

Digital competence and academic performance: The mediating role of e-learning risk management

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Highlights

- E-learning risk management is associated with the relationship between digital competence and academic performance.
- Adaptability and flexibility are associated with academic performance, while digital competence is associated with e-learning risk management.
- Integrating risk management concepts into digital education may support students' ability to manage challenges in technology-mediated learning environments.

Abstract

The rapid integration of digital technologies in higher education has made digital competence an important factor in students' learning experiences. However, exposure to e-learning risks may affect how digital competence relates to academic performance. This study examined whether e-learning risk management mediated the relationship between digital competence and academic performance among university students. Using a quantitative cross-sectional research design, data were collected from 241 university students in a rural Philippine setting through structured survey questionnaires measuring digital competence, e-learning risk management, and academic performance. Hayes' PROCESS Macro was used to examine the proposed mediation model. The findings suggest that digital competence was not significantly associated with academic performance through a direct pathway but was indirectly associated through e-learning risk management strategies, including adaptability, diversification of learning approaches, and flexible problem-solving. Students with higher levels of digital competence also tended to report stronger e-learning risk management practices, which were associated with better academic performance. These findings highlight the potential value of incorporating e-learning risk management into digital learning initiatives. However, because the study employed a cross-sectional design and relied on survey-based measures, the findings should be interpreted as associative rather than causal and may not be generalizable beyond similar educational contexts.

Article Info: Research Article

Keywords: *digital competence, e-learning risks management, academic performance, digital literacy*

1. Introduction

The rapid growth of internet technologies has transformed higher education by expanding the use of e-learning platforms and other digital learning tools (Alyoussef, 2023). These technologies have made learning more flexible, accessible, and convenient for many students (Palvia et al., 2018). However, the benefits of digital learning are not experienced equally across all educational settings. In many rural areas of the Philippines, students continue to face challenges such as unstable internet connectivity, limited access to digital devices, and inadequate technological support, which may affect their participation in online learning and their academic outcomes (Oducado & Estoque, 2021).

Within this context, digital competence has become an important capability for students to participate effectively in technology-supported learning. Digital competence refers to the knowledge, skills, and attitudes needed to use digital technologies to locate information, communicate, collaborate, create digital content, and solve problems in digital environments (Samane-Cutipa et al., 2022). Previous studies have

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shown that students with higher levels of digital competence tend to demonstrate better engagement and academic performance in online learning environments (Younas et al., 2022; Scheel et al., 2022). These findings suggest that digital competence is an important factor associated with students' learning experiences and academic success.

Despite these advantages, digital learning also exposes students to various risks that may influence their learning experiences. These risks include unstable internet connections, cybersecurity threats, data privacy concerns, limited access to learning resources, reduced interaction with teachers and classmates, and online learning fatigue (World Economic Forum, 2020; Bailenson, 2021). Such challenges may limit students' ability to fully benefit from digital learning and may be associated with lower academic performance (Shersad & Salam, 2020). These concerns are particularly evident in rural higher education institutions where connectivity problems, limited digital infrastructure, and fewer technological resources create additional barriers to effective online learning (Nouraei & Al-Badi, 2023; Suciptawati et al., 2023).

Previous research has established that digital competence is associated with academic performance and that e-learning risks influence students' online learning experiences (Younas et al., 2022; Kallas et al., 2022). However, these variables have generally been examined independently. For example, Shersad and Salam (2020) classified different types of e-learning risks without examining how students manage those risks in relation to their academic performance. Likewise, Bailenson (2021) investigated the effects of Zoom fatigue, while Sapanca and Kanbul (2022) focused on information security threats, each addressing specific aspects of e-learning risk rather than considering risk management as part of a broader learning process. Similarly, Ahmed (2023) examined strategic planning for university e-learning systems, and Akacha and Awad (2023) analyzed security vulnerabilities in major e-learning platforms, but neither study investigated the role of e-learning risk management in explaining the relationship between digital competence and academic performance.

Recent studies suggest that students' adaptability and use of appropriate learning strategies may help them respond more effectively to challenges encountered in digital learning environments (Frolova et al., 2021; Stockinger et al., 2021; Barrot et al., 2021). These findings indicate that students' ability to manage e-learning risks may be associated with how effectively they use their digital competence to support their academic performance. However, empirical evidence examining e-learning risk management as a mediating variable in this relationship remains limited, particularly within rural higher education settings. Addressing this gap may provide a better understanding of how digital competence and e-learning risk management are associated with academic performance.

This study draws on three complementary theoretical perspectives. The Digital Competence Framework (Lucas et al., 2022) explains that students require digital knowledge and skills to effectively participate in technology-enhanced learning. Risk Management Theory, particularly the Precautionary Principle (Rushton, 2007), suggests that individuals can reduce the effects of uncertainty by adopting preventive and adaptive strategies before problems occur. Constructivist Learning Theory (Vygotsky, 1978) further explains that learning is an active process in which students continually adapt their knowledge and behaviors in response to their learning environment. Together, these perspectives suggest that while digital competence equips students with the skills needed for digital learning, effective e-learning risk management may help explain how those skills are associated with academic performance when students encounter challenges in online learning environments.

Accordingly, this study examined the mediating role of e-learning risk management in the relationship between digital competence and academic performance among university students in a rural Philippine university. By focusing on a context that has received relatively limited attention in the literature, the study contributes to a better understanding of digital learning in rural higher education settings and extends existing research by examining whether e-learning risk management helps explain the association between digital competence and academic performance.

Guided by this objective, the study addressed the following research questions:

1. Is digital competence significantly associated with academic performance?

2. Is digital competence significantly associated e-learning risk management?
3. Is e-learning risk management significantly associated with academic performance?
4. Does e-learning risk management mediate the relationship between digital competence and academic performance?

Based on these research questions, the study established null hypotheses:

H₀₁: Digital competence is not significantly associated with academic performance.

H₀₂: Digital competence is not significantly associated with e-learning risk management.

H₀₃: E-learning risk management is not significantly associated with academic performance.

H₀₄: E-learning risk management do not mediate the relationship between digital competence and academic performance.

2. Literature

2.1. Digital Competence in Higher Education

The increasing integration of digital technologies into higher education has made digital competence an essential capability for students participating in technology-supported learning. Digital competence refers to the knowledge, skills, and attitudes required to use digital technologies effectively to access information, communicate, collaborate, create digital content, and solve problems in digital environments (Marrero-Sánchez & Vergara-Romero, 2023). Within e-learning contexts, the European Digital Competence Framework identifies three core dimensions that are particularly relevant to students: information and digital literacy, communication and collaboration, and digital content creation (Lucas et al., 2022).

Information and digital literacy enable students to locate, evaluate, organize, and ethically use digital information for academic purposes. Communication and collaboration involve interacting with instructors and peers, sharing learning resources, and participating in online discussions through digital platforms. Digital content creation refers to students' ability to produce digital learning materials such as reports, presentations, videos, and other multimedia outputs that support academic learning (Lucas et al., 2022).

A growing body of research suggests that digital competence is associated with positive learning experiences in online education. Students with stronger digital competence are generally more confident in navigating learning management systems, accessing digital resources, completing online learning activities, and participating in collaborative learning environments (Zhao et al., 2021; Lucas et al., 2022). Likewise, higher levels of digital competence have been associated with greater engagement and improved academic performance in technology-mediated learning environments. These findings highlight digital competence as an important factor that supports students' participation and success in e-learning.

2.2 E-learning Risk Management

Although e-learning provides greater flexibility and accessibility, it also exposes students to various challenges that may interrupt learning. Common risks include unstable internet connectivity, technical failures, cybersecurity threats, data privacy concerns, online fatigue, limited interaction with instructors and classmates, and insufficient instructional support (Shersad & Salam, 2020; Oducado & Estoque, 2021). These challenges may reduce students' engagement and limit their ability to achieve positive learning outcomes.

E-learning risk management refers to students' ability to recognize, anticipate, and respond effectively to challenges encountered in online learning environments. Rather than focusing solely on preventing risks, it emphasizes the ability to maintain learning continuity by adapting to changing conditions and applying appropriate learning strategies when disruptions occur. In this study, e-learning risk management is viewed as a behavioral capability that enables students to sustain effective learning despite technological, instructional, or environmental constraints.

Three complementary strategies are commonly discussed in the literature. Diversification involves using multiple digital platforms and learning resources to reduce dependence on a single system and minimize disruptions to online learning (Barrot et al., 2021; Shersad & Salam, 2020). Flexibility refers to students' ability to adjust their learning schedules, study pace, and learning strategies according to changing circumstances (Shearer & Park, 2018). Adaptability involves modifying learning behaviors and problem-solving approaches when faced with unexpected situations such as unstable internet connections, platform failures, or limited communication with instructors (Ammade et al., 2022; Stockinger et al., 2021). These strategies are also consistent with broader resilience approaches that emphasize adaptability and diversification as ways of responding flexibly to disruptions and sustaining activities during periods of crisis. In the context of e-learning, these strategies may help students manage challenges and maintain participation in technology-supported learning environments (Barrot et al., 2021).

2.3 Academic Performance in E-learning

Academic performance reflects the extent to which students achieve expected learning outcomes during a given academic period. In this study, academic performance was measured using students' General Weighted Average (GWA), following the grading system commonly used in Philippine higher education institutions. The GWA ranges from 1.00 to 5.00, where 1.00 represents the highest academic performance and 5.00 indicates failure. Because lower GWA values indicate better academic performance, the GWA scores were reverse-coded for statistical analysis so that higher scores represented better academic performance.

Within e-learning environments, academic performance is influenced by multiple factors, including students' engagement, participation, completion of online assessments, and ability to use digital technologies effectively (Bravo-Agapito et al., 2020). Previous studies have reported that students with stronger digital competence are generally more successful in accessing learning resources, completing online academic tasks, and participating in collaborative learning activities (Han & Ellis, 2021; Jaggars & Xu, 2016). Greater engagement and effective use of digital technologies have likewise been associated with better academic outcomes in online learning settings (Lai & Hong, 2015).

2.4 Relationship Between Digital Competence and Academic Performance

Numerous studies have reported a positive association between digital competence and academic performance. Students with stronger digital skills are generally better able to access learning materials, evaluate information, communicate and collaborate through digital environments, and complete technology-supported learning activities effectively (Cabero-Almenara et al., 2023; Younas et al., 2022). These competencies may improve students' engagement, self-directed learning, and problem-solving abilities, which are commonly associated with better academic outcomes. However, previous studies have primarily examined the direct association between digital competence and academic performance, with limited attention given to factors that may explain this relationship.

2.5 Relationship Between Digital Competence and E-learning Risk Management

Digital competence may also support students' ability to manage challenges encountered in online learning environments. Students with stronger digital skills are generally more capable of resolving technical problems, protecting personal information, managing online workloads, and using digital learning platforms safely and efficiently (Martin et al., 2019; Erarslan & Topkaya, 2017). Digital competence may therefore enhance students' ability to recognize potential risks and apply appropriate strategies that support continuous participation in e-learning despite technological or instructional challenges.

2.6 Mediating Role of E-learning Risk Management

Existing research has shown that digital competence is associated with academic performance, while students' coping strategies and adaptability are associated with their experiences and outcomes in online learning environments (Cabero-Almenara et al., 2023; Younas et al., 2022; Barrot et al., 2021; Stockinger et al., 2021). However, relatively few studies have examined whether e-learning risk management helps explain the relationship between digital competence and academic performance. Most previous studies have

focused on either digital competence or specific categories of e-learning risks without examining how these variables work together.

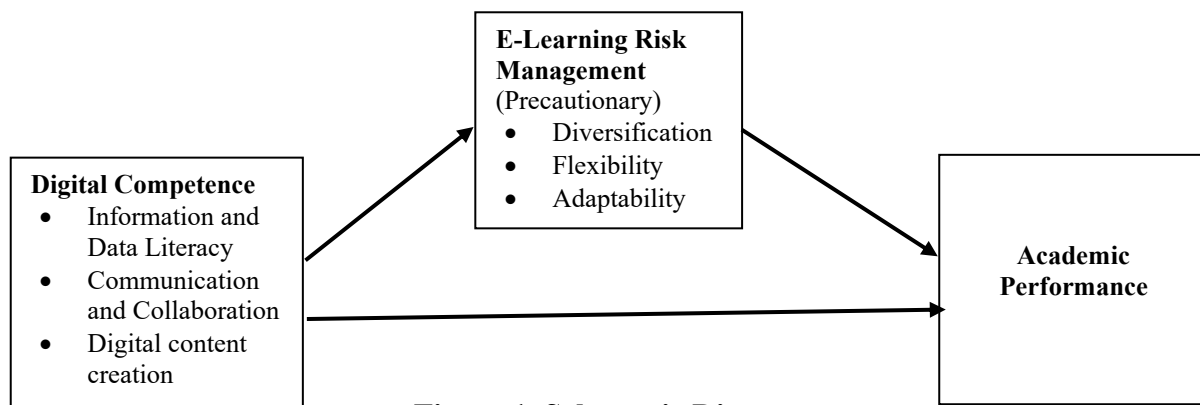


Figure 1. Schematic Diagram

Drawing from the Digital Competence Framework, Risk Management Theory, and Constructivist Learning Theory, this study proposes that e-learning risk management may serve as a mediating variable between digital competence and academic performance. Students with stronger digital competence may be better prepared to apply adaptive learning strategies, use alternative digital resources, and respond effectively to unexpected learning challenges (Ammade et al., 2022). In turn, these risk management practices may support greater learning continuity and more favorable academic outcomes. Examining this relationship may provide a better understanding of how digital competence is associated with academic performance, particularly among students studying in rural higher education institutions where technological and environmental challenges remain common.

3. Methodology

3.1. Research Model/Design

This study employed a quantitative cross-sectional research design to examine the relationships among digital competence, e-learning risk management, and academic performance. Multiple linear regression analysis was used to examine the associations among the study variables. To test the proposed mediation model, mediation analysis was performed using Hayes' PROCESS Macro (Model 4) (Hayes, 2022), with e-learning risk management specified as the mediating variable between digital competence and academic performance.

3.2. Data Collecting Tools

Data were collected using a modified survey questionnaire consisting of three sections corresponding to the study variables: digital competence, e-learning risk management, and academic performance.

The first section measured students' digital competence across three dimensions: information and digital literacy, communication and collaboration, and digital content creation. The instrument was adapted from the Digital Competence Framework developed by Lucas et al. (2022). Minor modifications were made to improve the suitability of the items for the higher education e-learning context in the Philippines while preserving the original constructs.

The second section measured e-learning risk management using a researcher-developed instrument. The scale was designed to assess students' ability to manage challenges encountered in online learning through three dimensions: diversification, flexibility, and adaptability. The items were developed by adapting concepts and indicators from Shearer and Park (2018), and Ammade et al. (2022). Diversification assessed students' use of alternative digital platforms, learning resources, and storage options to minimize learning disruptions. Flexibility measured students' ability to adjust their learning schedules, study pace, and learning strategies in response to changing learning conditions. Adaptability assessed students' capacity to modify their learning behaviors and problem-solving approaches when encountering technological or

instructional challenges. The adapted items were reviewed to ensure their relevance and consistency with the conceptual definition of e-learning risk management before being administered to the study participants.

To evaluate construct validity, Confirmatory Factor Analysis (CFA) was performed on the six-factor measurement model consisting of information and digital literacy, communication and collaboration, digital content creation, diversification, flexibility, and adaptability. The CFA results provided mixed evidence of model fit. The Root Mean Square Error of Approximation (RMSEA = 0.065) indicated an acceptable level of approximation error. However, several incremental fit indices were below commonly recommended thresholds, including the Comparative Fit Index (CFI = 0.882), Tucker-Lewis Index (TLI = 0.867), Goodness-of-Fit Index (GFI = 0.791), Adjusted Goodness-of-Fit Index (AGFI = 0.765), and Normed Fit Index (NFI = 0.791). Despite these limitations, the standardized factor loadings met acceptable levels and supported the representation of the proposed constructs. Considering that the e-learning risk management instrument was researcher-developed and adapted from established literature, it was considered adequate for the present study. Nevertheless, the measurement model may benefit from further refinement and validation using larger and more diverse samples in future studies.

The third section measured academic performance using students' General Weighted Average (GWA) for the first semester of Academic Year 2023–2024, the period during which e-learning was actively implemented through synchronous online classes, digital learning activities, and online submission of academic requirements. The GWA is the standard grading system used in Philippine higher education institutions and represents the weighted average of a student's grades across all enrolled courses during the semester. Under this grading system, a score of 1.00 represents the highest level of academic performance, whereas 5.00 indicates failure. The GWA was selected because it provides a comprehensive indicator of students' overall academic achievement during the study period and has been used in previous educational research as a measure of academic performance (Secreto et al., 2023).

3.3. Sampling or Study Group

The study population consisted of 643 undergraduate students enrolled during the first semester of Academic Year 2023–2024 at a state university located in a rural municipality in Northern Mindanao, Philippines. During the study period, the university implemented hybrid and asynchronous learning, requiring students to use learning management systems, videoconferencing platforms, and other digital technologies to complete academic requirements. Although internet connectivity and access to digital resources had improved following the COVID-19 pandemic, many students continued to experience challenges associated with unstable internet connections, limited access to digital devices, and varying levels of technological support, which are common concerns in rural higher education settings (Franco, 2020; Nouraey & Al-Badi, 2023; Suciptawati et al., 2023). Because the students regularly participated in technology-supported learning, they were considered appropriate participants for examining digital competence, e-learning risk management, and academic performance.

A multi-stage stratified random sampling technique was employed to ensure that the sample adequately represented the study population. In the first stage, the population was stratified according to campus, academic program, and year level. In the second stage, proportional allocation was used to determine the number of respondents to be selected from each stratum based on its proportion in the total population. In the final stage, students were selected through systematic random sampling using the official enrollment lists as the sampling frame.

The minimum required sample size was 241 students, as determined using the Raosoft Sample Size Calculator with a 95% confidence level, a 5% margin of error, and a 50% response distribution. Data collection continued until the required sample size was achieved. This sampling procedure was intended to improve the representativeness of the sample and reduce selection bias by ensuring that students from different campuses, academic programs, and year levels were proportionately represented in the study.

3.4. *Validity and Reliability*

Content validity was established through expert evaluation involving three specialists with expertise in psychometrics, educational management, and e-learning systems. Each expert independently reviewed the questionnaire for clarity, relevance, representativeness, and alignment with the study constructs using a content validation rating scale adapted from Oducado (2020). Item-level comments and recommendations were carefully examined to identify statements requiring improvement. Based on the experts' feedback, minor revisions were made to improve the wording, clarity, and contextual relevance of several items, while retaining their intended meaning. The revised questionnaire obtained an overall Content Validity Index (CVI) of 0.87, indicating good content validity and suggesting that the items were appropriate for measuring the intended constructs.

To further evaluate the consistency of the instruments, a pilot test was conducted with 40 undergraduate students from a college implementing a similar e-learning system who were not included in the final study sample. Internal consistency reliability was assessed using Cronbach's alpha. The Digital Competence scale obtained a coefficient of 0.951, while the E-learning Risk Management scale obtained a coefficient of 0.941, indicating excellent internal consistency. The pilot test also confirmed that the questionnaire items were understandable and appropriate for administration to the target population.

3.5. *Data Analysis*

To address the research questions, multiple linear regression analyses were conducted to examine the associations between (1) digital competence and academic performance, (2) digital competence and e-learning risk management, and (3) e-learning risk management and academic performance. Before conducting the regression analyses, the assumptions of multiple linear regression were evaluated. Linearity was assessed through scatterplots, independence of errors was examined using the Durbin–Watson statistic, normality of residuals was evaluated through normal probability plots and residual distributions, homoscedasticity was examined using standardized residual plots, and multicollinearity was assessed using tolerance and Variance Inflation Factor (VIF) values. The diagnostic results indicated that the assumptions for multiple linear regression were adequately satisfied.

The proposed indirect relationship was examined using Hayes' PROCESS Macro (Version 4.2, Model 4) with 5,000 bootstrap samples (Hayes, 2022). The indirect effect was considered statistically significant when the 95% bootstrap confidence interval did not include zero. Given the cross-sectional nature of the data, the analysis was used to evaluate the presence of a statistically significant indirect effect that is consistent with the proposed mediation model rather than to establish causal mediation (Maxwell & Cole, 2007). Accordingly, the findings are interpreted as evidence of an indirect association among the variables rather than proof of a causal mediating process.

3.6. *Research Procedures*

Prior to data collection, the study obtained ethics approval from the Bukidnon State University Research Ethics Board. After the ethical clearance was granted, permission to conduct the study was secured from the University President and the respective Campus Heads. Upon receiving these approvals, the researchers proceeded with the data collection.

Before participating, all respondents were informed about the purpose of the study, the voluntary nature of their participation, their right to decline or withdraw at any time without penalty, and the measures taken to protect the confidentiality of their information. Written informed consent was obtained from all participants before the administration of the survey.

The questionnaires were administered in person and collected immediately after completion to minimize non-response bias. Academic performance was measured using students' General Weighted Average (GWA), which was obtained from the university records with the appropriate institutional authorization. To protect participants' privacy, the GWA data were linked to the survey responses using unique identification codes rather than students' names or identification numbers. The dataset used for analysis was

anonymized, stored securely, and accessed only by the researchers. All results are reported in aggregate form to ensure that no individual participant can be identified.

4. Findings and Discussions

4.1. Findings Regarding the First Research Question

Table 1 presents the results of the multiple linear regression analysis examining the associations between the dimensions of digital competence and academic performance.

Table 1

Multiple Linear Regression of Digital Competence Dimensions and Academic Performance

Digital Competence Dimensions (Constant)	Academic Performance				
	Unstandardized Coefficients (B)	Std. Error	t-value	p-value	Decision on Ho
	3.051	.159	19.154		
Information and Digital Literacy	.143	.039	3.861	.000	Reject Ho
Communication and Collaboration	.045	.054	.846	.398	Fail to reject Ho
Digital Content Creation	.065	.036	1.789	.075	Fail to reject Ho

Adjusted $r^2 = .163$

ANOVA for Regression: $F=16.636, p < .01$

Note: Results were considered statistically significant at $p < 0.01$ (two-tailed).

Information and digital literacy was the only significant predictor of academic performance ($B = 0.143, t = 3.861, p < .01$). This indicates that, after controlling for the other dimensions of digital competence, higher levels of information and digital literacy were associated with better academic performance. This finding is consistent with previous studies showing that students who are able to effectively locate, evaluate, organize, and use digital information are better prepared to complete academic tasks and engage successfully in online learning (Siddiq et al., 2016; Han & Ellis, 2021).

In contrast, communication and collaboration ($B = 0.045, t = 0.846, p = .398$) and digital content creation ($B = 0.065, t = 1.789, p = .075$) were not significantly associated with academic performance. These findings suggest that, after accounting for information and digital literacy, the unique contributions of communication and collaboration and digital content creation to academic performance were not statistically supported in the present sample. One possible explanation is that these competencies may contribute more directly to students' engagement, collaboration, or learning experiences than to their overall academic performance as measured by General Weighted Average (GWA). This interpretation is consistent with studies suggesting that different dimensions of digital competence may influence educational outcomes in different ways rather than contributing equally to academic achievement (Junaid & Faizan, 2022; Lucas et al., 2022).

Overall, the regression model explained 16.3% of the variance in academic performance (adjusted $R^2 = .163$) and was statistically significant ($F = 16.636, p < .01$). These findings indicate that the dimensions of digital competence collectively showed a significant association with academic performance, although information and digital literacy emerged as the only dimension with a statistically significant independent contribution. This finding supports previous research emphasizing the importance of students' ability to access, evaluate, and use digital information effectively in technology-supported learning environments (Han & Ellis, 2021; Jaggars & Xu, 2016).

4.2. Findings Regarding the Second Research Question

Table 2 presents the results of the multiple linear regression analysis examining the associations between the dimensions of digital competence and e-learning risk management.

Table 2

Multiple Linear Regression of Digital Competence Dimensions on E-learning Risk Management

Digital Competence dimensions	E-learning risk management				
	Unstandardized Coefficients (B)	Std. Error	t-value	Sig.	Decision on Ho
(Constant)	1.432	.179	8.004		
Information and Digital Literacy	.204	.044	4.667	.000	Reject Ho
Communication and Collaboration	.225	.060	3.721	.000	Reject Ho
Digital Content Creation	.217	.041	5.345	.000	Reject Ho

Adjusted $r^2 = .473$ ANOVA for Regression: $F=72.883$ $p < .01$

Note: Results were considered statistically significant at $p < 0.01$ (two-tailed).

All dimensions—information and digital literacy ($B = 0.204$, $t = 4.667$, $p < 0.01$), communication and collaboration ($B = 0.225$, $t = 3.721$, $p < 0.01$), and digital content creation ($B = 0.217$, $t = 5.345$, $p < 0.01$)—showed significant positive effects on e-learning risk management, indicating that higher levels of digital competence are associated with stronger risk management practices. This further suggests that students with a stronger grasp of digital tools and platforms navigate e-learning environments more effectively, leading to better learning outcomes. This aligns with research by Bismala et al. (2022), who emphasize the importance of digital literacy skills for student satisfaction with e-learning platforms.

Overall, the model demonstrated strong explanatory power, accounting for 47.3% of the variance in e-learning risk management (adjusted $R^2 = 0.473$), and was statistically significant overall ($F = 72.883$, $p < 0.01$). These results suggest that higher levels of digital competence are associated with stronger e-learning risk management practices. It aligns with prior research indicating that digital skills enhance students' ability to navigate and manage risks in online learning environments (Martin et al., 2019; Erarslan & Topkaya, 2017).

4.3. Findings Regarding the Third Research Question

Table 3 presents the results of the multiple linear regression analysis examining the associations between the dimensions of e-learning risk management and academic performance.

Table 3

Multiple Linear Regression of E-learning risk management Dimensions on Academic Performance

E-learning Risk Management Dimensions	Academic Performance				
	Unstandardized Coefficients (B)	Std. Error	t-value	p-value	Decision on Ho
(Constant)	2.651	.161	16.484		
Diversification	.053	.040	1.327	.186	Fail to reject Ho
Flexibility	.182	.044	4.166	.000	Reject Ho
Adaptability	.118	.040	2.966	.003	Reject Ho

Adjusted $r^2 = .248$ ANOVA for Regression: $F=27.354$, $p < .01$

Note: Results were considered statistically significant at $p < 0.01$ (two-tailed).

Flexibility was significantly associated with academic performance ($B = 0.182$, $t = 4.166$, $p < .01$). This finding indicates that, after controlling for the other dimensions of e-learning risk management, students who reported higher levels of flexibility also tended to have better academic performance. Flexibility reflects students' ability to adjust their learning strategies, schedules, and study approaches in response to changing learning conditions. This finding is consistent with previous studies suggesting that flexible learning behaviors and self-regulated learning strategies are associated with more effective participation in online learning environments (Rasheed et al., 2020; Dhawan, 2020).

Diversification ($B = 0.053$, $t = 1.327$, $p = .186$) was not significantly associated with academic performance. This finding suggests that the use of multiple learning resources or digital platforms, by itself, was not independently associated with students' General Weighted Average after accounting for the other dimensions of e-learning risk management. One possible explanation is that merely having access to various learning resources may not improve academic performance unless students are able to use those resources effectively within their learning activities.

Adaptability ($B = 0.118$, $t = 2.966$, $p < .01$) was also significantly associated with academic performance. This result suggests that students who were better able to adjust their learning behaviors and respond to changing online learning conditions tended to demonstrate better academic performance. This finding is consistent with previous research indicating that adaptive learning behaviors help students respond more effectively to challenges encountered in technology-supported learning environments (Martin et al., 2021).

Overall, the regression model explained 24.8% of the variance in academic performance (adjusted $R^2 = .248$) and was statistically significant ($F = 27.354$, $p < .01$). These findings indicate that the dimensions of e-learning risk management were collectively associated with academic performance, although their individual contributions differed. Among the three dimensions, flexibility showed the strongest association with academic performance, followed by adaptability, whereas diversification did not demonstrate a statistically significant independent association in the present model.

4.4. Findings Regarding the Fourth Research Question

Table 4 presents the results of the mediation analysis examining whether e-learning risk management was associated with the relationship between digital competence and academic performance. Digital competence was significantly associated with e-learning risk management (path a, $B = 0.643$, $p < .01$), indicating that students with higher levels of digital competence also tended to report stronger e-learning risk management practices. Likewise, e-learning risk management was significantly associated with academic performance (path b, $B = 0.293$, $p < .01$), suggesting that students who reported stronger risk management practices also tended to demonstrate better academic performance.

Table 4

Results of Mediation Analysis

	M (E-learning Risk Management)					Y (Academic Performance)				
Antecedent (Constant)	B	SE	t	p-value		B	SE	t	p-value	
	1.442	.172	8.397	.000		2.582	.166	15.598	.000	
X (Digital Competence)	<i>α</i>	.643	.043	14.845	.000	<i>c'</i>	.079	.051	1.555	.121
(Constant)	-	-	-	-						
M (E-learning Risk Management)					<i>b</i>	.293	.055	5.341	.000	
	R ² = .480					R ² = .255				
	F (1,239) = 220.379, p < .01					F (2,238) = 40.789, p < .01				

Before e-learning risk management was included in the model, digital competence showed a significant total association with academic performance (path *c*, $B = 0.267$, $p < .01$). After accounting for e-learning risk management, the direct association between digital competence and academic performance was reduced and was no longer statistically significant (path *c'*, $B = 0.079$, $p = .121$). Furthermore, the bootstrap analysis showed a statistically significant indirect effect (Effect = 0.188, BootSE = 0.042, 95% Bootstrap

CI [0.111, 0.277]). Because the confidence interval did not include zero, the results support the presence of a statistically significant indirect association that is consistent with the proposed mediation model.

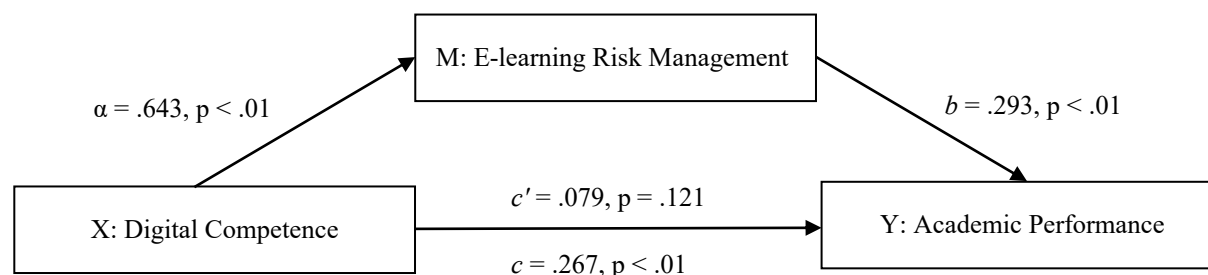


Figure 2. Framework of the Direct and Indirect Effect of Mediation

Taken together, these findings suggest that e-learning risk management may help explain how digital competence is associated with academic performance. Students with stronger digital competence also tended to report greater ability to manage challenges encountered in online learning, and these risk management practices were associated with better academic performance. Although the direct association between digital competence and academic performance was no longer statistically significant after including e-learning risk management, the cross-sectional design of the study does not permit conclusions about causal or full mediation. Instead, the findings provide evidence of an indirect association that is consistent with the proposed theoretical model.

The results highlight the importance of considering not only students' digital competence but also how they respond to the challenges of online learning. Possessing digital skills alone may not be sufficient to support academic success if students are unable to adapt to unstable internet connections, technical problems, changing learning requirements, or other challenges encountered in e-learning environments. Rather, the findings suggest that students who are able to apply their digital competence through effective risk management practices may be better positioned to sustain their learning under these conditions.

These findings are generally consistent with previous studies emphasizing the importance of digital competence and adaptive learning strategies in technology-supported education (Catena & Stephens, 2023; Martín-Gutiérrez et al., 2017). However, the present study extends this literature by suggesting that e-learning risk management may represent an important explanatory pathway linking digital competence with academic performance among students studying in a rural higher education context.

5. Conclusion and Suggestions

This study examined the associations among digital competence, e-learning risk management, and academic performance among university students in a rural Philippine higher education setting. The findings showed that digital competence was positively associated with e-learning risk management, while e-learning risk management was positively associated with academic performance. The mediation analysis further identified a statistically significant indirect effect that was consistent with the proposed mediation model, suggesting that e-learning risk management may help explain the association between digital competence and academic performance. These findings highlight the potential importance of students' ability to manage technological and learning-related challenges when participating in e-learning environments.

The study also showed that information and digital literacy was the only dimension of digital competence independently associated with academic performance, whereas flexibility and adaptability were the dimensions of e-learning risk management that demonstrated significant positive associations with academic performance. These findings suggest that developing digital skills alone may not be sufficient for academic success. Rather, students may also benefit from learning how to respond effectively to technological disruptions, changing learning conditions, and other challenges commonly encountered in online learning.

The findings should be interpreted in light of several limitations. First, the study employed a cross-sectional research design, which limits conclusions to statistical associations and does not permit causal inferences or confirmation of a causal mediation process. Second, the study relied primarily on questionnaire-based measures for digital competence and e-learning risk management, which may be subject to self-report bias. Finally, the participants were drawn from a single rural state university in the Philippines; therefore, the findings may not be generalizable to other higher education institutions or learning contexts.

Despite these limitations, the study offers practical implications for higher education institutions implementing technology-supported learning. Digital learning initiatives may be strengthened by integrating activities that develop not only students' digital competence but also their ability to manage common e-learning challenges, including technological disruptions, changing learning conditions, and online learning demands. Such initiatives may help students apply their digital skills more effectively in technology-mediated learning environments.

Future studies may extend the present findings by examining additional variables that could explain or influence the relationship between digital competence and academic performance, such as self-regulated learning, learner engagement, academic motivation, resilience, or technology acceptance. Employing longitudinal, experimental, or mixed-method research designs across multiple institutions would also provide stronger evidence regarding the temporal relationships among these variables and improve the generalizability of the findings.

Declaration of generative AI and AI-assisted technologies in the writing process

The author utilized an AI language tool (ChatGPT, OpenAI) to assist in enhancing the grammar, clarity, and flow of the manuscript. All concepts, analyses, interpretations, and conclusions presented in this paper remain entirely the work and responsibility of the author.

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