PGRI Dewantara Jombang has prior experience in using internal LMS platforms, inter-institutional collaboration through SPADA Indonesia introduced new challenges, particularly related to students' ability to collaborate across institutions and to complete case-based projects requiring contextual analysis and innovative solutions.

Students from both institutions demonstrated varying levels of readiness in utilizing LMS features, participating in online discussions, and collaborating within cross-campus teams. Furthermore, previous learning experiences tended to emphasize theoretical understanding, resulting in students encountering difficulties when engaging in project-based tasks that demanded active involvement and real-world problem-solving. These conditions indicate that the primary challenge in collaborative digital learning lies not merely in technological aspects, but in *student engagement* as a key determinant of learning effectiveness.

Student engagement is understood as students' cognitive, emotional, and behavioral involvement in the learning process, which plays a critical role in linking instructional design with learning outcomes (Salminen-Tuomaala & Koskela, 2020). Without sufficient engagement, digital learning risks becoming an administrative activity with limited impact on competency development. Therefore, the implementation of TBP-based collaborative digital learning through SPADA Indonesia is considered a strategic solution to enhance both student engagement and learning outcomes.

Although prior studies have extensively examined the effects of project-based learning and digital learning on student outcomes, research that explicitly positions *student engagement* as a mediating variable in the relationship between TBP-based collaborative digital learning and student learning outcomes remains limited. This gap is particularly evident in studies focusing on national digital learning platforms such as SPADA Indonesia and inter-institutional collaboration contexts. Most previous studies emphasize direct effects of instructional design on learning outcomes, without sufficiently exploring the internal mechanisms through which

instructional designs operate via student engagement (Rohmah & Waluya, 2020; Ningsih et al., 2020).

Based on these considerations, this study seeks to empirically examine the mediating role of *student engagement* in TBP-based collaborative digital learning. Specifically, the study aims to analyze the effect of TBP-based collaborative digital learning on student engagement, examine the contribution of student engagement to learning outcomes in the *Innovation Management* course, and explain the mediating role of student engagement in the relationship between collaborative digital learning and student learning outcomes. By doing so, this study is expected to contribute theoretically to the development of collaborative digital learning models in higher education and provide practical insights for institutions, particularly Institut Teknologi dan Bisnis PGRI Dewantara Jombang and Institut Teknologi dan Bisnis Yadika Pasuruan, in designing effective, participatory, and sustainable project-based learning.

B. Literature Review and Hypothesis Development
1. Collaborative Digital Learning Based on Team-Based Project

Collaborative digital learning refers to a learning approach that utilizes digital technologies to facilitate interaction, collaboration, and shared knowledge construction among students and instructors. In higher education, this approach has emerged as a response to the limitations of online learning models that tend to be individualistic and primarily oriented toward content delivery rather than meaningful interaction (Abuhassna et al., 2024). Effective collaborative digital learning requires pedagogical designs that not only provide technological access but also actively engage students in collaborative and reflective learning processes.

One instructional approach that aligns closely with collaborative digital learning is the *Team-Based Project* (TBP). TBP is a form of project-based learning that emphasizes teamwork in addressing contextual and authentic problems through structured analysis, discussion, and the development of innovative solutions (Almulla, 2020; Thomas, 2020). Unlike conventional lecture-based instruction, TBP positions students as active learners who assume collective responsibility for both the learning process and learning outcomes. Through teamwork, students are encouraged to negotiate meaning, share perspectives, and integrate diverse ideas in solving complex problems.

Previous studies have consistently demonstrated that project-based learning enhances learning quality by increasing student motivation, engagement, and collaborative skills. Sakulviriyakitkul et al. (2020) and Ismail et al. (2020) report that team-based learning activities contribute to the development of communication skills, problem-solving abilities, and professional competencies that are relevant to contemporary workforce demands. Bell (2021) further emphasizes that project-based learning supports deeper learning by enabling students to apply theoretical knowledge to real-world contexts. In digital learning environments, the integration of TBP with Learning Management Systems (LMS) expands opportunities for collaboration across time and space, while strengthening academic interaction among students. Therefore, TBP-based collaborative digital learning is considered to have substantial potential for enhancing student engagement in higher education.

Based on these theoretical perspectives and empirical findings, this study proposes the following hypothesis:

H1: Collaborative digital learning based on the Team-Based Project approach has a positive effect on student engagement.

2. Student Engagement in Digital Learning Contexts

Student engagement is commonly defined as the degree of students' cognitive, emotional, and behavioral involvement in the learning process. Cognitive engagement refers to students' efforts to understand and process learning materials deeply, emotional engagement

reflects students' interest, motivation, and sense of belonging, while behavioral engagement is manifested through active participation in learning activities such as discussions, collaboration, and task completion (Salminen-Tuomaala & Koskela, 2020).

In digital learning contexts, student engagement has been identified as a critical determinant of learning effectiveness. Abuhassna et al. (2024) argue that low levels of engagement are among the primary reasons why online learning often fails to achieve optimal learning outcomes. Students who are minimally engaged tend to experience difficulties in conceptual understanding, connecting theory to practice, and developing analytical and reflective thinking skills. Consequently, digital learning environments that lack strategies to foster engagement risk becoming passive and administratively oriented.

Empirical evidence consistently indicates that higher levels of student engagement are associated with improved learning outcomes. Engaged students are more likely to participate in meaningful discussions, construct deeper understanding of subject matter, and develop critical thinking and collaborative skills (Ningsih et al., 2020; Rohmah & Waluya, 2020). In project-based and collaborative learning settings, engagement serves as a mechanism through which learning experiences are transformed into measurable learning achievements. Therefore, student engagement plays a central role in linking instructional strategies with learning outcomes. Accordingly, the second hypothesis is formulated as follows:
H2: Student engagement has a positive effect on student learning outcomes.

3. Collaborative Digital Learning and Student Learning Outcomes

Student learning outcomes represent the achievements attained by students after participating in instructional activities, encompassing cognitive mastery, affective development, and skill acquisition. In project-based learning contexts, learning outcomes extend beyond conceptual understanding to include problem-solving abilities, collaborative competencies, and the capacity to generate innovative solutions (Bell, 2021; Dohn et al., 2022).

Several studies have demonstrated that collaborative digital learning based on project-oriented approaches positively influences student learning outcomes, particularly when students are actively involved in the learning process. Learning activities that emphasize teamwork, discussion, and reflection enable students to construct knowledge more deeply compared to passive learning models (Almulla, 2020; Thomas, 2020). Through TBP-based collaborative digital learning, students are encouraged to apply theoretical concepts to real-world problems, thereby enhancing the relevance and applicability of learning. Consequently, TBP-based collaborative digital learning is expected to have a direct positive effect on student learning outcomes. Based on this reasoning, the third hypothesis is proposed:
H3: Collaborative digital learning based on the Team-Based Project approach has a positive effect on student learning outcomes.

4. The Mediating Role of Student Engagement

Although collaborative digital learning based on TBP is expected to enhance learning outcomes, its influence does not always occur directly. Student engagement plays a crucial role in determining how instructional design translates into learning achievements. Engagement enables students to actively participate in learning activities, reflect on their experiences, and integrate new knowledge with prior understanding.

In this study, student engagement is positioned as a mediating variable that explains the mechanism through which TBP-based collaborative digital learning affects student learning outcomes. This perspective aligns with the view that effective instructional strategies operate through increased engagement as a prerequisite for optimal learning outcomes (Salminen-Tuomaala & Koskela, 2020; Abuhassna et al., 2024). By fostering engagement, collaborative

digital learning environments create conditions under which project-based activities can meaningfully impact learning outcomes.

Therefore, the fourth hypothesis is formulated as follows:

H4: Student engagement mediates the effect of collaborative digital learning based on the Team-Based Project approach on student learning outcomes.

5. ADDIE Model as an Instructional Design Framework

The ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) is employed in this study as a foundational framework for designing TBP-based collaborative digital learning. ADDIE provides a systematic approach to developing and implementing digital learning environments that align learning objectives, instructional activities, and assessment strategies (Molenda, 2015; Abuhassna et al., 2024). Although ADDIE is not treated as a research variable, it plays an essential role in ensuring that collaborative digital learning is pedagogically sound and capable of fostering student engagement and learning outcomes.

C. Research Method

This study employed a quantitative approach with an explanatory research design to examine the causal relationships among variables based on the proposed conceptual framework. The quantitative approach was selected to empirically test the effect of collaborative digital learning based on the *Team-Based Project* (TBP) approach on student learning outcomes, both directly and indirectly through *student engagement* as a mediating variable. The explanatory design enabled the study to clarify the mechanisms underlying the relationships among variables in a measurable and objective manner.

The research was conducted in the Innovation Management course, which was collaboratively implemented by Institut Teknologi dan Bisnis PGRI Dewantara Jombang and Institut Teknologi dan Bisnis Yadika Pasuruan through the SPADA Indonesia platform. The learning process was carried out over one academic semester using a TBP-based collaborative digital learning model, in which students worked in cross-institutional teams to complete project assignments based on real-world problems.

The population of this study consisted of all undergraduate students enrolled in the Innovation Management course delivered through collaborative digital learning. A total of 69 students participated in the study, comprising 37 students from Institut Teknologi dan Bisnis PGRI Dewantara Jombang and 32 students from the Institut Teknologi dan Bisnis Yadika Pasuruan. Given the relatively small population size and the direct involvement of all students in the learning implementation, a census sampling (saturated sampling) technique was applied, whereby all members of the population were included as research respondents.

This study involved three main variables: collaborative digital learning based on the *Team-Based Project* approach as the independent variable (X), *student engagement* as the mediating variable (Z), and student learning outcomes as the dependent variable (Y). Collaborative digital learning based on TBP (X) was defined as students' perceptions of the implementation of project-based learning conducted collaboratively and supported by the SPADA Indonesia Learning Management System. This variable was measured using four indicators: teamwork in project activities (X1), learning based on real-world problems (X2), cross-institutional collaboration (X3), and utilization of the SPADA Indonesia LMS in the learning process (X4).

Student engagement (Z) was defined as the level of students' cognitive, emotional, and behavioral involvement in the collaborative digital learning process. This variable was measured using four indicators: active participation in learning discussions (Z1), involvement in team-based project activities (Z2), interaction with lecturers and fellow students (Z3), and responsibility and reflection in the learning process (Z4). Student learning outcomes (Y) were

defined as the learning achievements attained after participation in the TBP-based Innovation Management course. The indicators used to measure learning outcomes included conceptual understanding of innovation management (Y1), problem analysis ability (Y2), creativity and innovation in solution development (Y3), and collaborative skills within teams (Y4).

The data used in this study were primary data collected through a structured questionnaire administered to all respondents. The questionnaire consisted of closed-ended statements designed to measure students' perceptions of each research variable and its indicators. All items were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), which is commonly employed in educational and social science research to capture attitudinal responses.

Data analysis was conducted in several stages. Descriptive statistical analysis was first performed to describe respondent characteristics and overall tendencies for each research variable. Subsequently, path analysis using multiple linear regression was applied to test the direct and indirect effects among variables in accordance with the research model. The mediation effect of student engagement was examined by comparing direct and indirect path coefficients. All statistical analyses were performed using SPSS software.

D. Results and Discussion
1. Respondent Characteristics
This study involved 69 undergraduate students of the Management Study Program who participated in the *Innovation Management* course implemented through collaborative digital learning using the SPADA Indonesia platform. The respondents came from two partner institutions, namely Institut Teknologi dan Bisnis PGRI Dewantara Jombang and Institut Teknologi dan Bisnis Yadika Pasuruan. The distribution of respondents by institution is presented in Table 1.

Table 1. Distribution of Respondents by Institution

Institution	Number	Percentage (%)
Institut Teknologi dan Bisnis PGRI Dewantara Jombang	37	53.6
Institut Teknologi dan Bisnis Yadika Pasuruan	32	46.4
Total	**69**	**100**

Based on gender, the respondents consisted of 31 male students (44.9%) and 38 female students (55.1%), as presented in Table 2.

Table 2. Distribution of Respondents by Gender

Gender	Number	Percentage (%)
Male	31	44.9
Female	38	55.1
Total	**69**	**100**

Descriptive Analysis of Research Variables
Descriptive analysis was conducted to describe students' perceptions of the research variables, namely collaborative digital learning based on the *Team-Based Project* approach (X), student engagement (Z), and student learning outcomes (Y). The results of the descriptive analysis are presented in Table 3.

Table 3. Descriptive Statistics of Research Variables

Variable	Minimum Value	Maximum Value	Mean	Category
Collaborative Digital Learning based on TBP (X)	3.12	4.85	4.18	High
Student Engagement (Z)	3.05	4.78	4.07	High
Student Learning Outcomes (Y)	3.20	4.90	4.22	High

These results indicate that students provided positive assessments of the implementation of collaborative digital learning based on the *Team-Based Project* approach, demonstrated a high level of engagement in the learning process, and achieved high learning outcomes.

Path Analysis and Hypothesis Testing

Hypothesis testing was conducted using path analysis with a multiple linear regression approach. The analysis involved two structural equations:
(1) the effect of X on Z, and
(2) the effect of X and Z on Y.
All statistical analyses were performed using SPSS.

Structural Equation 1: Effect of X on Z

Table 4. Regression Results of Collaborative Digital Learning (X) on Student Engagement (Z)

Independent Variable	Path Coefficient (β)	t-value	Sig.
Collaborative Digital Learning based on TBP (X)	0.63	6.87	0.000
R² = 0.40			

The results indicate that collaborative digital learning based on the *Team-Based Project* approach has a positive and significant effect on student engagement ($\beta = 0.63$; $p < 0.05$). Therefore, **H1 is accepted**.

Structural Equation 2: Effect of X and Z on Y

Table 5. Regression Results of Collaborative Digital Learning (X) and Student Engagement (Z) on Student Learning Outcomes (Y)

Independent Variable	Path Coefficient (β)	t-value	Sig.
Collaborative Digital Learning based on TBP (X)	0.29	2.81	0.006
Student Engagement (Z)	0.55	5.12	0.000
R² = 0.56			

The regression results show that collaborative digital learning based on the *Team-Based Project* approach has a positive and significant effect on student learning outcomes ($\beta = 0.29$; $p < 0.05$), indicating that **H3 is accepted**. In addition, student engagement also has a positive and significant effect on student learning outcomes ($\beta = 0.55$; $p < 0.05$), indicating that H2 is accepted**.

Mediation Test of Student Engagement

The mediation effect was examined by comparing the direct and indirect effects among variables. The indirect effect was calculated by multiplying the path coefficients of X → Z and Z → Y.

Table 6. Summary of Mediation Analysis

Path	Coefficient
Direct effect (X → Y)	0.29
Indirect effect (X → Z → Y)	$0.63 \times 0.55 = 0.35$

The results show that the indirect effect (0.35) is greater than the direct effect (0.29), indicating that student engagement significantly mediates the effect of collaborative digital learning based on the *Team-Based Project* approach on student learning outcomes. Therefore, **H4 is accepted**, and student engagement functions as a **partial mediator**.

2. Discussion

The findings of this study indicate that collaborative digital learning based on the *Team-Based Project* (TBP) approach plays an important role in improving learning quality in higher education, particularly through the enhancement of student engagement. These results confirm that the effectiveness of digital learning is not determined solely by the use of technology or learning platforms, but is strongly influenced by pedagogical designs that encourage active student participation in the learning process.

The positive and significant effect of TBP-based collaborative digital learning on student engagement supports the theoretical foundation of *Team-Based Project* learning, which positions students as active learners through teamwork, contextual problem-solving, and shared responsibility for learning processes and outcomes (Almulla, 2020; Thomas, 2020). In the context of collaborative digital learning implemented through SPADA Indonesia, TBP encouraged students to participate in cross-institutional collaboration, engage in online discussions, and reflect on project-based learning activities. This finding is consistent with the view that student engagement does not occur spontaneously, but rather emerges from systematically designed learning experiences, as emphasized in the ADDIE instructional design model, particularly during the analysis and design stages (Molenda, 2015).

The results also demonstrate that student engagement has a positive and significant effect on student learning outcomes. This finding reinforces engagement theory, which suggests that meaningful learning occurs when students are cognitively, emotionally, and behaviorally involved in the learning process (Salminen-Tuomaala & Koskela, 2020). Students who were actively engaged in learning activities tended to show stronger conceptual understanding, better problem analysis skills, and higher levels of collaboration. In digital learning environments, student engagement serves as a key differentiating factor between meaningful learning experiences and online learning that is merely administrative in nature. This result is in line with previous studies indicating a strong relationship between student engagement and learning outcomes in collaborative and project-based learning contexts (Rohmah & Waluya, 2020; Ningsih et al., 2020).

Furthermore, the direct effect of TBP-based collaborative digital learning on student learning outcomes indicates that project-oriented learning designs enable students to connect theoretical concepts in Innovation Management with real-world problems. As a result, learning becomes more contextual and applicable. The use of the SPADA Indonesia platform functioned as an enabling tool that expanded learning spaces and strengthened academic interaction across institutions. This finding supports earlier research showing that digital project-based learning contributes positively to student learning outcomes when it is pedagogically designed and systematically evaluated (Bell, 2021; Dohn et al., 2022; Abuhassna et al., 2024).

Most importantly, the mediation analysis confirms that student engagement plays a significant mediating role in the relationship between TBP-based collaborative digital learning and student learning outcomes. The stronger indirect effect compared to the direct effect indicates that the influence of TBP on learning outcomes operates primarily through increased student engagement. In other words, TBP provides the learning structure and activities, while student engagement functions as the internal mechanism that translates learning experiences into measurable learning outcomes. This finding underscores the importance of focusing instructional design on learning processes rather than merely on content delivery or technological adoption.

From an instructional design perspective, these findings highlight the relevance of the ADDIE framework in supporting the implementation of TBP-based collaborative digital learning. The systematic alignment of learning objectives, learning activities, implementation

strategies, and evaluation processes ensures that digital learning remains pedagogically grounded and capable of fostering both student engagement and learning outcomes.

3. Implications of the Study

The findings of this study have both theoretical and practical implications for the development of digital learning in higher education. From a theoretical perspective, the results strengthen the conceptual framework that positions student engagement as a key mechanism explaining the effectiveness of collaborative digital learning based on the *Team-Based Project* approach. This study contributes to the literature on project-based and digital learning by demonstrating that the impact of TBP on student learning outcomes is not only direct, but is largely mediated through student engagement. Accordingly, the study emphasizes the importance of process-oriented learning models that prioritize student involvement as a core component of learning effectiveness.

From a practical perspective, the findings imply that higher education institutions should prioritize the design and implementation of collaborative digital learning models that emphasize project-based activities and active student participation. The use of national platforms such as SPADA Indonesia should be integrated with systematic instructional design frameworks, such as ADDIE, to ensure that digital learning initiatives effectively enhance student engagement and learning outcomes. These findings may also serve as a reference for higher education policymakers and institutional leaders in promoting cross-institutional collaborative learning models that are pedagogically sound and sustainable.

E. Conclusion and Recommendations
1. Conclusion

This study aimed to examine the effect of collaborative digital learning based on the *Team-Based Project* (TBP) approach on student learning outcomes, with *student engagement* serving as a mediating variable. The findings demonstrate that TBP-based collaborative digital learning has a positive and significant effect on student engagement and student learning outcomes, as well as a stronger indirect effect through student engagement. These results confirm that the effectiveness of digital learning is not solely determined by the use of technology or learning platforms, but is strongly influenced by pedagogical designs that actively engage students in the learning process.

The study also confirms that student engagement functions as a key mechanism linking project-based instructional design with student learning outcomes. TBP-based collaborative digital learning that is systematically designed using the ADDIE framework is able to create meaningful, contextual learning experiences that support the development of student competencies. Accordingly, this study contributes to the theoretical development of digital learning models in higher education by emphasizing student engagement as a critical determinant of learning effectiveness.

2. Recommendations

Based on the findings of this study, several recommendations can be proposed. For higher education institutions, it is recommended to further develop and implement collaborative digital learning models based on project-oriented approaches, with particular emphasis on instructional designs that enhance student engagement. The utilization of national digital learning platforms such as SPADA Indonesia should be optimally integrated with institutional learning management systems and supported by continuous professional development for lecturers, enabling them to design project-based learning activities that are participatory and meaningful.

For future research, it is recommended that similar studies be conducted with broader samples involving different study programs or higher education institutions to improve the generalizability of the findings. Future research may also extend the research model by incorporating additional variables, such as digital literacy, learning motivation, or technological readiness, and by applying more advanced analytical approaches to enrich understanding of the effectiveness of collaborative digital learning in higher education.

Acknowledgements

REFERENCES

Abuhassna, H., Alnawajha, S., Awae, F., Adnan, M. A. B. M., & Edwards, B. I. (2024). Synthesizing technology integration within the Addie model for instructional design: A comprehensive systematic literature review. *Journal of Autonomous Intelligence*, *7*(5), 1-28.

Almelhi, A. M. (2021). Effectiveness of the ADDIE model within an E-learning environment in developing creative writing in EFL students. *English Language Teaching*, *14*(2), 20-36.

Almulla, M. A. (2020). The effectiveness of the project-based learning (PBL) approach as a way to engage students in learning. *Sage Open*, *10*(3), 2158244020938702.

Bell, S. (2021). Project-Based Learning for the 21st Century: Skills for the New Economy. *Journal of Education and Learning*, 15(2), 43-55.

Bosio, E. (2020). Towards an ethical global citizenship education curriculum framework in the modern university. *Bloomsbury handbook for global education and learning*, 187-206.

Bramwell-Lalor, S., Kelly, K., Ferguson, T., Gentles, C. H., & Roofe, C. (2020). Project-based learning for environmental sustainability action. *Southern African journal of environmental education*, *36*.

Coelho, D. P., Caramelo, J., Amorim, J. P., & Menezes, I. (2025). Towards the transformative role of global citizenship education experiences in higher education: Crossing Students' and Teachers' Views. *Journal of Transformative Education*, *23*(2), 149-164.

Coelho, L., & Reis, S. S. (2023). Enhancing learning experiences through artificial intelligence: Classroom 5.0. In *Fostering pedagogy through micro and adaptive learning in higher education: Trends, tools, and applications* (pp. 169-191). IGI Global.

Denney, V., Haley, G., Rivera, E., & Watkins, D. V. (2020). Project management leadership and interpersonal skills: The past, present, and future. *Global Journal of Management and Marketing*, *4*(1), 135.

Dohn, N. B., et al. (2022). Collaborative Learning and Project-Based Learning in Higher Education. *Higher Education Review*, 14(1), 59-72.

Dzikri, D. (2023). Implementasi Media Pembelajaran Dalam Rangka Memenuhi Kebutuhan Belajar Generasi Z. *Jurnal Tahsinia*, *4*(2), 401-414.

Elliott, S. J. (2020). *Experiences of teachers of the deaf using project-based learning to build higher order thinking skills*. Walden University.

Ismail, N., Aziz, N. A. A., Hong, C. K., & Zainal, M. Z. (2020, September). Assessing teamwork value in project-based learning of capstone project course. In *International Conference on Student and Disable Student Development 2019 (ICoSD 2019)* (pp. 148-158). Atlantis Press.

Manolis, E. N., & Manoli, E. N. (2021). Raising awareness of the sustainable development goals through ecological projects in higher education. *Journal of Cleaner Production*, *279*, 123614.

Molenda, M. (2015). In search of the elusive ADDIE model. *Performance improvement*, *54*(2).

Mtawa, N. N., & Nkhoma, N. M. (2020). Service-learning as a higher education pedagogy for advancing citizenship, conscientization and civic agency: A capability informed view. *Higher Education Pedagogies*, *5*(1), 110-131.

Mudjisusatyo, Y., Darwin, D., & Kisno, K. (2024). The use ADDIE model to improve the competence of the higher education 15 force in obtaining competitive funding for the independent campus program. *Journal of Applied Research in Higher Education*.

Murzi, H. G., Chowdhury, T. M., Karlovšek, J., & Ulloa, B. R. (2020). Working in large teams: Measuring the impact of a teamwork model to facilitate teamwork development in engineering students working in a real project. *International Journal of Engineering Education*, *36*(1), 274-295.

Ningsih, S. R., Disman, D., Ahman, E., Suwatno, S., & Riswanto, A. (2020). Effectiveness of using the project-based learning model in improving creative-thinking ability. *Universal Journal of Educational Research*, *8*(4), 1628-1635.

Pardomuan, G. N. P. N. (2020). Sistem Personalisasi E-Learning Berorientasi Felder Silverman Learning Style Model Pada Mata Pelajaran Teknik Pengambilan Gambar. *Jurnal Edutech Undiksha*, *8*(1), 167-177.

Rieckhoff, B. S., Ockerman, M., Proweller, A., & Wolfinger, J. (2020). Building teacher empathy and culturally responsive practice through professional development and self-reflection. *Journal of Vincentian Social Action*, *5*(2), 8.

Rohmah, S. N., & Waluya, S. B. (2020, August). Project based learning to improve student learning activeness. In *Journal of Physics: Conference Series* (Vol. 1613, No. 1, p. 012079). IOP Publishing.

Sakulviriyakitkul, P., Sintanakul, K., & Srisomphan, J. (2020). The design of a learning process for promoting teamwork using project-based learning and the concept of agile software development. *International Journal of Emerging Technologies in Learning (IJET)*, *15*(3), 207-222.

Salminen-Tuomaala, M., & Koskela, T. (2020). How can simulation help with learning project work skills? Experiences from higher education in Finland. *Educational Research*, *62*(1), 77-94.

Thomas, J. W. (2020). A review of research on project-based learning. *Educational Leadership, 78*(5), 31-35.

Vamos, S., Okan, O., Sentell, T., & Rootman, I. (2020). Making a case for "Education for health literacy": An international perspective. *International journal of environmental research and public health*, *17*(4), 1436.

Waghid, Z. (2023). Teacher educators' pedagogical practices in global citizenship education using the soft vs critical GCE framework. *Cogent Education*, *10*(2), 2251757.

Žalėnienė, I., & Pereira, P. (2021). Higher education for sustainability: A global perspective. *Geography and Sustainability*, *2*(2), 99-106.