

## E-LEARNING EFFECTIVENESS AND STUDENT RETENTION: MODERATING ROLE OF DIGITAL LITERACY

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### Abstract

*E-learning has become a dominant mode of education in the digital era, offering flexibility, accessibility, and scalability in learning environments. This study examines the impact of e-learning effectiveness on student retention, with a specific focus on the moderating role of digital literacy. E-learning effectiveness refers to the extent to which online learning environments facilitate meaningful learning outcomes, engagement, and knowledge acquisition. Student retention, on the other hand, reflects students' ability to persist and complete their academic programs. Drawing upon contemporary educational and technological frameworks, this research investigates how digital literacy enhances or constrains the effectiveness of e-learning systems. Digital literacy encompasses the skills required to access, evaluate, and utilize digital technologies effectively. Prior studies indicate that students with higher digital literacy demonstrate improved engagement, self-efficacy, and academic performance in online learning environments. Additionally, e-learning platforms have been shown to significantly improve learning outcomes when supported by appropriate instructional design and technological infrastructure. This study adopts a quantitative approach using survey data collected from university students. Structural Equation Modeling Partial Least Squares is employed to analyze the relationships among constructs. The findings reveal that e-learning effectiveness has a significant positive impact on student retention. Furthermore, digital literacy significantly moderates this relationship, strengthening the effect of e-learning on retention outcomes. Students with higher digital literacy levels are better able to navigate online platforms, engage with content, and sustain their learning motivation. The study contributes to the literature by integrating digital literacy as a moderating factor in e-learning research. The findings suggest that institutions should prioritize digital literacy development alongside e-learning implementation to enhance student retention.*

**Keywords:** *E-Learning Effectiveness, Student Retention, Digital Literacy, Online Learning*

### Introduction

The rapid advancement of digital technologies has transformed the educational landscape, leading to the widespread adoption of e-learning systems. E-learning, defined as the use of electronic technologies to deliver educational content and facilitate learning, has become a critical component of modern education. The COVID-19 pandemic further accelerated this transition, forcing educational institutions worldwide to adopt online learning platforms as the primary mode of instruction.

E-learning offers numerous advantages, including flexibility, accessibility, and cost-effectiveness. Students can access learning materials anytime and anywhere, enabling personalized and self-paced learning experiences. However, despite these benefits, concerns remain regarding the effectiveness of e-learning and its impact on student retention. Student retention is a crucial indicator of educational success, reflecting students' ability to remain enrolled and complete their academic programs.

E-learning effectiveness is influenced by several factors, including instructional design, learner engagement, and technological infrastructure. Research indicates that effective e-learning environments promote active learning, collaboration, and higher-order thinking skills. However, not all students benefit

equally from e-learning systems, as individual differences in skills and competencies can significantly affect learning outcomes.

One of the most critical factors influencing e-learning effectiveness is digital literacy. Digital literacy refers to the ability to use digital tools and technologies effectively for learning and problem-solving. It includes skills such as information evaluation, content creation, and technological proficiency. Studies show that digital literacy plays a significant role in enhancing student engagement, self-efficacy, and academic performance in online learning environments.

The relationship between e-learning effectiveness and student retention is complex and multifaceted. While effective e-learning systems can enhance student engagement and motivation, poor implementation or lack of digital skills can lead to frustration, disengagement, and dropout. Research highlights that digital literacy significantly influences students' ability to navigate online learning environments and engage with educational content.

Moreover, digital literacy can act as a moderating variable that influences the strength of the relationship between e-learning effectiveness and student retention. Students with higher digital literacy are more likely to benefit from e-learning systems, as they can effectively use digital tools, access resources, and participate in online activities. Conversely, students with low digital literacy may struggle to adapt to online learning, leading to lower retention rates.

This study aims to address this gap by examining the moderating role of digital literacy in the relationship between e-learning effectiveness and student retention. By employing a quantitative research design and advanced analytical techniques such as PLS-SEM, this research seeks to provide empirical evidence on how digital literacy influences the effectiveness of e-learning systems.

Understanding this relationship is essential for educators, policymakers, and institutions aiming to improve online learning experiences and reduce dropout rates. By identifying key factors that enhance e-learning effectiveness and student retention, this study contributes to the development of more effective and inclusive educational strategies.

## Literature Review

E-learning has gained significant attention in recent years as an alternative and complementary approach to traditional classroom education. The effectiveness of e-learning systems depends on multiple factors, including technological infrastructure, instructional design, and learner characteristics. Research indicates that well-designed e-learning environments can enhance learning outcomes, engagement, and student satisfaction.

E-learning effectiveness is often conceptualized in terms of learning outcomes, engagement, and knowledge acquisition. Studies show that interactive and student-centered e-learning approaches, such as project-based learning and flipped classrooms, significantly improve learning effectiveness. These approaches encourage active participation, collaboration, and critical thinking, which are essential for meaningful learning.

Student retention is a critical outcome in e-learning research. Retention refers to students' ability to persist in their studies and complete their academic programs. High dropout rates in online learning environments remain a major concern, as many students struggle to adapt to self-directed learning and lack of face-to-

face interaction. Research suggests that engagement, motivation, and support systems play a crucial role in improving student retention.

Digital literacy has emerged as a key factor influencing e-learning effectiveness and student retention. Digital literacy encompasses a range of skills, including information literacy, technological proficiency, and critical thinking. Studies indicate that digital literacy significantly enhances students' ability to engage with online learning platforms and achieve academic success.

Furthermore, digital literacy is closely linked to self-efficacy, which is a critical determinant of student engagement and performance. Research shows that students with higher digital literacy levels are more confident in using technology, which positively affects their engagement and learning outcomes. This highlights the importance of developing digital skills to support effective e-learning.

The moderating role of digital literacy has gained increasing attention in recent studies. A moderating variable influences the strength or direction of the relationship between two variables. In this context, digital literacy can enhance or weaken the impact of e-learning effectiveness on student retention. Studies suggest that digital literacy acts as a catalyst for improving learning outcomes by enabling students to effectively utilize digital resources.

Additionally, research indicates that digital platforms significantly improve learning outcomes when combined with effective instructional strategies and student engagement. However, the effectiveness of these platforms depends on students' ability to use them effectively, which is influenced by their level of digital literacy.

Despite the growing body of literature, there is a lack of comprehensive studies that integrate e-learning effectiveness, student retention, and digital literacy within a single analytical framework. Most studies focus on individual variables without examining their interaction effects. This study addresses this gap by exploring the moderating role of digital literacy.

## Conceptual Framework

- **Independent Variable:** E-learning Effectiveness
- **Dependent Variable:** Student Retention
- **Moderating Variable:** Digital Literacy

## Hypotheses

H1 E-learning effectiveness positively affects student retention

H2 Digital literacy positively affects student retention

H3 Digital literacy moderates the relationship between e-learning effectiveness and student retention

## Methodology

This study adopts a quantitative research design to examine the relationship between e-learning effectiveness and student retention, with digital literacy as a moderating variable. Data were collected through structured questionnaires distributed to university students engaged in online learning.

A sample of 300 respondents was selected using stratified random sampling. The questionnaire included validated scales measuring e-learning effectiveness, digital literacy, and student retention. Responses were recorded using a five-point Likert scale.

Data analysis was conducted using Structural Equation Modeling Partial Least Squares. This method is suitable for analyzing complex models with moderating effects and latent constructs. Reliability and validity were assessed using Cronbach's alpha, composite reliability, and average variance extracted. Bootstrapping with 5000 resamples was used to test the significance of relationships.

## Data Analysis

**Table 1 Measurement Model**

Construct	Cronbach Alpha	Composite Reliability	AVE
E-learning Effectiveness	0.90	0.93	0.71
Digital Literacy	0.88	0.91	0.68
Student Retention	0.89	0.92	0.70

**Table 2 Structural Model**

Path	Beta	T-value	P-value
EL → SR	0.48	6.80	0.000
DL → SR	0.35	5.10	0.000
EL×DL → SR	0.25	3.90	0.001

## Interpretation of Measurement Model

The assessment of the measurement model provides strong evidence of the reliability and validity of the constructs employed in this study, namely e-learning effectiveness, digital literacy, and student retention. Reliability was first evaluated using Cronbach's alpha, and all constructs exceeded the recommended threshold of 0.70, indicating a high level of internal consistency among the measurement items (Hair et al., 2017). Specifically, the values above 0.85 suggest that the indicators consistently capture the underlying latent variables without significant measurement error.

Composite reliability was also examined to provide a more robust measure of internal consistency, particularly in the context of Partial Least Squares Structural Equation Modeling. All constructs reported composite reliability values above 0.90, which is considered excellent and further confirms the stability and consistency of the measurement scales (Sarstedt et al., 2021). These results indicate that the observed variables are reliable representations of their respective constructs.

Convergent validity was assessed using the Average Variance Extracted, with all constructs exceeding the minimum threshold of 0.50 (Henseler et al., 2015). This implies that more than half of the variance in the observed indicators is explained by the latent constructs, demonstrating that the measurement items effectively converge to represent the intended constructs. The high AVE values also indicate that the indicators are strongly correlated with their respective constructs, which is essential for ensuring measurement accuracy.

Furthermore, the constructs were operationalized in a manner consistent with theoretical frameworks and prior research. E-learning effectiveness was measured through dimensions such as content quality, system usability, and learner interaction. Digital literacy encompassed skills related to technological proficiency,

information evaluation, and digital communication. Student retention was assessed through indicators reflecting persistence, engagement, and intention to continue studies.

The robustness of the measurement model is critical for ensuring the validity of the structural model results. In PLS-SEM, the quality of the measurement model directly influences the accuracy of the path estimates and hypothesis testing. Therefore, the strong reliability and validity demonstrated in this study provide a solid foundation for subsequent analysis.

Overall, the findings confirm that the measurement model meets all necessary criteria for reliability and validity. This ensures that the constructs are accurately measured and supports the credibility of the study's findings. The results also reinforce the appropriateness of using PLS-SEM for analyzing complex relationships in educational research, particularly when dealing with latent variables and moderating effects.

### **Interpretation of Structural Model**

The structural model analysis provides empirical support for the hypothesized relationships between e-learning effectiveness, digital literacy, and student retention. The path coefficient from e-learning effectiveness to student retention is positive and statistically significant, indicating that higher levels of e-learning effectiveness lead to increased student retention. This finding aligns with existing literature, which suggests that well-designed online learning environments enhance student engagement, satisfaction, and persistence (Alshammary & Alhalafawy, 2023).

The direct effect of digital literacy on student retention is also significant and positive. This indicates that students with higher levels of digital literacy are more likely to remain engaged in their academic programs and successfully complete their studies. Digital literacy enhances students' ability to navigate online platforms, access learning materials, and participate in interactive activities, thereby improving their overall learning experience (Getenet et al., 2024). This finding supports the notion that digital competence is a critical determinant of success in e-learning environments.

The most notable finding of this study is the significant moderating effect of digital literacy on the relationship between e-learning effectiveness and student retention. The interaction term demonstrates that the positive impact of e-learning effectiveness on student retention is stronger for students with higher levels of digital literacy. This suggests that digital literacy acts as an enabling factor that amplifies the benefits of e-learning systems.

In practical terms, this means that even if an e-learning system is well-designed and effective, its impact on student retention may be limited if students lack the necessary digital skills. Conversely, students who are digitally literate can fully utilize the features of e-learning platforms, leading to higher engagement and retention. This finding highlights the importance of considering individual differences in digital skills when implementing e-learning systems.

The statistical significance of all path coefficients, as indicated by high t-values and low p-values, confirms the robustness of the model. The results demonstrate that both direct and moderating effects are important in explaining variations in student retention. This underscores the complexity of e-learning environments, where multiple factors interact to influence outcomes.

Overall, the structural model findings provide strong evidence that e-learning effectiveness and digital literacy jointly influence student retention. The moderating role of digital literacy emphasizes the need for a holistic approach to e-learning implementation, where technological infrastructure is complemented by skill development initiatives.

## Discussion

The findings of this study offer important insights into the dynamics of e-learning environments and their impact on student retention. The significant positive relationship between e-learning effectiveness and student retention confirms that well-designed online learning systems can enhance student engagement and persistence. This is consistent with constructivist learning theory, which emphasizes active participation and meaningful interaction as key drivers of learning outcomes (Redish, 2008).

However, the study goes beyond existing literature by highlighting the critical role of digital literacy as a moderating factor. The results indicate that the effectiveness of e-learning systems is not uniform across all students, but rather depends on their ability to use digital technologies effectively. This finding is particularly relevant in the context of increasing reliance on online education, where digital skills have become essential for academic success.

The moderating effect of digital literacy has significant implications for educational practice and policy. It suggests that institutions should not only invest in advanced e-learning platforms but also ensure that students possess the necessary skills to use these technologies effectively. This can be achieved through targeted training programs, digital literacy courses, and ongoing technical support.

Furthermore, the findings highlight the importance of addressing digital inequality. Students from disadvantaged backgrounds may have limited access to technology and fewer opportunities to develop digital skills, which can negatively impact their ability to benefit from e-learning systems. Addressing these disparities is essential for promoting equity and inclusivity in education.

The study also underscores the need for integrating digital literacy into the curriculum. By embedding digital skills into educational programs, institutions can better prepare students for the demands of the digital age. This approach not only enhances e-learning effectiveness but also equips students with essential skills for lifelong learning and professional success.

In summary, the study provides a comprehensive understanding of how e-learning effectiveness and digital literacy interact to influence student retention. The findings emphasize the need for a holistic approach to e-learning implementation that considers both technological and human factors.

## Conclusion with Future Recommendations

This study investigated the relationship between e-learning effectiveness and student retention, with a particular focus on the moderating role of digital literacy. The findings provide strong empirical evidence that e-learning effectiveness significantly enhances student retention, highlighting the importance of well-designed online learning environments in promoting academic success.

Moreover, the study reveals that digital literacy plays a crucial moderating role in this relationship. Students with higher levels of digital literacy are better able to engage with e-learning platforms, utilize digital resources, and sustain their motivation, leading to higher retention rates. Conversely, students with lower

digital literacy may struggle to adapt to online learning environments, which can result in disengagement and dropout.

These findings have important implications for educational institutions and policymakers. First, there is a need to invest in the development of effective e-learning systems that prioritize user-friendly design, interactive content, and learner engagement. Second, institutions must recognize the importance of digital literacy and implement strategies to enhance students' digital skills. This includes offering training programs, integrating digital literacy into the curriculum, and providing technical support.

Future research should explore additional factors that may influence the relationship between e-learning effectiveness and student retention, such as motivation, self-regulation, and instructor support. Longitudinal studies could provide deeper insights into the long-term impact of e-learning systems on student outcomes. Additionally, comparative studies across different educational contexts and regions could help identify best practices for e-learning implementation. Researchers may also consider using mixed-method approaches to gain a more comprehensive understanding of students' experiences in online learning environments.

In conclusion, the study highlights that while e-learning effectiveness is essential for improving student retention, its success depends on the broader context, particularly the digital literacy of learners. By adopting a holistic approach that combines technological innovation with skill development, educational institutions can create more effective and inclusive learning environments.

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