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Can Student Learning Engagement Strengthen The Link Between Deep Learning Approach And Perceived Learning?

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A R T I C L E I N F O

Keywords:

Deep Learning Approach; Perceived Learning; Student Learning Engagement;

ABSTRACT

This study sought to explore how engagement-oriented learning processes support students' more profound understanding and sustained knowledge retention, thereby offering contributions to both educational theory and practice. A quantitative approach was applied to examine the determinants of perceived learning. The study encompassed 386 students selected from a total population of 7,261 students. Data analysis was carried out using Structural Equation Modeling (SEM) with a Partial Least Squares (PLS) technique to investigate the relationships among three latent constructs: deep learning approach, student learning engagement, and perceived learning. The findings revealed that the deep learning approach significantly influenced perceived learning and had a substantial effect on student learning engagement. Additionally, student learning engagement was found to affect perceived learning significantly. With regard to indirect effects, the results showed that the deep learning approach affected perceived learning through student learning engagement. These results indicate that deep learning strategies not only directly enhance perceived learning but also indirectly strengthen it by promoting higher levels of student engagement, highlighting the mediating role of student learning engagement.

Kata Kunci:

Pendekatan Pembelajaran Mendalam; Pembelajaran Perseptual; Keterlibatan Pembelajaran Siswa;

Studi ini bertujuan untuk mengeksplorasi bagaimana proses pembelajaran berorientasi keterlibatan mendukung pemahaman siswa yang lebih mendalam dan retensi pengetahuan yang berkelanjutan, sehingga memberikan kontribusi baik pada teori maupun praktik pendidikan. Pendekatan kuantitatif diterapkan untuk meneliti penentu pembelajaran yang dirasakan. Studi ini mencakup 386 siswa yang dipilih dari total populasi 7.261 siswa. Analisis data dilakukan menggunakan Structural Equation Modeling (SEM) dengan teknik Partial Least Squares (PLS) untuk menyelidiki hubungan antara tiga konstruk laten: pendekatan pembelajaran mendalam, keterlibatan belajar siswa, dan pembelajaran yang dirasakan. Temuan menunjukkan bahwa pendekatan pembelajaran mendalam secara signifikan memengaruhi pembelajaran yang dirasakan dan memiliki efek substansial pada keterlibatan belajar siswa. Selain itu, keterlibatan belajar siswa ditemukan secara signifikan memengaruhi pembelajaran yang dirasakan. Mengenai efek tidak langsung, hasil menunjukkan bahwa pendekatan pembelajaran mendalam memengaruhi pembelajaran yang dirasakan melalui keterlibatan belajar siswa. Hasil ini menunjukkan bahwa strategi pembelajaran mendalam tidak hanya secara langsung meningkatkan pembelajaran yang dirasakan tetapi juga secara tidak langsung memperkuatnya dengan mendorong tingkat keterlibatan siswa yang lebih tinggi, menyoroti peran mediasi dari keterlibatan belajar siswa.

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1. INTRODUCTION

Perceived Learning is a fundamental component in achieving student competencies. They form the core of the educational process, where students not only acquire knowledge but also comprehend and internalize what they learn. Through learning, students build the foundation of their intellectual and practical abilities, while understanding enables them to apply that knowledge meaningfully and effectively. These two aspects ensure that students can demonstrate mastery, adaptability, and critical thinking within their fields of study. Therefore, emphasizing perceived Learning is essential to ensure comprehensive and sustainable development of student competencies.

The gap between the competence of higher education graduates and industry requirements in Indonesia remains a crucial challenge. According to the National Labor Force Survey (Sakernas) by BPS as of February 2025, the Open Unemployment Rate (TPT) for university and higher education graduates (Diploma 4, Bachelor's, Master's, and Doctorate) remains between 5.25% and 5.39%. This phenomenon indicates that merely possessing an academic degree does not guarantee job readiness if it is not accompanied by a profound mastery of the subject matter. Low perceived learning the students' own perception of what they have understood during their studies is suspected to be the root cause of this competency gap. A common practical issue found in Indonesian higher education is the dominance of a surface learning approach for the sake of exam grades, which ultimately leads to weak student engagement in the process of knowledge transformation.

Learning and comprehension do not transpire spontaneously; they are contingent upon the degree of student engagement in the educational process and the methodology employed in learning. Student learning engagement reflects the cognitive, affective, and behavioral involvement of students in their academic experiences, determining how deeply they interact with learning materials and activities. Meanwhile, the deep learning approach represents students' tendency to seek meaning, connect concepts, and think critically about what they learn. The combination of student learning engagement and a deep learning approach creates learning conditions that foster deeper comprehension and enhance the overall quality of perceived Learning (Zhao & Li, 2024). The deep learning approach represents a cognitive intent; however, engagement serves as the behavioral engine that drives it. Without active engagement, a deep approach remains merely a conceptual intent without execution. Consequently, perceived learning cannot be optimally achieved as the transformation from intention to actual learning outcomes requires the catalyst of active participation (Hailikari et al., 2022; Stamov Roßnagel et al., 2021a).

Several previous studies have consistently demonstrated that student learning engagement has a significant influence on perceived learning across various educational contexts. A mixed-methods study in college science courses revealed that instructional strategies and learning styles collectively shape engagement, which is crucial for creating meaningful learning experiences (Abdullah et al., 2024). Similarly, research in Malaysia grounded in self-determination theory found that students' motivation enhances online learning engagement, which in turn improves learning outcomes (Ojo et al., 2024). Experiential learning activities have also been shown to increase motivation, engagement, confidence, and understanding in a natural resource policy course (Watkins & Poudyal, 2021). In the field of English as a Foreign Language (EFL), growth mindset and grit were found to mediate the relationship between motivation and engagement, ultimately enhancing learning (Derakhshan & Fathi, 2024). Collectively, these findings affirm that

stronger student learning engagement consistently enhances learning comprehension, understanding, and academic success across different learning environments and disciplines. Beyond student learning engagement, the deep learning approach has also been widely recognized as a key determinant in enhancing students perceived learning.

A growing body of literature has highlighted that deep learning significantly contributes to enhancing perceived learning across diverse educational and technological contexts (Dolmans et al., 2016). A review of problem-based learning demonstrates that this approach fosters deep learning and leads to improved understanding and learning outcomes among students (Wu, 2022). Similarly, a study involving students from kindergarten to third grade emphasizes the importance of deep learning approaches in supporting educational development (Egger et al., 2021). Research on online discussions in general education also shows that technology-supported pedagogies promoting deep learning improve the quality and depth of student learning (Aderibigbe, 2021). In educational data science, surveys indicate that deep learning techniques effectively analyze student affect, behavior, and learning patterns to enhance learning outcomes (Yu et al., 2022). Moreover, integrating symbolic knowledge with artificial intelligence–based deep learning approaches has been found to create more interpretable and trustworthy AI tools that support learning comprehension (Kumar et al., 2023). A systematic literature review in mathematics education confirms that AI technologies, including deep learning, foster critical thinking and deeper conceptual understanding among students (Opesemowo & Adewuyi, 2024). Investigations into deep learning architectures reveal training mechanisms that strengthen learning stability and generalization, essential for effective educational applications (Mahamud et al., 2025). In the field of medical imaging, task-specific deep learning has been shown to improve both outcome understanding and observer performance. Finally, research on instructional methods in religious education found that interactive, student-centered approaches grounded in deep learning principles significantly enhance comprehension and personal engagement with the subject matter (Ruiz-Rojas et al., 2023). Collectively, these studies affirm that deep learning plays a vital role in cultivating higher-order understanding and improving learning effectiveness across multiple domains.

However, research examining the relationship between learning engagement, deep learning, and perceived learning remains limited, particularly in the context of higher education in Indonesia. A comprehensive understanding of how students' engagement influences the depth of their learning and their ability to construct meaningful understanding is essential for improving educational outcomes. High levels of learning engagement can foster intrinsic motivation and encourage students to move beyond surface learning strategies. Engagement itself is a multifaceted construct encompassing four key dimensions: behavioral, emotional, social-cognitive, and agentic engagement (Harris et al., 2022; Stringfellow et al., 2024) . Meanwhile, deep learning emphasizes critical thinking, reflection, and the integration of new knowledge with prior experiences. By exploring how these dimensions interact, this study aims to reveal new insights into how engagement-driven learning processes can enhance students' capacity for deeper understanding and long-term knowledge retention, offering a novel contribution to educational practice and theory.

1.1 Literature Review

1.1.1 Perceived Learning

Learning is a dynamic process that involves acquiring knowledge, skills, attitudes, and competencies through experience, study, or instruction, leading to relatively permanent changes in behavior or understanding (Nyquist & Jubran, 2012; Pilat & Person, 2022). It encompasses cognitive, emotional, and social dimensions, where individuals actively engage with content, tasks, self-reflection, and social interaction to construct meaningful knowledge. Understanding, as an integral part of learning, refers to the cognitive ability to grasp the meaning, significance, and interconnections among concepts, enabling the effective application of knowledge in various contexts (Gauthier, 2013; Nyquist & Jubran, 2012; Pilat & Person, 2022). This process of perceived learning is strengthened through active engagement, reflection, and interaction, which enhances conceptual comprehension, critical thinking, and the ability to apply knowledge in real-life situations (Gauthier, 2013; Nyquist & Jubran, 2012; Pilat & Person, 2022).

1.1.2 Deep Learning Approach

Deep learning approach in higher education is a learning approach that emphasizes deep engagement, meaningful understanding, and higher-order cognitive competencies through active cognitive–emotional involvement, deep information processing, metacognitive regulation, and the integration of new knowledge with prior understanding to support effective learning and assessment (Baharudin & Lajis, 2021; Liu et al., 2022). High-level engagement positively influences the deep learning approach in higher education by fostering intrinsic motivation, active participation, and deeper cognitive processing that leads to meaningful understanding (Alhammadi, 2021; Gamage et al., 2022). Problem-solving ability positively influences the deep learning approach in higher education, with self-directed and self-regulated learning enhancing students' motivation, data evaluation, and learning control (Hwang & Oh, 2021). The study found statistically significant relationships between metacognition, self-determined learning climate, and the deep learning approach, which are closely linked with academic performance in higher education, regardless of students' academic background (Medina et al., 2023). The pursuit of challenge and meaning, as reflected in mastery-approach and mastery-avoidance goals, mediates the relationship between learning environment perception and deep learning approaches in higher education (Han & Xu, 2025). Previous studies indicate that students using deep learning strategies achieve better outcomes and rely less on surface learning approaches (Saqr et al., 2023).

1.1.3 Student Learning Engagement

Student learning engagement is conceptualized as a multifaceted and malleable construct comprising the energy and effort students direct towards learning, predominantly characterized by four distinct but interrelated dimensions: behavioral (observable actions and participation), emotional (affective reactions and feelings), cognitive (psychological investment and strategic thinking), and social (interaction with peers and teachers) engagement (Voak et al., 2023; Wang, 2021). This meta-construct is not a single state but a dynamic process that is responsive to instructional factors and the learning context, serving as a critical mediator between teaching activities and educational outcomes such as academic performance, persistence, and reduced dropout intentions(Ahmadi et al., 2023; Lup & Mitrea, 2021). Research highlights that while behavioral engagement is often the most frequently measured dimension—particularly in digital settings through proxies like Learning Management System (LMS) logins and clicks—a comprehensive understanding requires exploring all dimensions to capture the full scope of a student's involvement in learning activities (Ahmadi et al., 2023).

1.2 Hypothesis Development

1.2.1 The Influence of Deep Learning Approach on Perceived Learning

Previous research highlights that the deep learning approach significantly enhances perceived learning by engaging students in meaningful, constructive, and self-regulated learning processes. Studies have shown that factors such as constructive alignment, effective feedback, technological support, peer interactions, and positive academic emotions play mediating roles in this relationship (Alwafi, 2023a). For instance, constructive alignment fosters adaptation towards deep learning strategies, while learner-generated digital materials and supportive online environments strengthen both deep learning engagement and self-efficacy (Stamov Roßnagel et al., 2021b). Across diverse educational contexts including online courses, internships, and digital learning settings these findings consistently indicate that adopting deep learning approaches positively influences students' perceptions of their learning, though contextual nuances determine the effectiveness of implementation (Liu et al., 2022).

These studies illustrate the intricate relationship between the deep learning process and perceived learning. They highlight that a deep learning approach, characterized by active engagement, critical thinking, and reflective practice, significantly enhances learners' ability to construct meaningful knowledge and achieve deeper conceptual understanding. Based on the discussion above, this research proposes:

H1: *The deep learning approach has a significant positive influence on perceived learning*

1.2.2 The Influence of Student Learning Engagement on Perceived Learning

Student learning engagement significantly influences perceived learning by fostering deeper cognitive processing, emotional investment, and behavioral participation in educational activities. Research demonstrates that active engagement in learning—characterized by emotional, cognitive, behavioral, and agentic components—positively correlates with improved academic outcomes and comprehension across various disciplines (Chatterjee & Parra, 2022; Xu et al., 2023). Emotional engagement boosts motivation and persistence, which helps people understand difficult ideas better. Cognitive engagement, on the other hand, encourages critical thinking and processing of information (Jia et al., 2022; Umar & Ko, 2022). Furthermore, a positive learning environment and supportive teacher-student relationships serve as vital external factors that enhance student engagement, thus indirectly improving learning outcomes (Zhou et al., 2021). The dynamic interplay between student behavior and learning contexts underscores that engagement is not merely an individual characteristic but also a result of interactive factors, such as goal clarity and classroom climate (Luo & Luo, 2022; Sattar et al., 2022; Septiana et al., 2021). These findings underscore that promoting student learning engagement through well-structured pedagogical strategies is essential for achieving meaningful understanding and academic success.

These studies demonstrate the significant connection between student learning engagement and perceived learning. They emphasize that high levels of engagement—reflected through behavioral participation, emotional involvement, and cognitive investment play a vital role in fostering meaningful learning experiences and deeper comprehension. When students are actively engaged, they are more likely to interact critically with learning materials, reflect on their understanding, and apply knowledge in diverse contexts, resulting in improved conceptual mastery and long-term retention. Based on the discussion above, this research proposes:

H2: *Student learning engagement has a significant positive influence on perceived learning.*

1.2.3 The Influence of Deep Learning Approach on Student Learning Engagement

The deep learning approach significantly influences student learning engagement by fostering active, meaningful, and reflective learning experiences that promote cognitive, emotional, and behavioral involvement. Research indicates that integrating deep learning principles, such as project-based learning, continuous reflection, and collaborative knowledge construction, enhances students' critical thinking and scientific skills, thereby increasing motivation and engagement (Taufik et al., 2025). Moreover, deep learning models have shown high effectiveness across educational levels, improving focus, retention, and long-term understanding by connecting new knowledge to prior experiences (Mi et al., 2022). In online and technology-mediated settings, deep learning-based frameworks can identify fluctuations in engagement and tailor interventions, thereby enhancing sustained student attention and participation (Martinez & Johnson, 2024). These approaches collectively strengthen student satisfaction and academic performance by creating immersive and tailored learning contexts that encourage deeper cognitive processing and emotional investment in learning tasks (Mi et al., 2022; Taufik et al., 2025).

These studies reveal the strong relationship between the deep learning approach and student learning engagement. They indicate that when learners adopt a deep learning approach characterized by curiosity, critical analysis, and reflection they tend to demonstrate higher levels of behavioural, emotional, agentic, and cognitive engagement. This kind of engagement happens when students actively try to connect new information to what they already know, think deeply about ideas, and take charge of their own learning. Consequently, the deep learning approach not only enhances motivation and persistence but also fosters a more meaningful and sustained involvement in learning activities. Based on the discussion above, this research proposes:

H3: *The deep learning approach has a significant positive influence on student learning engagement.*

The research hypotheses are illustrated in the research model shown in Fig. 1. This study aims to provide a comprehensive understanding of the role of student learning engagement in mediating the influence of the deep learning approach on perceived learning.

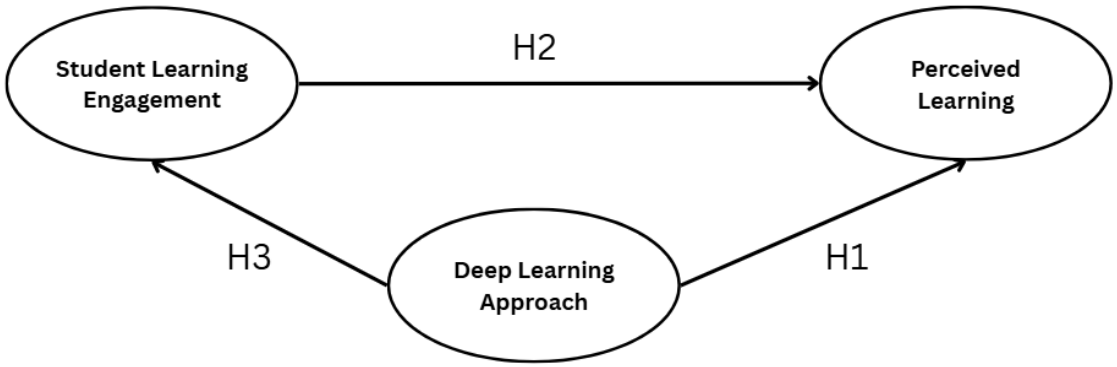

Figure 1. Research Model

2. RESEARCH METHOD

2.1 Research Design and Sample

This study adopts a quantitative research design to comprehensively analyze the factors that influence perceived learning. Data were collected using a structured questionnaire developed to assess three main variables: the deep learning approach, student learning engagement, and perceived learning. Responses were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), enabling the quantitative evaluation of participants' perceptions of each variable (Pauji, et.al., 2025).

This study employed a specially designed questionnaire to explore respondents' perceptions of three main variables: the deep learning approach, student learning engagement, and perceived learning. The questionnaire was carefully developed through a validation process before being distributed to the respondents selected as the research sample.

The discriminant validity of the measurement model was evaluated using the Fornell–Larcker criterion. The results indicate that the square root of the Average Variance Extracted (AVE) for each construct Deep Learning Approach, Perceived Learning, and Student Learning Engagement—is higher than the correlations between the constructs. This finding demonstrates that each construct shares more variance with its own indicators than with other constructs in the model, thereby confirming that they are empirically distinct. Consequently, the measurement model satisfies the discriminant validity requirement and is appropriate for further structural analysis.

Table 1. Discriminant Validity

	Deep Learning Approach	Perceived Learning	Student Learning Engagement
Deep Learning Approach	0.931		
Perceived Learning	0.953	0.931	
Student Learning Engagement	0.939	0.936	0.917

Prior to distribution, the questionnaire was tested to ensure its validity and reliability. Convergent and discriminant validity tests were used to check the instrument's accuracy. The results showed that a loading factor value greater than 0.500 means that there is a strong link between the latent variables and their indicators. Furthermore, an Average Variance Extracted (AVE) value greater than 0.5 demonstrates adequate (J.-H. Cheah et al., 2018; Kim et al., 2013). Reliability testing was carried out using Cronbach's alpha and composite reliability values, where Cronbach's alpha above 0.700 and higher composite reliability indicate the internal consistency of the measurement instrument (Irawan et al., 2024). Discriminant validity analysis using the HTMT method also showed that all variables had values below 1 (Boudreau et al., 2001), confirming that the discriminant validity criteria were met and that further analysis could be conducted.

This study involved 386 students as respondents, drawn from a total population of 7,261 students. The sample size was determined using the Slovin formula to ensure an adequate level of precision in representing the population. The simple random sampling method was employed to ensure that every member of the population had an equal chance of being selected as part of the sample (Creemers et al., 2010; Watson, 2015). This approach guarantees sample representativeness and minimizes potential bias in respondent selection. The collected data were then analyzed to identify the relationships and effects among the variables, aiming to produce valid and reliable findings.

To provide a comprehensive overview of the educational phenomenon, the respondents were drawn from a diverse range of academic backgrounds and study programs, including Management, Visual Communication Design, Information Technology, and various other departments. This multi-disciplinary approach was deliberately utilized to ensure that the findings regarding the deep learning approach and student engagement are not confined to a single field of study but instead reflect a broader, more holistic perspective across different disciplines (Alwafi, 2023; Fuente et al., 2020). The data collected through the questionnaire were thoroughly analyzed to examine the relationships and impacts among the studied variables. Through this analysis, the study aims to provide a comprehensive understanding of how the deep learning approach and student learning engagement contribute to enhancing students perceived learning.

2.2 Data Analysis

The data analysis in this study was conducted using the Structural Equation Modeling (SEM) method with a Partial Least Squares (PLS) approach to examine the relationships among three latent variables, the deep learning approach, student learning engagement, and perceived learning (Hair Jr. et al., 2017; Mohd Dzin & Lay, 2021). This method was selected due to its capacity to facilitate the concurrent analysis of intricate causal relationships among latent variables. In PLS analysis, there are two main types of testing: the outer model and the inner model. The outer model test is used to assess the validity and reliability of the indicators that form each latent variable by examining the factor loading, Average Variance Extracted (AVE), and composite reliability values (Cheah et al., 2018; Hair Jr. et al., 2017; Janadari et al., 2016). Meanwhile, the inner model test analyzes the structural relationships among latent variables to determine the extent to which the deep learning approach and student learning engagement influences perceived learning. This approach provides a comprehensive understanding of the strength and direction of the relationships among the latent variables under investigation.

3. RESULTS AND DISCUSSIONS

3.1. Result

3.1.1. Descriptive Statistic of Research Variables

Before conducting the structural equation modeling (SEM) analysis, a descriptive analysis was performed to provide an overview of the data collected from the 386 respondents. As shown in Table 2, the results indicate high levels of engagement and deep learning among the participants.

Table 2. Descriptive Statistic

Construct	Mean	Standard Deviation	Interpretation
Perceived Learning	4.36	0.75	Very High
PL1 – PL7 (Range)	4.31 – 4.40	0.71 – 0.79	
Deep Learning Approach (DLA)	4.34	0.77	Very High
DLA1 – DLA 8 (Range)	4.29 -4.38	0. 73 -0.83	
Student Learning Engagement (SLE)	4.33	0.77	Very High
SLE1 – SLE8 (Range)	4.25 – 4.39	0.74 – 0.86	

Table 2 presents the descriptive statistics for each indicator within the three main constructs. The analysis reveals that students at Universitas Surabaya exhibit a very high

level of engagement and learning quality. Perceived Learning (PL) obtained the highest average score (Mean = 4.36). The Deep Learning Approach (DLA) followed closely with an average mean of 4.34, indicating that students are highly inclined to seek a deeper understanding of their subjects rather than just memorizing information. Furthermore, Student Learning Engagement (SLE) recorded an average mean of 4.33, reflecting active and consistent participation in the learning process. The standard deviation for all items remains below 1.0, ranging from 0.71 to 0.86, which signifies a high level of consensus among the 386 respondents and confirms that the data is robust and free from extreme fluctuations.

3.1.2. Measurement Model

This section presents the results of the measurement model assessment, which includes evaluating the validity and reliability of each construct in the study. Reliability was assessed using Cronbach's Alpha (CA), rho_A, and Composite Reliability (CR). All constructs demonstrated CA, rho_A, and CR values exceeding the minimum threshold of 0.700, confirming the internal consistency of the measurement instruments. In addition, the factor loading values for each indicator ranged from 0.903 to 0.947 for the Perceived Learning construct, 0.910 to 0.945 for Deep Learning Approach, and 0.864 to 0.937 for Student Learning Engagement. All these values are above the minimum requirement of 0.500, indicating that each indicator strongly and significantly represents its respective construct.

Furthermore, convergent validity was confirmed through the Average Variance Extracted (AVE), with all constructs showing values above 0.500. Specifically, 0.866 for Perceived Learning, 0.867 for Deep Learning Approach, and 0.841 for Student Learning Engagement. These AVE values indicate that more than 50% of indicator variance is explained by the constructs being measured. The model also reports R^2 values of 0.922 for perceived learning and 0.822 for student learning engagement, demonstrating the predictive capability of exogenous constructs toward endogenous constructs within the structural model. Overall, these findings confirm that all constructs meet the established criteria for validity and reliability, indicating that the measurement model is appropriate for further analysis.

Table 3. Measurement model

Construct	Factor Loading	CA	rho_a	CR	AVE	R2
Perceived Learning		0.974	0.974	0.978	0.866	0,922
PL1	0,927					
PL2	0,903					
PL3	0,947					
PL4	0,945					
PL5	0,935					
PL6	0,922					
PL7	0,935					
Deep Learning Approach		0.978	0.978	0.981	0.867	-
DLA1	0,936					
DLA2	0,945					
DLA3	0,934					
DLA4	0,943					
DLA5	0,922					
DLA6	0,910					
DLA7	0,923					
DLA8	0,935					
Student Learning Engagement		0.973	0.974	0.977	0.841	0,822
SLA1	0,901					
SLA2	0,933					
SLA3	0,932					
SLA4	0,915					
SLA5	0,937					
SLA6	0,932					
SLA7	0,920					
SLA8	0,864					

3.1.3. Structural Model

Table 4 presents the results of the path analysis, illustrating the structural relationships among the variables in the model. All relationships show p-values of 0.000, which are far below the significance threshold of 0.05. Consequently, all tested pathways are deemed significant, and the corresponding hypothesis is accepted.

The first result indicates that the deep learning approach has a significant effect on perceived learning, with a path coefficient of 0.622 (p = 0.000). This finding suggests that the stronger the deep learning approach adopted by students, the higher their perception of their learning outcomes. Furthermore, the deep learning approach also exerts a forceful influence on student learning engagement, with a coefficient of 0.939 (p = 0.000), indicating that deeper learning strategies directly enhance students' engagement in learning activities.

In addition, student learning engagement significantly affects perceived learning, with a coefficient of 0.352 (p = 0.000). This shows that higher levels of student engagement lead to stronger perceptions that the learning process is effective and meaningful.

Regarding the indirect effect, the deep learning approach is shown to influence perceived learning through student learning engagement. The indirect effect coefficient of 0.330 (p = 0.000) indicates that deep learning strategies not only have a direct impact but also indirectly strengthen perceived learning by increasing student engagement. In other words, student learning engagement serves as a significant mediator in this relationship.

Overall, these findings confirm that the deep learning approach is a key factor shaping student engagement and perceived learning through both direct and significant mediated effects.

Table 4. Path Analysis

Path Analysis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Decision
Deep Learning Approach -> Perceived Learning	0.622	0.618	0.073	8.500	0.000	Support
Deep Learning Approach -> Student Learning Engagement	0.939	0.939	0.012	78.372	0.000	Support
Student Learning Engagement -> Perceived Learning	0.352	0.356	0.074	4.783	0.000	Support
Deep Learning Approach -> Student Learning Engagement -> Perceived Learning	0.330	0.335	0.070	4.704	0.000	Support

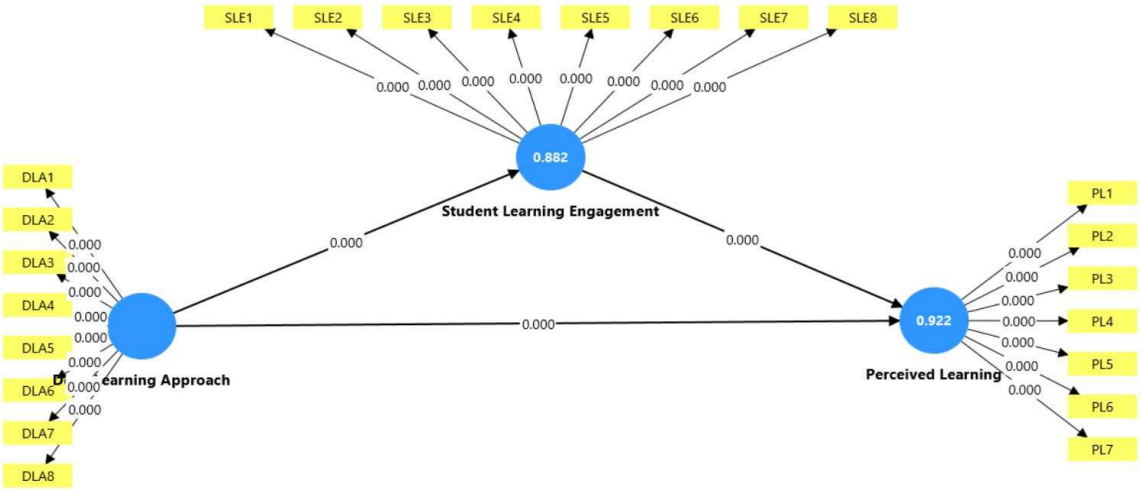

Figure 2. Path Analysis

3.1.4. Model Fit

Table 5 explains the *fit summary* of the tested model. The SRMR value of 0.031 indicates a very low level of residual error and is well below the recommended threshold. The d_ULS (0.262) and d_G (0.867) values indicate that the difference between the empirical and estimated covariance matrices is acceptable. The chi-square value of 1766.541 reflects model complexity and sample size, while the NFI of 0.885 shows an adequate fit compared to the null model. Overall, the model demonstrates stability and acceptable fit. In PLS-SEM, these fit indices are complementary indicators rather than mandatory thresholds (Hair & Alamer, 2022).

Table 5. Fit Summary

	Saturated Model	Estimated Model
SRMR	0.031	0.031
d_ULS	0.262	0.262
d_G	0.867	0.867
Chi-square	1766.541	1766.541
NFI	0.885	0.885

3.2. Discussions

The hypothesis testing results in this study indicate that the deep learning approach has a significant effect on perceived learning. This finding is supported by a sample mean value of 0.618, a standard deviation of 0.073, a T statistic of 8.500, and a P value of 0.000, confirming that the relationship is empirically supported. Several previous studies have reported similar evidence, demonstrating that deep learning approaches contribute significantly to perceived learning. The first study emphasizes that teaching quality not only has a direct impact on perceived learning outcomes but is also mediated by deep learning strategies measured using the R-SPQ-2F, whereby students with higher deep approach scores report better perceived learning (Lim & Richardson, 2021). Another study conducted in an online learning context shows that learning support, affective factors, and self-regulation promote the adoption of a deep approach, which in turn is positively associated with students perceived learning (Han & Geng, 2023). In addition, a nationwide study involving students from various educational institutions found that social motivation plays a crucial role in encouraging the use of deep learning strategies, subsequently enhancing perceived learning (Jing & Charanjit Kaur Swaran Singh, 2024).

The results of this study are consistent with a larger body of international research that shows a positive link between deep learning approaches and perceived learning. Studies published in the past five years consistently show that deep learning approaches play a central role in mediating the influence of teaching quality on perceived learning, operate through learning support and self-regulation in online environments, and are closely linked to social motivation that enhances students' perceptions of their learning achievements.

The results of this study indicate that the deep learning approach serves as the cognitive intent while student learning engagement acts as the behavioral engine that translates that intent into actual learning outcomes. Mechanistically, a deep learning approach triggers engagement because it requires students to move beyond mere memorization toward seeking meaning, connecting concepts critically, and engaging in self-reflection, which naturally activates their emotional, cognitive, and agentic involvement (Zhang, 2022). This engagement then functions as a vital catalyst; without the active participation characterized by energy (vigor) and dedication, the cognitive intention for deep learning cannot successfully transform into deep conceptual mastery or perceived learning (Acosta-Gonzaga & Ramirez-Arellano, 2022; Chagas & Muñoz-García, 2023). Taken together, this empirical evidence strengthens the argument that when students adopt more profound learning approaches characterized by analysis, reflection, and active engagement they are more likely to report more positive and meaningful learning experiences.

Next, the hypothesis testing results of this study indicate that the deep learning approach has a significant effect on student learning engagement, as reflected in the sample mean of 0.939, standard deviation of 0.012, T statistic of 78.372, and P value of 0.000; these findings strongly confirm the second hypothesis. This result aligns with a wide range of international studies demonstrating the crucial role of deep learning approaches in enhancing student engagement. Research on study approaches shows that higher deep-approach scores are positively associated with engagement and perceived learning and function as a mediator between students' perceptions of teaching quality and outcomes such as engagement and satisfaction (Long et al., 2025). In online learning settings, perceived support, affective factors, and self-regulation have also been found to promote the adoption of a deep approach, which subsequently increases student engagement indicators and perceived learning, forming a causal pathway of support → deep approach → engagement (Han & Geng, 2023). Similarly, experimental studies on design-based learning reveal that interventions emphasizing higher-order thinking, problem-solving, and reflective tasks strengthen the use of deep approaches and significantly enhance student engagement compared to control groups (Han, 2021; Ryan & Aasetre, 2021). Overall, these findings reinforce that deep learning approaches function as a key mechanism for fostering more active, meaningful, and sustained student learning engagement.

The findings of this study, supported by a high T statistic and a P value of 0.000, confirm that the deep learning approach plays a significant role in enhancing student learning engagement. These results align with various international studies showing that deep learning strategies not only increase engagement directly but also mediate the influence of teaching quality on engagement and satisfaction. In online learning contexts, learning support, affective factors, and self-regulation further encourage the adoption of deep approaches, which in turn strengthen engagement. Experimental research likewise demonstrates that instructional designs that stimulate higher-order thinking activate deep learning mechanisms and significantly boost engagement. In sum, this body of evidence highlights that the deep learning approach is a crucial mechanism for fostering more active and meaningful student engagement.

The hypothesis testing results indicate that student learning engagement has a significant effect on perceived learning, as shown by a sample mean of 0.356, a standard deviation of 0.074, a T statistic of 4.783, and a P value of 0.000, confirming this relationship statistically. These findings are consistent with various studies in online learning contexts demonstrating that student engagement plays a direct role in enhancing perceived learning and learning satisfaction(Gray & Diloreto, 2016). Aligned with the Community of Inquiry framework, factors such as teaching presence and social presence have been shown to strengthen engagement, which in turn significantly impacts perceived learning, particularly in digital learning environments (Li et al., 2023). Additional evidence from other research further emphasizes that components of engagement namely vigor, dedication, and absorption—serve as mediating mechanisms linking self-efficacy to perceived learning, reinforcing the view that engagement is not merely correlated but is a key factor influencing learning perceptions (Zhuofan et al., 2024).

Based on these findings, the author argues that student learning engagement constitutes a central determinant of perceived learning, both statistically and theoretically. The strong empirical evidence—reflected in the significant T statistic and near-zero P value—demonstrates that engagement is not incidental but serves as a reliable predictor of how effectively students perceive their learning outcomes. This is in line with what other researchers have said: when students are mentally, emotionally, and behaviorally engaged, they are more likely to see their learning experiences as meaningful and successful. Furthermore, the alignment with the community inquiry framework reinforces the notion that engagement is shaped by instructional design quality, particularly through teaching and social presence, which foster interactive and supportive learning environments. The mediating role of vigor, dedication, and absorption further substantiates that engagement enhances perceived learning through deeper psychological involvement in the learning process. Therefore, the author concludes that strengthening student learning engagement is a strategic and necessary condition for improving perceived learning, especially within digital or hybrid learning ecosystems.

In addition, the path analysis revealed that the deep learning approach has an indirect effect on perceived learning through student learning engagement. This indirect mechanism is supported by the statistical evidence, shown by a sample mean of 0.335, a

standard deviation of 0.070, a T statistic of 4.704, and a P value of 0.000, indicating that the mediation pathway is strongly validated by the data. These findings are consistent with several related studies demonstrating that study approaches including deep learning serve as mediating factors linking the learning environment to academic outcomes, implying that deep learning shapes learning perceptions through intermediary processes such as motivation and engagement (Bonsaksen et al., 2024). Other path-model studies similarly position deep learning as a process variable associated with perceived learning, showing that engagement and self-perceptions mediate the relationship between learning approaches and perceived outcomes (Schrempft et al., 2021). Research on pedagogical strategies further supports this mechanism, highlighting that interventions that foster deep learning lead to increases in cognitive and behavioral engagement, which subsequently enhance perceived learning (Xu et al., 2025). Complementary evidence also shows that teaching-learning experiences and learning environments are associated with deep learning and perceived learning gains, with engagement and environmental perceptions functioning as intermediaries in these relationships(O'Neill et al., 2023). Collectively, these findings reinforce the robustness of the indirect effect pathway from deep learning to perceived learning through student engagement.

The findings of this study offer important theoretical implications for the development of research on learning approaches and students' learning experiences. The evidence showing that the deep learning approach has both direct and indirect effects on perceived learning through student learning engagement strengthens theoretical models that position deep learning as a foundational mechanism for enhancing the quality of learning engagement and students' perceptions of their learning outcomes. Future research may expand this model by examining additional mediating or moderating variables such as instructor support, academic self-efficacy, or digital learning environments to further understand the factors that strengthen or weaken the relationships among these variables.

Practically, the findings of this study underscore the importance for higher education institutions to design instructional strategies that encourage students to adopt a deep learning approach. Institutions can develop pedagogical interventions such as reflective assignments, project-based learning, and high-quality discussions that enhance learning engagement and ultimately improve students' perceived learning. To improve student engagement and learning outcomes, university leaders and program managers should implement concrete policies encompassing both learning strategies and governance dimensions. First, curriculum development should shift away from surface-level learning oriented toward exam scores and instead adopt strategies such as Project-Based Learning (PjBL) or reflective assignments that challenge students to employ higher-order thinking, particularly in courses emphasizing case studies and project work. Second, institutions should prioritize faculty training that focuses on enhancing teaching presence and the ability to foster supportive teacher-student relationships, creating a classroom climate that encourages student autonomy. Third, the design of campus facilities and digital ecosystems, such as Learning Management Systems (LMS), should be optimized to facilitate social interaction and collaboration, as supportive environments have been shown to strengthen the link between learning approaches and active engagement.

Furthermore, to reinforce the governance dimension, university leaders can integrate deep learning indicators into the Internal Quality Assurance System (SPMI) and faculty Key Performance Indicators (IKU). For example, IKU 7, which measures in-class teaching effectiveness, can explicitly recognize the use of PjBL and case-based assignments that promote higher-order thinking and active student engagement. By formally linking these pedagogical practices to faculty evaluation, universities not only encourage instructors to adopt deep learning strategies but also institutionalize a culture of reflective, project-oriented learning across programs. Incorporating metrics such as the quality of student projects, the level of collaborative problem-solving, and outcomes of reflective assignments into SPMI ensures that pedagogical innovations are systematically monitored, assessed, and rewarded, bridging the gap between teaching practice and institutional governance. By implementing these integrated policies, higher education institutions can bridge the competency gap and ensure sustainable knowledge retention. Moreover, future research may evaluate the effectiveness of these strategies across different academic programs and learning modalities whether face-to-face, hybrid, or online to examine the consistency of their impact on diverse student groups.

4. CONCLUSION

This study concludes that the *deep learning approach* is a critical determinant of both *student learning engagement* and *perceived learning.* The results confirm that deep learning strategies strongly and significantly enhance student engagement and directly improve students' perceptions of their learning achievements. Furthermore, student engagement plays a mediating role, strengthening the impact of deep learning on perceived learning through an indirect pathway.

The findings emphasize that effective learning environments should encourage students to engage in deeper learning processes, as these strategies not only stimulate active participation but also contribute to higher perceived learning outcomes. In practical terms, educators and institutions should design instructional approaches, assessments, and learning activities that promote critical thinking, reflection, and conceptual understanding.

In summary, the study provides empirical evidence that fostering deep learning strategies can significantly enhance students' engagement and perceived learning, making it a valuable foundation for improving teaching and learning practices in higher education.

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