



Examining the Influence of Tutors on Learning Management System Use in Driving Motivation and Effectiveness of Online Learning

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Abstract: This study examines the role of tutor facilitation in optimizing the use of the Learning Management System (LMS) to enhance learning motivation and online learning effectiveness among millennial students. Although LMS platforms are widely implemented, prior research has focused on technological aspects, leaving the pedagogical role of tutors as mediators of LMS-based learning outcomes underexplored. A quantitative design involved 160 students from Universitas Terbuka in Indonesia. Data were collected via structured questionnaires and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS). Results indicate tutor facilitation contributes significantly to students' learning motivation and the effectiveness of LMS-based online learning. The structural model demonstrates explanatory power and predictive relevance, confirming the tutor's key role in strengthening the link between technology adoption and student learning outcomes. Practical implications include strengthening tutors' pedagogical and digital competencies and recommending institutional policies that integrate technological support with human facilitation to improve learning. Further research should employ cross-institutional samples and mixed-method approaches to enhance generalizability.

Abstrak: Penelitian ini mengkaji peran fasilitasi tutor dalam mengoptimalkan pemanfaatan Learning Management System (LMS) untuk meningkatkan motivasi belajar dan efektivitas pembelajaran daring pada mahasiswa generasi milenial. Meskipun LMS telah banyak diterapkan, penelitian terdahulu cenderung menitikberatkan aspek teknis sehingga peran pedagogis tutor dalam memediasi hasil belajar berbasis LMS kurang mendapat perhatian. Penelitian kuantitatif ini melibatkan 160 mahasiswa Universitas Terbuka di Indonesia sebagai responden. Data dikumpulkan melalui kuesioner terstruktur dan dianalisis menggunakan Structural Equation Modeling–Partial Least Squares (SEM-PLS). Hasil penelitian menunjukkan bahwa fasilitasi tutor memberikan kontribusi signifikan terhadap motivasi belajar dan efektivitas pembelajaran daring berbasis LMS. Model struktural memperlihatkan daya jelaskan dan relevansi prediktif yang kuat, menegaskan peran kunci tutor dalam memperkuat hubungan antara pemanfaatan teknologi dan hasil belajar mahasiswa. Implikasi praktis mencakup penguatan kompetensi pedagogik serta literasi digital tutor, dan rekomendasi kebijakan institusional untuk mengintegrasikan dukungan teknologi dengan fasilitasi manusia demi peningkatan kualitas pembelajaran daring. Saran penelitian lanjutan melibatkan sampel lintas institusi dan pendekatan mixed-method yang relevan.

A. Introduction

The rapid development of information and communication technology has significantly transformed many sectors, including higher education. One of the most prominent technological innovations in contemporary education is the Learning Management System (LMS), which facilitates the organisation and delivery of online learning activities. LMS platforms enable educators and students to manage learning materials, communicate, conduct assessments, and monitor learning progress through digital environments. As a result, LMS implementation has become increasingly common among higher education institutions seeking to improve accessibility, flexibility, and efficiency in teaching and learning. However, the mere presence of technological infrastructure does not automatically guarantee effective learning outcomes. The success of online learning environments depends not only on technological tools but also on how these tools are pedagogically integrated into the learning process.

In this regard, the role of tutors becomes essential in transforming LMS from a technological platform into a meaningful learning environment. Tutors are not only responsible for delivering instructional content but also for designing, organising, and facilitating learning activities that support student Engagement and comprehension. In Moodle-based courses, tutors play a critical role in structuring both asynchronous and synchronous learning experiences and in ensuring that course management processes operate effectively within higher education settings (Quansah & Essiam, 2021; Retnani et al., 2024; Simelane-Mnisi, 2023). Empirical studies demonstrate that LMS platforms such as Moodle have been widely adopted in universities, particularly during the transition to online learning during the COVID-19 pandemic, highlighting their ability to sustain student Engagement, organise course content, and facilitate online assessments (Park et al., 2022). Within this context, LMS can serve as an important innovation that addresses various challenges associated with traditional and online learning environments (Elfeky et al., 2020; Sumardi et al., 2021).

Despite these advantages, the effectiveness of LMS-based online learning warrants further investigation amid the evolving dynamics of digital education. Although LMS platforms provide various technological affordances that support learning activities, their effectiveness largely depends on how instructors and tutors utilise these tools to facilitate meaningful learning interactions (Elmunsyah et al., 2023; Megayanti, 2022). The integration of technology into learning processes has the potential to foster the development of critical skills required in the digital era, including independent learning, problem-solving, and collaborative Engagement. Furthermore, technology-supported learning environments can help learners understand complex concepts that may be difficult to grasp through traditional instructional methods (Pérez-Cusó et al., 2024). Consequently, effective learning outcomes are not solely determined by technological availability but also by the pedagogical strategies employed in managing technology-enhanced learning environments.

In LMS-based learning environments, tutors who serve as facilitators play a key role in helping students overcome learning challenges. Through guidance, feedback, and

structured learning activities, tutors can help students navigate digital learning platforms and maintain their motivation for learning (Akindele et al., 2021). Nevertheless, many LMS implementations are still primarily used as repositories for uploading and distributing learning materials rather than as platforms that support interactive and collaborative learning experiences (Hasan, 2019). Although LMS platforms offer features such as activity tracking, communication tools, and learning analytics that allow instructors to monitor student Engagement and progress, these features are often underutilised in practice (Akindele et al., 2021). As a result, students may experience limited interaction and reduced Engagement in online learning environments.

Previous studies have indicated that the use of LMS increased substantially during the COVID-19 pandemic, accelerating the transition toward online learning across educational institutions (Sumardi et al., 2021). Several empirical studies also suggest that LMS utilisation can positively influence students' learning motivation and learning effectiveness when supported by appropriate instructional strategies (Mu'minah et al., 2021). However, challenges remain in maintaining active student participation within online learning environments. Some studies report that students tend to become passive and less interactive when learning through LMS platforms, particularly when instructional facilitation is limited (Sari & Djamdjuri, 2021). These findings indicate that technological platforms alone are insufficient to sustain meaningful Engagement and that effective facilitation is necessary to maximise the benefits of digital learning systems.

The success of LMS implementation is therefore influenced by multiple factors, including tutors' ability to manage digital learning environments and facilitate meaningful learning processes. Tutors play a central role in guiding students, encouraging participation, and ensuring that LMS tools are used effectively to support learning objectives (Chng et al., 2011). In addition, the characteristics of millennial learners further emphasise the importance of adaptive learning approaches. Millennial students are generally familiar with digital technologies and are accustomed to accessing information through online platforms. Consequently, they require learning environments that integrate technological tools with interactive and engaging pedagogical strategies (Handoyo & Anas, 2019). Understanding how tutor facilitation interacts with LMS use is therefore important in order to improve learning motivation and the overall effectiveness of online learning among millennial students.

Research Gap. Despite the growing body of literature on Learning Management Systems, most previous studies have focused primarily on technological adoption, system usability, or learners' perceptions of LMS platforms. While these studies provide valuable insights into the technological dimensions of online learning, relatively limited research has examined the pedagogical facilitation role of tutors within LMS environments. In particular, few studies have empirically investigated how tutor facilitation influences both learning motivation and learning effectiveness within an integrated analytical framework. This limitation is especially evident in the context of distance higher education institutions, where online learning plays a central role in instructional delivery. Therefore, there remains

a need for empirical research that examines the role of tutor facilitation as a critical factor in maximising LMS-based learning outcomes among millennial learners.

Research Novelty. This study contributes to the existing literature by positioning tutor facilitation as a central explanatory variable within an LMS-based learning model that examines both motivational and effectiveness outcomes. Unlike previous studies that primarily emphasise technological aspects of LMS adoption, this research highlights the importance of human facilitation in shaping the quality of technology-enhanced learning environments. By integrating tutor facilitation into the analytical model, this study provides new empirical evidence regarding the mechanisms through which pedagogical guidance can strengthen the relationship between LMS utilisation and student learning outcomes. Furthermore, this research contributes to understanding LMS-based learning in the context of Indonesian distance education, offering insights that may inform institutional strategies to improve online learning practices.

Research Questions and research Contribution. Based on the identified research gap, this study aims to examine the role of tutor facilitation in LMS-supported online learning among millennial students. Specifically, this research addresses the following questions: RQ1: How does tutor facilitation influence learning motivation in LMS-based learning environments? RQ2: How does tutor facilitation affect the effectiveness of online learning? By addressing these questions, the study contributes both theoretically and practically. From a theoretical perspective, it expands understanding of how pedagogical facilitation interacts with technological systems to shape online learning outcomes. From a practical perspective, the findings offer higher education institutions insights into the importance of strengthening tutors' pedagogical and digital competencies to optimise the effectiveness of LMS-based learning environments.

B. Method

The population of this study is millennial students from Universitas Terbuka regions in Indonesia. The sampling method used in this study is purposive sampling, which deliberately selects samples based on specific considerations. The respondents in this study were students, both recipients of the Smart Indonesia Card-Lecture (KIP-K) and Corporate Social Responsibility (CSR) scholarships, and independent students in semesters 2 and 3, resulting in a total sample of 160 respondents.

The data type in this study is quantitative, namely, numerical or computable data (Sugiyono, 2019). The data are analysed and processed using statistical analysis techniques. The data source in this study is primary data collected directly from respondents via the distribution of questionnaires via Google Forms.

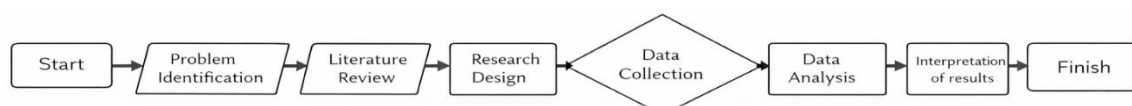


Figure 1. Research Flow Diagram

The research procedure follows a structured research flow, as illustrated in the research Flow Diagram (Figure 1). The diagram outlines the sequential stages of the study, starting from problem identification and literature review, followed by construct development, questionnaire design, data collection, data analysis using SEM-PLS, and interpretation of results. This research flow ensures methodological rigour and clarity in achieving the research objectives.

The research instrument was developed based on established constructs from previous studies. The learning motivation construct was adapted from prior motivation theories in online learning contexts, emphasising intrinsic and extrinsic motivational dimensions. The online learning effectiveness construct was derived from studies focusing on learning outcomes, perceived usefulness, and learning performance in LMS-based environments. Meanwhile, the tutor role construct was developed based on literature highlighting tutor facilitation, guidance, feedback, and interaction management in online learning using LMS. All measurement items were operationalised using a five-point Likert scale.

This study uses descriptive statistics and Structural Equation Modelling–Partial Least Squares (SEM-PLS) to develop and test existing theory. Descriptive analysis was conducted in Microsoft Excel to provide a comprehensive overview of respondent characteristics and variable distributions. SEM-PLS analysis was performed using SmartPLS to evaluate both the measurement and structural models.

Several considerations justify the use of SEM-PLS. First, SEM-PLS is appropriate for predictive-oriented research and theory development rather than theory confirmation. Second, it is suitable for studies with moderate sample sizes, such as the 160 respondents used in this study. Third, SEM-PLS is robust in handling complex models with multiple constructs and does not require strict data normality assumptions. Through SEM analysis, the researchers were able to minimise potential bias while simultaneously assessing relationships among latent variables (Soenyono, 2020).

According to Hair et al (2021), path model analysis consists of two main stages: (1) measurement model analysis (outer model) to assess validity and reliability, and (2) structural model analysis (inner model) to evaluate the relationships among constructs. SEM Partial Least Squares data analysis is therefore suitable for developing and predicting existing theory in LMS-based online learning research (Sarwono & Narimawati, 2015).

C. Result

Primary data in this study were collected by distributing 170 questionnaires to respondents who actively used the Learning Management System (LMS). The questionnaires were distributed directly to students at the regional offices of Universitas Terbuka Ambon and Bandung, while students from other UT regions completed them online via Google Forms.

Of the distributed questionnaires, 160 responses were returned and deemed valid for further analysis, yielding a response rate of 94.1%. The respondents were grouped by

age, gender, LMS experience, and regional UT origin to ensure the sample adequately represented millennial students engaged in LMS-based online learning. Thus, the number of respondents used for data processing in this study was 160, and an overview of the respondent profile is presented in the following figures.

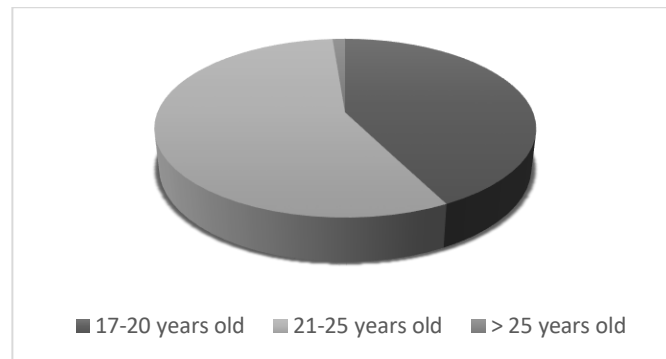


Figure 1. Age of Respondents

As shown in Figure 1, the majority of respondents were aged 21–25 years (90 students), followed by those aged 17–20 years (68 students), while only 2 respondents were aged 25 or older. This age distribution confirms that the sample predominantly represents millennial learners in early adulthood, which is highly relevant to the research objective of examining motivation and learning effectiveness in LMS-based online learning environments among millennial students.

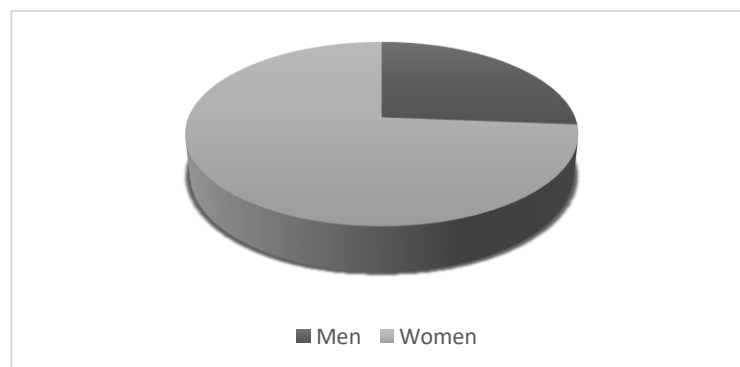


Figure 2. Gender

Figure 2 indicates that of the 160 respondents, 118 were female and 42 were male. This composition suggests a higher participation of female students in the selected study programs. From a research perspective, this distribution remains appropriate, as the study focuses on learning processes and LMS utilisation, which are not gender-specific but reflect actual enrollment characteristics at Universitas Terbuka.

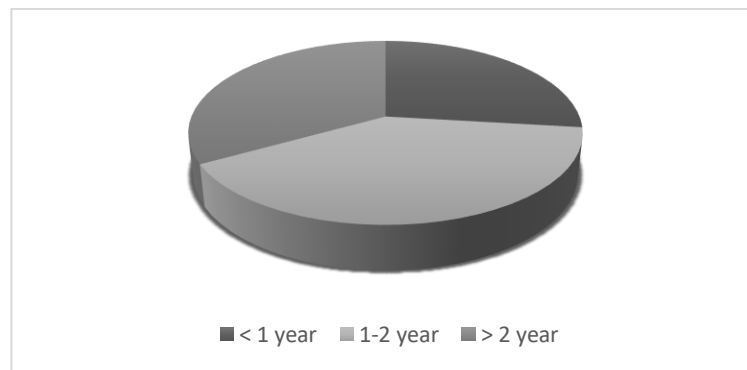


Figure 3. LMS Experience

Based on Figure 3, respondents exhibited varying levels of LMS experience. A total of 43 students had less than 1 year of experience with LMSs, 64 had 1-2 years, and 53 had more than 2 years. This variation is essential for the study, as it reflects differing levels of familiarity with online learning technologies, which may influence both learning motivation and perceived learning effectiveness within LMS-supported environments.

Data Analysis

The indicator properties of each construct are based on the construct of effectiveness and motivation, and the influence of the tutor on the outer model is reflexive. So that the direction of the arrow in the measurement model is from the direction of the construct to the indicator. The outer model design generated by Smart-PLS is shown in Figure 4.

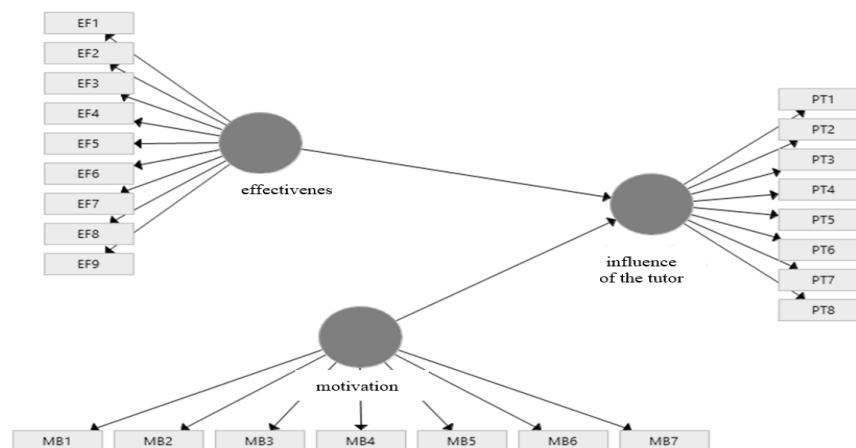


Figure 4. Outer Model Design

Evaluation of the measurement model using reflective indicators involves testing the validity and reliability of each indicator variable relative to its latent variable. The criteria for individual reflexive measures are said to be high if they correlate more than 0.70 with the construct being measured. However, the loading factor of 0.50-0.60 can still be

maintained for the development-stage model (Chin, 1998). The results of the PLS Algorithm model execution are shown in Figure 5.

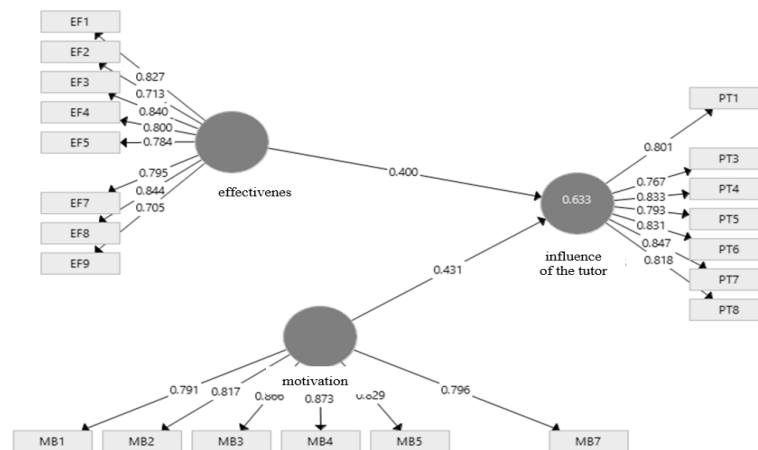


Figure 5. Loading Factor Model Execution

Figure 5 shows that none of the model's indicators have a loading factor below 0.50, so the following model can be evaluated. The path chart in the figure above shows the loading factor value between the indicator and its latent variable. The detailed loading factor values are shown in Table 1 below.

Testing for discriminant validity of reflective indicators is assessed using cross-loadings. Good discriminant validity can explain the indicator's correlation better than other latent-variable indicators. Cross-loading refers to the correlation between an indicator and its latent variables, as well as between an indicator and other latent variables. If the correlation of each indicator with its latent variable is higher than its correlations with other latent variables, this indicates good discriminant validity.

Table 1. Output Cross-Loading

	Effectiveness	Learning Motivation	Influence of LMS Usage on Tutors
EF1	0.827	0.743	0.641
EF2	0.713	0.558	0.519
EF3	0.840	0.726	0.692
EF4	0.800	0.643	0.516
EF5	0.784	0.665	0.586
EF7	0.795	0.667	0.642
EF8	0.844	0.643	0.592
EF9	0.705	0.603	0.573
MB1	0.662	0.791	0.558
MB2	0.687	0.817	0.564
MB3	0.718	0.866	0.703
MB4	0.683	0.873	0.665
MB5	0.683	0.829	0.642
MB7	0.718	0.796	0.649
PT1	0.613	0.625	0.801

	Effectiveness	Learning Motivation	Influence of LMS Usage on Tutors
PT3	0.564	0.590	0.767
PT4	0.614	0.594	0.833
PT5	0.609	0.596	0.793
PT6	0.625	0.644	0.831
PT7	0.674	0.651	0.847
PT8	0.617	0.646	0.818

The table above shows that the correlation between the latent variable Tutor Influence and its indicator is higher than the correlations between the indicator and the other latent variables (Motivation and effectiveness). Conversely, the correlation between the latent variables of motivation and effectiveness is higher than that for different indicators. This shows that the latent variable predicts the indicators within its block better than it does in other blocks.

In addition to the construct validity test, a construct reliability test was also carried out, measured by two criteria: composite reliability and Cronbach's *alpha* from the indicator block that measures the construct. The construct is declared reliable if the composite reliability and Cronbach's alpha values are above 0.70 (Ghozali, 2006). The output of composite reliability and Cronbach's *alpha* is as follows:

Table 2. Output Composite Reliability and Cronbach's Alpha

	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Effectiveness	0.913	0.930	0.624
Learning Motivation	0.909	0.929	0.687
Influence of LMS Usage on Tutors	0.915	0.932	0.662

The results of the measurement model evaluation demonstrate that all constructs meet the reliability requirements for SEM-PLS analysis. The composite reliability values indicate strong internal consistency among the indicators measuring each latent construct. Specifically, the learning effectiveness construct achieved a composite reliability of 0.930, the learning motivation of 0.929, and the construct representing the influence of tutors on LMS usage of 0.932. These values are well above the recommended threshold of 0.70, confirming that the measurement items consistently capture the underlying constructs. Similarly, the Cronbach's Alpha coefficients for tutor influence, learning effectiveness, and learning motivation are 0.915, 0.913, and 0.909, respectively. These high reliability values indicate that the indicators used in this study provide stable, consistent measurements of the theoretical constructs in the model.

Beyond reliability, the constructs' convergent validity was evaluated using the Average Variance Extracted (AVE) criterion. AVE assesses the extent to which a latent construct explains the variance of its associated indicators. In SEM-PLS analysis, an AVE value above 0.50 indicates that a construct explains more than half of the variance of its

indicators and therefore demonstrates adequate convergent validity. The results show that all three constructs have AVE values exceeding the recommended threshold. This finding confirms that the indicators used in the model adequately represent their respective constructs and that the measurement model possesses satisfactory convergent validity.

Following the confirmation of reliability and validity, the structural model was evaluated to examine the relationships among the latent variables proposed in the research framework. The model's explanatory power was first assessed using the coefficient of determination (R^2). The R^2 value represents the proportion of variance in an endogenous construct that can be explained by the exogenous constructs included in the model. The analysis results show that the R^2 value for the tutor influence construct is 0.633. This indicates that learning motivation and learning effectiveness together explain approximately 63.3% of the variance in tutor influence within LMS-based learning environments. In SEM-PLS research, an R^2 value above 0.50 is generally interpreted as indicating moderate to substantial explanatory power. Therefore, the obtained value suggests that the proposed model has a relatively strong capacity to explain the relationships among the examined variables.

In addition to explanatory power, the model's predictive capability was evaluated using the Q-square predictive relevance statistic. The Q^2 value measures the model's ability to predict observed data through its structural relationships accurately. A Q^2 value greater than zero indicates that the model is predictive, meaning the included constructs contribute meaningfully to predicting the endogenous variables. In this study, the Q^2 value was calculated as $Q^2 = 1 - (1 - R^2)$, yielding 0.633. This value indicates strong predictive relevance, suggesting that the structural relationships between learning motivation, learning effectiveness, and tutor influence provide meaningful predictive insight into the dynamics of LMS-based online learning environments.

Hypothesis testing was subsequently conducted using bootstrap resampling to evaluate the statistical significance of relationships among constructs. Bootstrapping allows estimation of standard errors and significance levels for structural path coefficients, enabling assessment of both direct and indirect relationships between variables. The analysis examined the relationships between exogenous and endogenous constructs, as well as among endogenous constructs, within the proposed model. The results of the hypothesis testing confirm that the examined constructs are significantly related, supporting the proposed theoretical relationships within the research framework.

Taken together, the results of the measurement and structural model evaluations indicate that the proposed SEM-PLS model demonstrates satisfactory reliability, validity, explanatory power, and predictive capability. These findings suggest that the relationships among tutor facilitation, learning motivation, and learning effectiveness are statistically significant in the context of LMS-based online learning. More importantly, the results provide empirical evidence that the role of tutors represents a significant factor influencing the effectiveness of LMS-supported learning environments.

These findings provide an important foundation for interpreting the relationships among the constructs examined in this study. The next section discusses these results in greater depth by linking the empirical findings with existing theoretical perspectives and previous research on LMS-based learning, tutor facilitation, and student motivation in online learning environments.

Table 3. Path Coefficients

	Loading Factor	T Statistics	P Values
EF1 <- Effectiveness	0.827	32.605	0.000
EF2 <- Effectiveness	0.713	16.609	0.000
EF3 <- Effectiveness	0.840	32.710	0.000
EF4 <- Effectiveness	0.800	18.770	0.000
EF5 <- Effectiveness	0.784	25.675	0.000
EF7 <- Effectiveness	0.795	23.168	0.000
EF8 <- Effectiveness	0.844	29.637	0.000
EF9 <- Effectiveness	0.705	13.005	0.000
MB1 <- Learning Motivation	0.791	18.554	0.000
MB2 <- Learning Motivation	0.817	23.719	0.000
MB3 <- Learning Motivation	0.866	29.611	0.000
MB4 <- Learning Motivation	0.873	34.807	0.000
MB5 <- Learning Motivation	0.829	32.366	0.000
MB7 <- Learning Motivation	0.796	21.313	0.000
PT1 <- The Influence of LMS Use on Tutors	0.801	21.359	0.000
PT3 <- The Influence of Tutors on the Use of LMS	0.767	16.821	0.000
PT4 <- Influence of LMS Use on Tutors	0.833	29.220	0.000
PT5 <- The Influence of LMS Use on Tutors	0.793	23.220	0.000
PT6 <- The Influence of LMS Use on Tutors	0.831	24.663	0.000
PT7 <- The Influence of LMS Use on Tutors	0.847	30.004	0.000
PT8 <- Influence of LMS Use on Tutors	0.818	28.093	0.000

The table above shows that the indicator values for each indicator against its latent variable, and the t-count values, indicate a level of significance at the 5% confidence level; all indicator t-count values exceed the t-table value (1.96), indicating that all indicators are valid and significant. This is also marked by a p-value < 0.05.

Table 4. Test The Hypothesis Based on the Total Effects

	Loading Factor	P Values
Effectiveness -> Influence of Tutors on LMS Use	0.400	0.001
Learning motivation -> Influence of LMS Use on Tutors	0.431	0.000

Hypothesis testing was conducted using the bootstrapping resampling method, with a significance level of 5%. As shown in Table 4, learning effectiveness had a significant positive effect on tutor influence in LMS usage ($\beta = 0.400$; $p = 0.001$), while learning motivation also showed a significant positive effect ($\beta = 0.431$; $p = 0.000$). Thus, both

hypotheses were supported, indicating that learning motivation and learning effectiveness significantly influence tutors' roles in LMS-based online learning.

Overall, the structural model demonstrates strong explanatory and predictive power, as indicated by the substantial R^2 and Q^2 values. The results confirm that learning motivation and learning effectiveness are significant determinants of tutor influence in LMS usage. These findings validate the proposed model and support the central argument that tutor facilitation plays a critical role in enhancing motivation and effectiveness within LMS-based online learning environments.

D. Discussion

The findings of this study demonstrate that learning motivation significantly influences tutors' use of the Learning Management System (LMS), as indicated by the path coefficient of 0.400 and a p-value of 0.001. This result suggests that higher levels of student motivation contribute to more active Engagement with LMS-based learning environments, thereby strengthening the role of tutors in facilitating learning through digital platforms. From a conceptual perspective, motivated learners are more likely to participate actively in learning activities, interact with digital learning resources, and respond positively to instructional guidance delivered through LMS tools. Consequently, when students exhibit higher levels of motivation, tutors are better able to utilise LMS features such as discussion forums, feedback mechanisms, and learning materials to guide and support the learning process. These findings are consistent with prior studies that highlight the role of LMS platforms in enhancing student Engagement and participation in online learning contexts. In particular, research examining LMS implementation has shown that the effective use of digital learning tools can stimulate student Engagement, while learning motivation plays a central role in enabling students to fully benefit from LMS-based learning environments (Simelane-Mnisi, 2023). Similarly, studies on LMS adoption indicate that motivated learners tend to develop more positive attitudes toward digital learning systems, which ultimately increases the frequency and depth of their interaction with tutors through LMS platforms (Irfandi et al., 2023; Quansah & Essiam, 2021).

Beyond confirming previous empirical findings, this study provides further insight into the mechanisms by which motivation enhances the effectiveness of tutor facilitation in online learning environments. When students are motivated, they tend to demonstrate higher levels of cognitive Engagement, persistence, and willingness to interact with instructional support provided through digital learning platforms. This condition allows tutors to deliver feedback more effectively, provide additional learning resources, and guide problem-solving activities through LMS features. Previous empirical work has similarly shown that learning motivation mediates perceptions of technology-based learning effectiveness and enhances student participation in LMS environments (Heo & Han, 2021; Irfandi et al., 2023). In this regard, motivated learners are more responsive to tutor guidance and are more likely to participate in structured learning activities facilitated through LMS platforms. As a result, the interaction between student motivation and tutor facilitation

becomes a critical mechanism that determines the success of technology-supported learning environments. These findings therefore extend the current understanding of LMS-based learning by emphasising that technological systems alone are insufficient to ensure meaningful learning outcomes; rather, student motivation and tutor facilitation interact dynamically to create an effective learning environment.

In addition to the relationship between learning motivation and tutor facilitation, this study also reveals that the effectiveness of LMS-based learning significantly influences the role of tutors in supporting student learning, as indicated by a path coefficient of 0.431 and a p-value of 0.000. This finding indicates that when LMS platforms are perceived as effective learning environments, tutors are better able to guide students and positively influence their learning experiences. The effectiveness of LMS-based learning environments can enhance the quality of instructional interactions by providing structured learning materials, communication tools, and monitoring features that allow tutors to track student progress. In such environments, tutors can more easily identify learning difficulties, provide timely feedback, and design interactive learning activities that promote deeper understanding. Consequently, effective LMS design not only supports the technical delivery of learning materials but also strengthens tutors' pedagogical role in guiding the learning process.

These results align with previous studies demonstrating that the quality of tutor-student interaction within LMS environments is a critical determinant of learning outcomes and student Engagement in digital learning contexts (García-Méndez et al., 2024; Setiawan et al., 2024; Simelane-Mnisi, 2023). Research has consistently shown that LMS platforms that support communication, collaboration, and interactive learning activities are more effective in promoting student understanding and participation. For instance, LMS environments that incorporate features such as discussion forums, collaborative tasks, and real-time feedback enable tutors to facilitate more meaningful learning interactions and guide students more effectively throughout the learning process (Setiawan et al., 2024; Simelane-Mnisi, 2023). Furthermore, recent studies highlight that advances in digital learning technologies, including AI-supported tutoring systems and large language models, have the potential to further enhance the effectiveness of tutor facilitation in LMS environments by providing additional instructional support and personalised feedback mechanisms (García-Méndez et al., 2024). These developments suggest that integrating advanced technologies into LMS platforms can strengthen tutors' capacity to influence student learning outcomes when combined with effective pedagogical strategies.

The findings of this study are also consistent with theoretical perspectives emphasising the importance of perceived usefulness and perceived ease of use in determining the effectiveness of technology-supported learning environments. Previous studies indicate that user perceptions of LMS usability significantly influence both the adoption and instructional effectiveness of digital learning systems (Altawalbeh, 2023; Park et al., 2022; Quansah & Essiam, 2021). When LMS platforms are perceived as accessible, intuitive, and beneficial for learning activities, tutors are more likely to utilise their features

effectively to support student learning. Within the extended Technology Acceptance Model (TAM), perceived usefulness and perceived ease of use are key determinants of individuals' willingness to adopt and effectively utilise technological systems in educational settings (Altawalbeh, 2023). In the context of LMS-based learning, these perceptions enable tutors to design structured learning activities, deliver feedback efficiently, and facilitate meaningful interactions that enhance students' learning experiences. Consequently, the effectiveness of LMS platforms not only depends on technological functionality but also on how tutors integrate these features into pedagogical practices that support student Engagement and understanding.

Overall, the findings of this study reinforce the view that the dynamic interaction between technological systems and human facilitation shapes the effectiveness of LMS-based online learning. While LMS platforms provide the technological infrastructure for digital learning, the role of tutors remains essential in guiding students, fostering Engagement, and ensuring that digital tools support meaningful learning outcomes. The results, therefore, contribute to the broader literature on technology-enhanced learning by demonstrating that the effectiveness of LMS-based learning environments cannot be fully understood without considering the pedagogical role of tutors and learners' motivational characteristics. These findings highlight the importance of integrating technological design, tutor facilitation, and student motivation within a comprehensive framework for improving the quality of online learning in higher education contexts.

E. Implication

The findings of this study provide important theoretical and practical implications for the development of LMS-based online learning in higher education. From a theoretical perspective, this study strengthens the conceptual understanding of tutor facilitation within LMS environments by demonstrating that targeted tutor intervention plays a critical role in improving learning outcomes. The results highlight that the effectiveness of LMS-based learning is not determined solely by the availability of technological infrastructure but also by the extent to which human facilitation is integrated into the learning process. In this regard, tutors function not only as content providers but also as pedagogical facilitators who guide students' Engagement, support interaction, and enhance motivation in digital learning environments. Therefore, the findings contribute to the growing body of literature on technology-enhanced learning by emphasising the importance of integrating technological systems with effective pedagogical practices to maximise the educational benefits of LMS platforms.

From a practical perspective, the results of this study suggest several strategic considerations for higher education institutions implementing LMS-based learning systems. First, universities need to prioritise continuous professional development programs that strengthen tutors' pedagogical, technological, and digital facilitation competencies. Effective use of LMS platforms requires tutors to possess not only technical skills but also the ability to design interactive learning activities, provide meaningful feedback, and manage student

Engagement in online environments. Second, LMS design and development should prioritise features that support active tutor–student interaction, such as collaborative learning tools, discussion forums, real-time feedback mechanisms, and learning analytics that enable tutors to monitor student progress more effectively. Finally, institutional policies should encourage the integration of technological innovation with human facilitation by promoting collaboration between instructional designers, technology developers, and teaching staff. Through such integrated efforts, universities can create adaptive and effective online learning ecosystems that leverage both technological capabilities and pedagogical expertise to enhance student learning experiences.

F. Limitation and Suggestions for Further Research

This study has several limitations that should be considered when interpreting the findings. First, the data used in this research were collected through self-reported questionnaires, which may introduce potential response bias because participants' perceptions and responses can be influenced by subjective judgments or social desirability. Although self-report instruments are commonly used in educational research, they may not fully capture the complexity of students' learning experiences and interactions within LMS-based environments. Second, the research employed a cross-sectional design, which limits the ability to draw strong causal inferences regarding the relationships among tutor facilitation, learning motivation, and learning effectiveness. While the SEM-PLS analysis provides insights into the structural relationships among variables, longitudinal data would allow a deeper understanding of how these relationships evolve in online learning environments.

Another limitation relates to the scope of the research sample. The participants in this study consisted of millennial students from a single institutional context, namely Universitas Terbuka, which may limit the generalizability of the findings to broader higher education contexts. Differences in institutional characteristics, technological infrastructure, learning cultures, and student demographics may influence the effectiveness of LMS-based learning and the role of tutors in facilitating online learning processes. Therefore, the results of this study should be interpreted with caution when applied to other educational settings.

Future research is encouraged to address these limitations by adopting more diverse methodological and contextual approaches. For example, future studies may employ mixed-method research designs that combine quantitative analysis with qualitative data, such as interviews or classroom observations, to provide a deeper understanding of how tutor facilitation influences student Engagement and learning experiences within LMS environments. In addition, longitudinal studies could examine how relationships among tutor facilitation, motivation, and learning effectiveness develop over time in online learning contexts. Further research may also expand the scope of participants by including students from different generations, institutions, or cultural backgrounds to enhance the external validity of the findings. Finally, future studies may consider incorporating additional variables, such as digital literacy, learning Engagement, or technological readiness, as

moderating or mediating factors to provide a more comprehensive understanding of the mechanisms that shape the effectiveness of LMS-based learning in higher education.

G. Conclusion

This study concludes that tutor facilitation plays a significant role in strengthening both learning motivation and the effectiveness of LMS-based online learning among millennial students. The findings indicate that active tutor guidance, supported by the interactive use of LMS features, can enhance student Engagement and encourage sustained participation in digital learning environments. In particular, the results confirm that tutor facilitation positively contributes to learning motivation (RQ1) and enhances the overall effectiveness of online learning processes (RQ2). These findings highlight that the success of LMS-based learning environments is not determined solely by technological infrastructure but also by the quality of pedagogical facilitation provided by tutors.

From a broader perspective, this study contributes to the growing body of research on technology-enhanced learning by empirically demonstrating the central role of tutor facilitation in linking technological systems with meaningful learning outcomes. The findings suggest that effective integration between digital learning platforms and human facilitation can strengthen student motivation and improve learning effectiveness in higher education contexts. Therefore, enhancing tutors' pedagogical and digital competencies becomes a critical strategy for maximising the potential of LMS-based learning systems.

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