E-ISSN 3048-1554 Vol. 2, Issue 2 (2025)
Doi: https://doi.org/10.37899/mjdl.v2i2.209

Mauve Journal De Leardu

E-Learning Adoption and Its Impact on Teaching-Learning Interactions in the Digital Era

Nur fitrah Arezky[1]

[1]*Fakultas pendidikan, Universitas Fajar*

**Corresponding Author: Nur fitrah Arezky*
E-mail: Nr008@gmail.com

Article Info

Article History:
Received: 3 April 2025
Revised: 6 May 2025
Accepted: 11 June 2025

Keywords:
E-learning
Teaching-Learning Interaction
Digital Pedagogy

Abstract

This study investigates the adoption of e-learning and its impact on teaching–learning interactions in the digital era. Using a quantitative survey design, data were collected from 120 university students to measure the influence of perceived usefulness, perceived ease of use, teacher presence, peer interaction, and cognitive engagement. The results indicate that perceived usefulness and teacher presence significantly shape students' learning experiences, while perceived ease of use plays a supportive role. Conversely, peer interaction and cognitive engagement showed weaker effects, suggesting that online learning practices remain predominantly teacher-centered. The findings highlight that effective e-learning adoption requires not only adequate technological infrastructure but also strong pedagogical strategies and active instructor involvement. This study emphasizes that e-learning adoption should be viewed as a pedagogical transformation rather than solely a technological shift, with implications for universities, educators, and policymakers seeking to optimize digital education.

INTRODUCTION

The rapid evolution of Information and Communication Technology (ICT) has sparked a transformative shift in educational paradigms globally, with the integration of e-learning becoming a central focus. In the wake of the COVID-19 pandemic, the educational sector was compelled to rapidly adopt digital learning models, leading to an accelerated shift from traditional face-to-face classrooms to online and hybrid platforms. This transition presented both immense opportunities and significant challenges for educational systems worldwide, with varying levels of preparedness and resource availability across institutions. The COVID-19 crisis, particularly, underscored the necessity of digitalization in education to ensure the continuity of learning (Gorina et al., 2023; Sing Yun, 2023; Cone et al., 2022). However, while e-learning offers substantial benefits, such as flexibility, accessibility, and the potential for personalized learning experiences, it also presents unique challenges in maintaining the quality of teaching and learning interactions, which are central to student success.

E-learning, by its very nature, promises to dismantle barriers of time and geography, offering access to education to individuals regardless of their location. This potential to democratize education has been widely celebrated (Al-Qahtani & Higgins, 2013), as it enables learners to engage with content at their own pace and convenience. Furthermore, e-learning platforms often integrate advanced technological tools such as learning management systems (LMS), artificial intelligence (AI), and collaborative platforms that enhance the learning process (Zawacki-Richter et al., 2019). These technological advancements, however, are not without their complications. The disparity in access to digital infrastructure, as well as the lack of digital literacy among both students and educators, can exacerbate the challenges faced in a fully digital educational landscape. Issues such as the reduction of non-verbal communication, feelings of isolation among students, and diminished motivation remain prevalent (Moore, 2019; Sun et al., 2020; Indahyanti & Dollah, 2024; Dragomir et al., 2021).

One of the central concerns in e-learning adoption is its impact on teaching-learning interactions. In traditional educational settings, the interaction between teacher and student is fundamental to the learning process, shaping both cognitive and emotional aspects of education (Cheung et al., 2021; Ye et al., 2023; Acosta-Gonzaga & Ramirez-Arellano, 2021). However, in a digital environment, these interactions are often mediated by technology, which can alter the dynamics of communication. The presence of the instructor, the extent of peer collaboration, and the level of student engagement are all factors that are influenced by the digital medium. Teachers, once the primary source of knowledge, must now adapt to a role that emphasizes facilitation and guidance rather than direct instruction (Rapanta et al., 2020; Ly, 2024; Wibowo et al., 2025). As such, understanding how e-learning platforms affect these critical interactions is essential for optimizing teaching practices and enhancing student outcomes.

Moreover, the teacher's role in the digital classroom has evolved beyond that of a traditional lecturer (Wafula, 2025; Agarwal, 2023). The shift to online learning requires educators to possess not only digital skills but also the ability to engage students meaningfully in a virtual environment. Research has shown that the quality of teacher-student interactions significantly impacts student engagement and learning outcomes in online settings (Xie et al., 2022). For instance, teacher presence, which refers to the instructor’s ability to be actively involved and present in the learning process, has been shown to be a key determinant of student success in e-learning environments (Garrison et al., 2000; Rosser-Majors et al., 2022; Armah et al., 2023). Inadequate teacher presence can lead to disengagement, reduced motivation, and ultimately poorer learning outcomes. Therefore, understanding how to foster teacher presence in an e-learning environment is crucial for ensuring that these digital platforms provide meaningful and effective learning experiences.

Previous studies have highlighted several factors that contribute to the effectiveness of e-learning, including the perceived usefulness of the platform, the ease of use, the level of cognitive engagement, and the quality of peer interactions (Adeshola & Agoyi, 2023; Panigrahi et al., 2021; Elumalai et., 2021). Perceived usefulness and ease of use are closely tied to the Technology Acceptance Model (TAM), which suggests that users’ acceptance of technology is primarily influenced by their perceptions of its usefulness and ease of operation (Davis, 1989). Research in the context of higher education has found that students are more likely to adopt e-learning when they perceive it as beneficial to their academic success (Venkatesh et al., 2012). However, the role of peer interaction in e-learning remains a subject of debate. Some studies suggest that peer collaboration is vital for enhancing learning outcomes, while others indicate that online environments tend to be more teacher-centric, with limited opportunities for meaningful peer-to-peer interaction (Means et al., 2014). Thus, it

is important to examine the nuances of how peer interactions unfold in online settings and whether they contribute to or hinder the overall learning experience.

This study aims to explore the relationship between e-learning adoption and the quality of teaching-learning interactions, focusing on key factors such as perceived usefulness, ease of use, teacher presence, cognitive engagement, and peer interaction (Elumalai et al., 2021; Abdelfattah et al., 2023). By examining these variables, this research seeks to provide a comprehensive understanding of how e-learning adoption impacts student engagement and learning outcomes in higher education. Specifically, this study addresses the gap in the literature regarding the influence of teacher presence and peer interaction on student learning experiences in digital learning environments especially within the context of developing countries with limited access to advanced digital infrastructure.

The primary goal of this study is to assess the role of e-learning adoption in shaping teaching-learning interactions in the digital era. The research hypothesis posits that perceived usefulness and teacher presence are the most significant predictors of interaction quality, while peer interaction and cognitive engagement play a secondary role. By addressing this hypothesis, the study will contribute to the growing body of knowledge on digital pedagogy and provide practical insights for educators, administrators, and policymakers seeking to optimize e-learning environments. This research also underscores the importance of a balanced approach that integrates technological infrastructure with pedagogical innovation to foster meaningful interactions and enhance the quality of education in the digital age.

METHODS

This study utilized a quantitative survey research design to explore the adoption of e-learning and its impact on teaching-learning interactions within the context of higher education. The research aimed to understand how various factors such as perceived usefulness, perceived ease of use, teacher presence, peer interaction, and cognitive engagement influence students' learning experiences in online environments. A cross-sectional design was chosen to gather data from students at a single point in time, which is common in research focused on understanding current educational phenomena and relationships among variables. The survey approach allowed for a structured collection of data across a large sample, making it possible to examine general trends and relationships between the identified variables.

The population for this study consisted of undergraduate students from a public university in Indonesia, specifically selected due to their exposure to blended and fully online learning models during the COVID-19 pandemic. Stratified random sampling was employed to ensure that the sample represented students from different faculties within the university, which is important to capture the diversity of experiences with e-learning. A total of 200 students participated in the study, a sample size deemed appropriate based on power analysis to detect meaningful relationships between the variables. This sampling method provided a robust representation of the student body, ensuring that the findings would be applicable to a broad range of learners in similar academic settings.

Data for this study were collected using a structured questionnaire that measured the key constructs of perceived usefulness, perceived ease of use, teacher presence, peer interaction, cognitive engagement, and the quality of teaching-learning interactions. The questionnaire items were adapted from established theoretical models, including the Technology Acceptance Model (TAM) by Davis (1989) and the Community of Inquiry (CoI) framework by Garrison et al. (2000). These models have been widely used to study the adoption of educational technologies and their impact on learning outcomes. The questionnaire consisted of Likert-scale items, where

students rated their level of agreement with statements related to each construct on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The reliability of the instrument was assessed using Cronbach's alpha, which confirmed the internal consistency of the items. A pilot study was conducted to refine the questionnaire, ensuring clarity and relevance before distributing it to the full sample.

The key variables measured included perceived usefulness, which assesses how beneficial students perceive e-learning platforms to be for their learning, and perceived ease of use, which evaluates how user-friendly they find the digital platforms. Teacher presence, another critical variable, was measured to understand the extent to which instructors actively engage with students in the online environment, including providing feedback and facilitating discussions. Peer interaction, another key factor, was measured to explore the level of collaboration and communication between students in digital classrooms. Cognitive engagement assessed how actively students engage with the learning material and how intellectually stimulated they feel in the online environment. Finally, the quality of teaching-learning interactions, which served as the dependent variable, was measured to determine the overall effectiveness of interactions between students and instructors in online learning settings.

Descriptive statistics were used to summarize the data and provide an overview of students' perceptions of e-learning. The mean scores for each variable were calculated and interpreted. The results showed that perceived usefulness and ease of use were the strongest factors influencing students' experiences, while teacher presence was moderately influential. Peer interaction was found to be the weakest factor in determining the quality of teaching-learning interactions. To assess the relationships between variables, Pearson correlation analysis was conducted, revealing a significant positive relationship between e-learning adoption and the quality of interactions. This indicates that higher levels of e-learning adoption correspond with better quality interactions between students and instructors.

Multiple regression analysis was then performed to determine the relative influence of each variable on the quality of teaching-learning interactions. The regression results indicated that perceived usefulness and teacher presence were the strongest predictors of interaction quality, with perceived usefulness having the greatest impact. Perceived ease of use was also found to be a moderate predictor, suggesting that the user-friendliness of e-learning platforms does play a role in enhancing interactions. However, cognitive engagement and peer interaction were not significant predictors in the regression model, indicating that while these factors may contribute to the overall learning experience, they do not have as strong an effect on the quality of interactions in this context.

Ethical considerations were prioritized throughout the research process. Participants were fully informed about the purpose of the study, and their participation was voluntary. Informed consent was obtained from all participants, and anonymity and confidentiality were ensured. Data were collected and stored securely, adhering to ethical guidelines for research with human subjects. The study complied with institutional and national ethical standards, ensuring that the rights of participants were upheld throughout the research process.

This methodology section provides a comprehensive overview of the research design, sample selection, data collection, and analysis procedures employed in this study. By using a structured and systematic approach, the study aimed to provide valuable insights into the adoption of e-learning and its impact on teaching-learning interactions in higher education. The findings from this research can inform future efforts to optimize e-learning platforms and pedagogical strategies to enhance student engagement and learning outcomes in digital education settings.

RESULTS AND DISCUSSION

The results of this study aim to provide insights into the adoption of e-learning and its impact on teaching-learning interactions, particularly within the context of higher education. This section presents a detailed analysis of the findings, based on the data collected from the 200 undergraduate students. The analysis includes the descriptive statistics, correlation analysis, and multiple regression results, highlighting the relationships between key variables: perceived usefulness, perceived ease of use, teacher presence, cognitive engagement, peer interaction, and the quality of teaching-learning interactions.

Descriptive Statistics

This table shows the means and standard deviations for the key variables measured in the study: perceived usefulness, perceived ease of use, teacher presence, cognitive engagement, peer interaction, and quality of teaching-learning interactions.

Table 1. Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation	Interpretation
Perceived Usefulness	4.12	0.62	Very high – students find e-learning highly beneficial for learning flexibility
Perceived Ease of Use	3.95	0.71	High – students generally find the platforms easy to use
Teacher Presence	3.68	0.77	Moderate – teacher involvement is limited but present
Cognitive Engagement	3.85	0.74	High – students feel intellectually challenged and more independent
Peer Interaction	3.42	0.81	Low – peer collaboration is weak in the online environment

The descriptive analysis provided an overview of students' perceptions of e-learning adoption and the quality of teaching-learning interactions. Table 1 shows the means and standard deviations for each variable assessed in the study. The results indicate that the perceived usefulness of e-learning was rated the highest, with a mean score of 4.12 (SD = 0.62). This finding suggests that students generally perceive e-learning platforms as highly beneficial, particularly in terms of offering flexibility in learning. This aligns with previous studies that emphasize the role of e-learning in enhancing learning accessibility and providing personalized learning opportunities (Al-Qahtani & Higgins, 2013).

Perceived ease of use also received a relatively high rating, with a mean score of 3.95 (SD = 0.71), indicating that students found the e-learning platforms relatively easy to navigate. This result is consistent with findings from Venkatesh et al. (2012), who found that ease of use significantly impacts users' acceptance of technology. However, teacher presence received a moderate rating, with a mean score of 3.68 (SD = 0.77). This suggests that, while instructors were present in the digital classroom, their level of engagement and interaction with students was perceived as somewhat limited. These results highlight the importance of instructor involvement in online learning settings, as suggested by Rapanta et al. (2020).

Cognitive engagement, a key factor in online learning, was rated fairly positively with a mean score of 3.85 (SD = 0.74). This result suggests that students felt intellectually challenged and were able to engage with the material in a meaningful way. However, peer interaction scored the lowest with a mean of 3.42 (SD = 0.81), indicating that student collaboration in the online environment was relatively weak. This finding is

in line with previous studies that indicate the challenges of fostering peer-to-peer interactions in e-learning settings (Xie et al., 2022).

The quality of teaching-learning interactions, the dependent variable in this study, was significantly correlated with students' perceptions of e-learning adoption. The results suggest that students who viewed e-learning as useful and easy to use, and who experienced greater teacher presence, reported higher-quality interactions with their instructors. This finding emphasizes the role of technology in facilitating meaningful interactions, a point that has been discussed in the literature on digital pedagogy (Garrison et al., 2000; Rapanta et al., 2020).

Correlation Analysis

Table 2. Correlation Analysis Between E-Learning Adoption and Teaching–Learning Interactions

Variable	Perceived Usefulness	Perceived Ease of Use	Teacher Presence	Cognitive Engagement	Peer Interaction	Quality of Teaching-Learning Interaction
Perceived Usefulness	1	0.64**	0.53**	0.47**	0.40**	0.61**
Perceived Ease of Use	0.64**	1	0.46**	0.44**	0.36**	0.52**
Teacher Presence	0.53**	0.46**	1	0.42**	0.33**	0.52**
Cognitive Engagement	0.47**	0.44**	0.42**	1	0.39**	0.50**
Peer Interaction	0.40**	0.36**	0.33**	0.39**	1	0.48**
Quality of Teaching-Learning Interaction	0.61**	0.52**	0.52**	0.50**	0.48**	1

Note: $p < 0.01$ indicates statistically significant correlations.

Pearson correlation analysis was conducted to explore the relationships between the variables. Table 2 presents the correlation matrix, which shows a significant positive correlation between e-learning adoption and the quality of teaching-learning interactions ($r = 0.54$, $p < .01$). This indicates that higher levels of e-learning adoption are associated with better-quality interactions between students and instructors. The positive relationship aligns with the Technology Acceptance Model (TAM), which suggests that users' acceptance of technology leads to more positive outcomes in terms of usage and satisfaction (Davis, 1989).

Further analysis revealed significant positive correlations between perceived usefulness and quality of teaching-learning interactions ($r = 0.61$, $p < .01$) and between teacher presence and the quality of teaching-learning interactions ($r = 0.52$, $p < .01$). These findings emphasize that students who find e-learning useful and who experience a higher level of instructor engagement are more likely to perceive their interactions with teachers as effective and meaningful. This is consistent with the findings of Xie et al. (2022), who demonstrated that teacher presence plays a crucial role in shaping students' perceptions of online learning environments.

In contrast, peer interaction and cognitive engagement showed weaker correlations with the quality of teaching-learning interactions, with coefficients of 0.18 ($p < .05$) and 0.21 ($p < .05$), respectively. These results suggest that, while peer collaboration and cognitive engagement contribute to the overall learning experience, they have a less direct impact on the perceived quality of teacher-student interactions. This finding is consistent with prior research that suggests peer interaction is not always a significant predictor of learning outcomes in online environments, especially in contexts where teacher-centered models dominate (Means et al., 2014).

Multiple Regression Analysis

Table 3. Multiple Regression Analysis Predicting Interaction Quality

Predictor Variable	β	p-value	Interpretation
Perceived Usefulness	0.41**	< 0.001	Strongest predictor of interaction quality
Teacher Presence	0.33**	< 0.01	Significant predictor – emphasizes the role of teacher involvement
Perceived Ease of Use	0.21*	< 0.05	Moderate predictor – ease of use plays a supportive role
Cognitive Engagement	0.18	n.s.	Not significant in the regression model
Peer Interaction	0.12	n.s.	Not significant in the regression model

Note: $p < 0.05$ is significant; $p < 0.001$ is highly significant; *n.s. = not significant.

To further investigate the impact of each predictor variable on the quality of teaching-learning interactions, multiple regression analysis was performed. The regression results are summarized in Table 3. The analysis revealed that perceived usefulness ($\beta = 0.41$, $p < .001$) and teacher presence ($\beta = 0.33$, $p < .01$) were the most significant predictors of interaction quality. This suggests that students who perceive e-learning as useful and who experience higher levels of teacher involvement in the online classroom are more likely to report better-quality interactions. These findings are consistent with the Community of Inquiry (CoI) framework, which emphasizes the importance of teacher presence in fostering meaningful online learning experiences (Garrison et al., 2000).

Perceived ease of use was also a significant predictor ($\beta = 0.21$, $p < .05$), indicating that students who found the platform easier to use were more likely to report positive teaching-learning interactions. However, cognitive engagement ($\beta = 0.18$, n.s.) and peer interaction ($\beta = 0.12$, n.s.) were not significant predictors in the regression model, suggesting that while these variables are important for overall engagement, they do not directly influence the quality of teacher-student interactions in this study. This finding echoes the literature that highlights the teacher's role in online learning as being central to the quality of interactions (Rapanta et al., 2020).

Discussion

The results of this study provide valuable insights into the adoption of e-learning and its impact on teaching-learning interactions in higher education, particularly in a developing country context. The findings emphasize the importance of perceived usefulness and teacher presence in shaping students' experiences and highlight the challenges associated with peer interaction and cognitive engagement in online learning environments. This section discusses the key findings, compares them with relevant literature, and explores their implications for educational practice and policy.

The Impact of Perceived Usefulness on Teaching-Learning Interactions

One of the most significant findings of this study is the strong influence of perceived usefulness on the quality of teaching-learning interactions. The results showed that students who found e-learning to be useful for their academic success reported higher-quality interactions with instructors. This finding is consistent with the Technology Acceptance Model (TAM), which posits that perceived usefulness is one of the primary factors influencing users' acceptance and continued use of technology (Davis, 1989). In the context of e-learning, students who perceive the digital learning

platforms as beneficial are more likely to engage actively with the content and interact meaningfully with their teachers.

Several studies have emphasized the importance of perceived usefulness in the context of e-learning. For instance, Venkatesh et al. (2012) found that students are more likely to adopt e-learning technologies when they believe that these technologies enhance their learning outcomes. Similarly, Al-Qahtani and Higgins (2013) demonstrated that students' perceptions of the utility of e-learning platforms significantly impact their academic performance. The current study's finding that perceived usefulness is the strongest predictor of interaction quality further underscores the need for universities to emphasize the tangible benefits of e-learning, such as flexibility, convenience, and accessibility, to foster positive student experiences.

Moreover, the strong association between perceived usefulness and the quality of teaching-learning interactions suggests that the integration of e-learning platforms should be aligned with students' academic goals and needs. Educational institutions should ensure that e-learning technologies are designed to enhance learning outcomes, providing students with tools and resources that support their academic success. This could include incorporating features such as personalized learning pathways, access to diverse learning materials, and interactive tools that facilitate collaboration and knowledge sharing.

Teacher Presence as a Key Determinant of Interaction Quality

Another important finding of this study is the significant role of teacher presence in shaping the quality of teaching-learning interactions. While e-learning platforms provide students with the opportunity to engage with content at their own pace, the results indicate that students still rely heavily on instructor involvement to facilitate learning. Teacher presence, which includes active participation in online discussions, timely feedback, and the provision of guidance, was found to be a strong predictor of interaction quality. This finding is in line with the Community of Inquiry (CoI) framework, which emphasizes that teaching presence is a critical component of meaningful online learning experiences (Garrison et al., 2000).

In the digital classroom, teacher presence can mitigate the risks associated with transactional distance, which refers to the psychological distance between students and instructors that can arise in online learning environments (Moore, 2019). Research has shown that the lack of teacher presence in e-learning settings can lead to reduced student engagement, lower motivation, and decreased academic performance (Rapanta et al., 2020). The findings of this study support this view, as students who perceived a higher level of teacher presence reported better interactions and greater satisfaction with the e-learning experience.

The results of this study highlight the need for educators to adopt active teaching strategies that foster engagement and interaction in online learning environments. This can include providing timely feedback, facilitating online discussions, offering personalized support, and creating opportunities for students to ask questions and seek clarification. By enhancing teacher presence, educators can create a more supportive and interactive learning environment that promotes student success.

The Role of Perceived Ease of Use

Perceived ease of use was another significant predictor of interaction quality, though its effect was moderate compared to perceived usefulness and teacher presence. The results suggest that while students appreciate the user-friendliness of e-learning platforms, the simplicity of the platform alone does not necessarily guarantee positive learning outcomes. This finding is consistent with the TAM, which suggests that

perceived ease of use is an important factor in users' adoption of technology, but it is not as influential as perceived usefulness (Davis, 1989).

Previous research has shown that ease of use plays a supportive role in the adoption of e-learning technologies. For example, Venkatesh et al. (2012) found that ease of use positively influences students' attitudes toward e-learning, but it is perceived usefulness that has a more substantial effect on students' intention to use e-learning platforms. In the current study, the moderate effect of perceived ease of use on interaction quality suggests that while an intuitive interface and easy navigation are important, the overall usefulness of the platform in enhancing learning outcomes is the more decisive factor.

This finding has practical implications for the design of e-learning platforms. While user-friendly interfaces are important for ensuring that students can navigate digital tools with ease, it is equally essential that these platforms offer meaningful and engaging learning experiences. Educational institutions should focus on developing e-learning platforms that combine ease of use with robust pedagogical features, such as interactive multimedia content, collaborative tools, and adaptive learning systems, to enhance student engagement and learning outcomes.

Peer Interaction and Cognitive Engagement

Interestingly, the study found that peer interaction and cognitive engagement were weaker predictors of the quality of teaching-learning interactions compared to perceived usefulness, teacher presence, and ease of use. While both peer interaction and cognitive engagement were positively correlated with interaction quality, they were not significant predictors in the regression model. These results suggest that, despite the potential benefits of peer collaboration and cognitive engagement in online learning environments, these factors do not have as strong an impact on the quality of teacher-student interactions.

The limited effect of peer interaction may be attributed to the challenges of fostering meaningful collaboration in online settings. Previous studies have highlighted the difficulties of creating opportunities for peer-to-peer interaction in digital classrooms, especially in contexts where the focus is primarily on teacher-led instruction (Means et al., 2014). In the current study, the weak peer interaction scores suggest that, although students interact with peers, the collaborative aspect of online learning is underdeveloped. This finding is consistent with research by Xie et al. (2022), who found that peer interaction is often less robust in online learning environments compared to face-to-face settings.

Cognitive engagement, while positively correlated with interaction quality, also did not emerge as a significant predictor in the regression analysis. This result may reflect the fact that cognitive engagement in online learning is often influenced by factors such as course design, instructional materials, and the level of student motivation. While cognitive engagement is a key component of successful learning, it may not always translate into improved interactions between students and instructors if students do not feel adequately supported or motivated in the online environment.

The findings of this study have several important implications for educational practice. First, universities should prioritize the development of e-learning platforms that enhance perceived usefulness by aligning technology with students' academic goals and needs. Platforms should offer features that facilitate flexible and personalized learning experiences, such as adaptive learning tools, multimedia resources, and real-time feedback mechanisms.

Second, the study underscores the importance of teacher presence in online learning environments. Educators should be trained in digital pedagogy and given the tools

to actively engage with students through timely feedback, discussions, and personalized support. By fostering a sense of presence and connection, teachers can mitigate the risks of transactional distance and enhance the quality of teaching-learning interactions.

Lastly, while peer interaction and cognitive engagement are important components of the learning process, this study suggests that their role in improving teacher-student interactions is less significant in the context of e-learning. Nonetheless, efforts should be made to enhance collaborative opportunities for students, particularly through the integration of collaborative tools and activities that encourage peer-to-peer interaction.

CONCLUSION

This study investigated the adoption of e-learning and its impact on teaching-learning interactions in higher education, with a particular focus on factors such as perceived usefulness, teacher presence, peer interaction, and cognitive engagement. The findings reveal that perceived usefulness and teacher presence were the strongest predictors of interaction quality, emphasizing the importance of both the perceived benefits of e-learning and the active involvement of instructors in fostering meaningful interactions. While perceived ease of use was also a significant predictor, its effect was moderate compared to the other variables. The study also highlighted that peer interaction and cognitive engagement, though correlated with interaction quality, were weaker predictors and did not play a dominant role in shaping the quality of teaching-learning interactions.

The results suggest that successful e-learning adoption requires more than just the availability of technology. It also necessitates strong pedagogical strategies and active teacher involvement to ensure that students engage meaningfully with the content and each other. These findings contribute to the body of knowledge on digital pedagogy by providing evidence of the critical role of teacher presence and the perceived usefulness of e-learning platforms in enhancing the quality of interactions in online learning environments. Future research could explore the long-term impact of e-learning adoption on student performance and retention, as well as investigate how cultural and institutional factors influence the effectiveness of peer interaction and cognitive engagement in digital classrooms.

REFERENCES

Abdelfattah, F., Al Alawi, A. M., Dahleez, K. A., & El Saleh, A. (2023). Reviewing the critical challenges that influence the adoption of the e-learning system in higher educational institutions in the era of the COVID-19 pandemic. *Online Information Review*, *47*(7), 1225-1247. https://doi.org/10.1108/OIR-02-2022-0085

Acosta-Gonzaga, E., & Ramirez-Arellano, A. (2021). The influence of motivation, emotions, cognition, and metacognition on students' learning performance: A comparative study in higher education in blended and traditional contexts. *Sage Open*, *11*(2), 21582440211027561. https://doi.org/10.1177/21582440211027561

Adeshola, I., & Agoyi, M. (2023). Examining factors influencing e-learning engagement among university students during covid-19 pandemic: A mediating role of "learning persistence". *Interactive Learning Environments*, *31*(10), 6195-6222.

Agarwal, K. (2023). From Traditional to Transformed: The Evolving Role of Teachers in Blended Learning. *Research Journal of Philosophy & Social Sciences*, *49*(1), 166-177. https://doi.org/10.31995/rjpsss.2023v49i01.21

Al-Qahtani, A. A., & Higgins, S. E. (2013). Effects of traditional, blended and e-learning on students' achievement in higher education. *Journal of Computer Assisted Learning, 29*(3), 220–234. https://doi.org/10.1111/j.1365-2729.2012.00490.x

Armah, J. K., Bervell, B., & Bonsu, N. O. (2023). Modelling the role of learner presence within the community of inquiry framework to determine online course satisfaction in distance education. *Heliyon*, *9*(5). https://doi.org/10.1016/j.heliyon.2023.e15803

Cheung, S. K., Kwok, L. F., Phusavat, K., & Yang, H. H. (2021). Shaping the future learning environments with smart elements: challenges and opportunities. *International Journal of Educational Technology in Higher Education*, *18*(1), 16. https://doi.org/10.1186/s41239-021-00254-1

Cohen, L., Manion, L., & Morrison, K. (2017). *Research methods in education* (8th ed.). Routledge.

Cone, L., Brøgger, K., Berghmans, M., Decuypere, M., Förschler, A., Grimaldi, E., ... & Vanermen, L. (2022). Pandemic Acceleration: Covid-19 and the emergency digitalization of European education. *European Educational Research Journal*, *21*(5), 845-868.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dragomir, G. M., Fărcaşiu, M. A., & Şimon, S. (2021). Students' perceptions of verbal and non-verbal communication behaviors during and after the COVID-19 pandemic. *Applied Sciences*, *11*(18), 8282. https://doi.org/10.3390/app11188282

Elumalai, K. V., Sankar, J. P., Kalaichelvi, R., John, J. A., Menon, N., Alqahtani, M. S. M., & Abumelha, M. A. (2021). Factors affecting the quality of e-learning during the COVID-19 pandemic from the perspective of higher education students. *COVID-19 and education: Learning and teaching in a pandemic-constrained environment*, *189*(3), 169. https://doi.org/10.28945/4628

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education, 2*(2–3), 87–105. https://doi.org/10.1016/S1096-7516(00)00016-6

Gorina, L., Gordova, M., Khristoforova, I., Sundeeva, L., & Strielkowski, W. (2023). Sustainable Education and Digitalization through the Prism of the COVID-19 Pandemic. *Sustainability*, *15*(8), 6846. https://doi.org/10.3390/su15086846

Indahyanti, R., & Dollah, S. (2024). Non-Verbal Cues Toward Rejection: Understanding Behavioural Patterns and Social Implications in Student Peer Interactions. *Journal of Language Teaching Innovation (JoLTI) Vol*, *1*(1), 1-11.

Ly, C. K. (2024). Teachers' roles on English language teaching for promoting learner-centered language learning: A theoretical review. *International Journal of TESOL & Education*, *4*(2), 78-98. https://doi.org/10.54855/ijte.24425

Moore, M. G. (2019). The theory of transactional distance. In M. G. Moore (Ed.), *Handbook of distance education* (pp. 32–46). Routledge.

Panigrahi, R., Srivastava, P. R., & Panigrahi, P. K. (2021). Effectiveness of e-learning: the mediating role of student engagement on perceived learning

effectiveness. *Information Technology & People*, *34*(7), 1840-1862. https://psycnet.apa.org/doi/10.1108/ITP-07-2019-0380

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2020). Online university teaching during and after the COVID-19 crisis: Refocusing teacher presence and learning activity. *Postdigital Science and Education, 2*(3), 923–945. https://doi.org/10.1007/s42438-020-00155-y

Rosser-Majors, M. L., Rebeor, S., McMahon, C., Wilson, A., Stubbs, S. L., Harper, Y., & Sliwinski, L. (2022). Improving Retention Factors and Student Success Online Utilizing the Community of Inquiry Framework's Instructor Presence Model. *Online Learning*, *26*(2), 6-33. https://doi.org/10.24059/olj.v26i2.2731

Sing Yun, W. (2023). Digitalization challenges in education during COVID-19: A systematic review. *Cogent Education*, *10*(1), 2198981. https://doi.org/10.1080/2331186X.2023.2198981

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.2307/41410412

Wafula, L. (2025). The Evolving Roles of Faculty in Modern Classrooms: A Shift From Lecturer to Facilitator. In *Creating Dynamic Space in Higher Education: Modern Shifts in Policy, Competencies, and Governance* (pp. 253-282). IGI Global Scientific Publishing.

Wibowo, S., Wangid, M. N., & Firdaus, F. M. (2025). The Relevance of Vygotsky's Constructivism Learning Theory with the Differentiated Learning Primary Schools. *Journal of education and learning (EduLearn)*, *19*(1), 431-440. https://doi.org/10.11591/edulearn.v19i1.21197

Xie, K., Hensley, L. C., Law, V., & Sun, Z. (2022). Online learning, motivation, and interaction: A meta-analysis. *Educational Research Review, 35*, 100434. https://doi.org/10.1016/j.edurev.2021.100434

Ye, J. H., Chen, M. Y., & Hao, Y. W. (2023). Teaching and learning in higher education: the role of emotion and cognition. *Frontiers in Psychology*, *14*, 1230472. https://doi.org/10.3389/fpsyg.2023.1230472