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Bridging Learning and Technology: How Digital Platforms Impact Academic Performance

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ABSTRACT

Digital learning platforms' growing presence in educational systems has transformed conventional teaching methods and provided students with learning environments that prioritize flexibility and access. The research analyzes how digital learning platforms affect student academic performance by exploring learning engagement as a mediating factor and digital literacy as a moderating factor. The study gathered data from 300 university students who used digital learning tools through a survey-based research design. The research team applied structural equation modeling (SEM) to examine the validity of the study's hypotheses. Digital learning platforms have a significant positive impact on academic performance as indicated by $\beta = 0.495$ and $p = 0.000$ and learning engagement partially mediates this effect with $\beta = 0.121$ and $p = 0.001$. The study demonstrates that students who possess advanced digital literacy skills experience more substantial benefits from digital learning tools as evidenced by the statistical relationship ($\beta = 0.062$, $p = 0.044$). The study demonstrates that learning outcomes can be maximized through the combination of interactive learning approaches to improve engagement alongside enhanced digital literacy programs and the reduction of digital access gaps. Educators, policymakers, and technology developers should use these findings to create digital education systems that reach all learners with engaging and effective content. Longitudinal studies and additional mediating factors need further examination alongside the impact of emerging technologies to improve digital learning experiences.

Introduction

Digital learning platforms experienced worldwide growth because of fast technological developments and rising need for educational solutions that offer flexibility and easy access. Digital tools available on these platforms encompass Learning Management Systems (LMS), Massive Open Online Courses (MOOCs), virtual classrooms, and adaptive learning technologies. These educational platforms transform traditional teaching models by providing remote access options while creating interactive learning spaces that personalize education to meet student-specific needs (Ahmed, 2024). Digital learning platforms differ from traditional classrooms by offering students the ability to learn at their own pace while receiving immediate feedback and accessing varied multimedia content which together greatly improve both student engagement and academic results (Vetrivel et al., 2024). These platforms deliver inclusive education experiences by supporting students from different socioeconomic backgrounds and locations while providing for multiple learning styles (Monica et al, 2025). Digital learning platforms provide multiple benefits but face ongoing difficulties in achieving widespread effectiveness and accessibility. The effectiveness of these platforms is largely contingent upon two critical factors: student engagement and digital literacy. The capacity to find, assess and use digital information and technologies defines digital literacy which serves as a cornerstone for successfully implementing digital learning solutions (Nikou et al , 2022). Students who do not possess digital literacy skills often face challenges navigating intricate LMS interfaces and understanding digital educational resources which hampers their ability to use interactive learning tools and reduces the advantages of digital education (D'Agustino, 2024). A lack of digital literacy skills leads to greater frustration and decreased motivation which causes students to achieve lower academic results. Student engagement serves as a key factor that determines academic success in digital learning settings. Digital education engagement consists of behavioral, emotional, and cognitive components that play a significant role in determining learning results (Panigrahi et al., 2021). Research indicates that students demonstrating higher engagement levels in digital learning settings tend to achieve superior academic results. Improved learning outcomes result from students actively participating in discussion forums and completing assignments on time while meaningfully interacting with digital course materials (Serrano et al, 2019).

Self-regulated online learning environments require students to independently manage their schedules and this becomes especially challenging because disengagement and lack of motivation act as significant obstacles to digital learning success (Stewart, 2025). Without traditional classroom structures and in-person contact students show lower commitment levels which results in reduced academic participation and weakened educational outcomes.

The persistent digital divide remains a significant obstacle in digital education because it intensifies educational inequalities. The digital divide describes socioeconomic gaps in access to technology such as high-speed internet and personal computers (Kuteesa et al , 2024). The capacity for students to utilize digital learning platforms successfully depends heavily on socioeconomic conditions. The technological infrastructure needed for digital education remains out of reach for many lower-income students who encounter various obstacles, preventing full participation. The unequal distribution of digital learning resources exacerbates educational inequalities which highlights the need for educators and policymakers to develop targeted strategies to close this educational divide (Rana, 2024).

The COVID-19 pandemic highlighted digital learning's importance by spurring broad adoption of online education platforms. The transition to digital learning during lockdowns and social

distancing created new possibilities along with several obstacles. Digital learning platforms enabled educational continuity during remote learning periods but exposed substantial problems concerning student engagement and digital readiness alongside online learning fatigue (Oliveira, 2021). The transition to digital learning environments created significant challenges for both students and educators who experienced decreased motivation levels along with higher cognitive demands and insufficient interpersonal interaction (Conrad, 2022). The challenges faced by students and educators showcase the critical need to investigate how digital literacy and student engagement interact to improve learning experiences and achieve better academic results. This study intends to analyze how digital literacy and student engagement determine the success of digital learning platforms based on these considerations. The purpose of this research is to understand the impact of key factors on learning outcomes which will lead to best practice recommendations for designing successful digital education strategies. This study aims to identify solutions for overcoming digital divide barriers while proposing methods to establish digital learning environments that are inclusive, engaging, and fair. Educators, policymakers, and technology developers need to grasp these dynamics to improve digital learning experiences and equal educational access while supporting effective digital teaching methods as education continues to change.

Problem Statement

The effectiveness of digital learning platforms to improve academic performance remains challenged by ongoing disparities in student engagement and digital literacy despite their widespread adoption. The advanced educational tools provided by digital platforms may become barriers for students who lack sufficient digital literacy skills (Haleem et al, 2022). Student engagement levels vary and this difference determines how effectively students can engage with digital content which in turn impacts their learning outcomes (Lee et al., 2022). Students from low-income backgrounds face increased educational challenges because their limited digital access generates a divide that reduces the effectiveness of digital learning tools (Francis et al, 2022). Through examination of digital learning platforms and student engagement alongside digital literacy this study aims to determine how these factors affect academic performance.

Research Objectives

1. To examine the impact of digital learning platforms on student academic performance.
2. To analyze the mediating role of learning engagement in the relationship between digital learning platforms and student academic performance.
3. To investigate the moderating effect of students' digital literacy on the relationship between digital learning platforms and student academic performance.

Research Questions

1. What is the impact of digital learning platforms on student academic performance?
2. What is the mediating impact of learning engagement in relation between digital learning platforms and student academic performance?
3. What is the moderating impact of digital literacy of students in relation between digital learning platforms and student academic performance?

Significance of the Study

Educators along with policymakers and technology developers can use this study to improve digital learning experiences. The study reveals essential factors that impact student engagement and digital literacy which lead to meaningful pedagogical strategies improving digital learning outcomes (Nkomo et al., 2021). The study uses thorough analysis of student engagement patterns and digital skills development to establish instructional methods that enhance student participation and academic performance while maintaining student motivation. This study makes a crucial impact by working to bridge the digital divide through the resolution of access disparities to digital resources. The ability of students to effectively use digital learning tools depends heavily on socioeconomic factors which necessitates policy implementation to ensure all students have equal access to digital education opportunities. The study reveals the difficulties faced by underprivileged students and suggests government-funded digital literacy programs along with better internet infrastructure and affordable digital devices to provide equal learning opportunities (Mcguire, 2024). This study provides essential insights for creating educational policies and institutional structures that enhance student participation and digital competence. The study's findings provide policymakers with valuable guidance to develop digital learning standards and teacher training programs while supporting student-focused digital learning approaches. The implementation of these policies will enable educational institutions to build digital learning environments which engage students better and adapt to their needs resulting in improved online educational success.

Technology developers will find this study provides essential guidance for creating digital learning platforms that are both user-friendly and adaptive to meet various learning requirements. The research findings demonstrate that intuitive design combined with accessibility features and interactive learning tools significantly improves learning engagement and experience quality. These insights enable technology developers to establish educational platforms that support different levels of digital literacy and learning preferences which creates an inclusive and effective digital education environment. This study aims to create an enhanced digital education landscape through solutions that address student engagement and digital literacy challenges in order to achieve greater efficacy and inclusion. This research provides educators, policymakers, and technology developers with practical strategies to enhance digital education which will allow students from diverse backgrounds to access superior and reachable learning opportunities.

Conceptual Framework

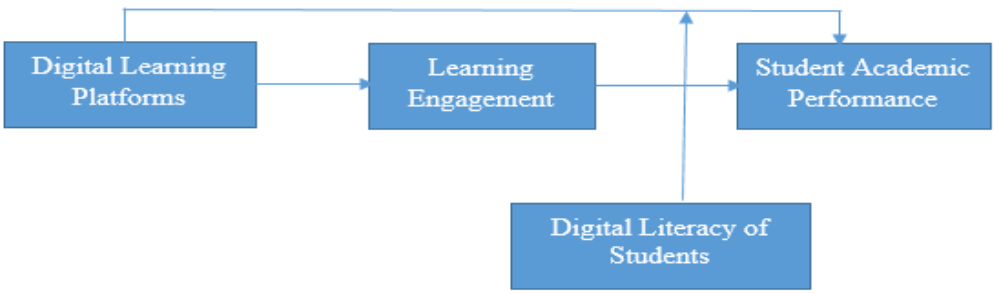

Figure 1: Conceptual framework

Literature Review

Digital Learning Platforms and Academic Performance

The educational landscape has been transformed by digital learning platforms which deliver students flexible, interactive, and tailored learning experiences (Roff et al., 2022). The list of platforms comprises Learning Management Systems (LMS), Massive Open Online Courses (MOOCs), virtual classrooms, and adaptive learning technologies. Educational platforms deliver organized instructional materials and enable live cooperative learning while boosting student participation with multimedia content alongside discussion forums and real-time feedback systems (Lasekan et al., 2024). Digital platforms have become widespread which allows students to learn at their own pace while removing physical location constraints and making education globally accessible.

Numerous research studies demonstrate that digital learning platforms contribute to enhanced academic performance in students. These platforms function as extensive collections of educational resources such as video lectures, e-books, simulations, and self-assessment tools which support various learning styles and improve student understanding (Das, 2024). Digital learning provides students with tools to monitor their progress while supporting self-regulated learning through content revisitation and active involvement in group discussions. Bender's 2023 research shows that students who regularly use digital learning platforms perform better in knowledge retention and understanding concepts and demonstrate stronger problem-solving abilities than students who study through traditional classroom settings alone.

The success of digital learning platforms depends on both student engagement levels and their digital literacy skills. According to research by Ong et al. (2023), students who engage actively in digital learning environments benefit more because they utilize interactive features and participate in peer discussions while managing to submit assignments punctually. Students who display low engagement levels often face difficulties maintaining self-motivation and managing their time which results in decreased learning performance.

Digital learning platforms experience difficulties such as uneven access to technology and varying levels of digital literacy while students face motivational barriers (Raihan et al., 2024). The lack of technology access and poor internet connectivity prevents students from making full use of digital platforms which in turn worsens educational disparities. Students risk losing important communication and collaboration abilities because excessive use of digital learning tools cuts down real-time interactions with teachers and classmates (Firdausi, 2024). The potential of digital platforms to boost academic performance depends significantly on students' active participation and their ability to effectively use digital tools.

Hypothesis 1: Digital learning platforms positively impact students' academic performance.

Learning Engagement as a Mediator

Learning engagement serves as a key factor that determines student achievement within digital educational settings. It encompasses three critical dimensions: Learning engagement consists of behavioral engagement through active academic participation by students and emotional

engagement which shows their learning motivation and enthusiasm while cognitive engagement represents their use of deep learning strategies and critical thinking (lai et al., 2021).

Studies show that student engagement benefits greatly from digital learning platforms which offer interactive tools alongside gamified elements and real-time feedback. According to Ahmed (2021) digital learning platforms support student motivation through features like quizzes and discussion-based learning as well as dynamic ways of delivering content. The study by Zen et al. (2022) suggests that students displaying higher engagement levels in digital learning settings perform better academically because their comprehension and knowledge retention improve which leads to better application of concepts.

However, engagement levels vary considerably among students. Kostaki (2022) noted some learners lose motivation because of online distractions, technical issues, or insufficient social interaction. According to Wang et al. (2024), active engagement with digital learning materials serves as an intermediary that fuels better academic results for students. Students who exhibit minimal engagement in digital education systems often fail to maximize their learning benefits which results in increased dropout rates and lower academic success (Kwake, 2021).

Educators need to deploy specific methods that will boost student involvement in digital learning platforms to meet these challenges. Educational research indicates that the use of gamification elements including achievement badges, leaderboards and interactive learning modules results in improved student motivation and participation. AI-driven tutoring systems and instant grading solutions provide personalized feedback which helps students to maintain focus while monitoring their academic achievements. According to Gopinathan et al. (2024), social learning features like collaborative assignments and virtual study groups significantly foster student engagement.

The implementation of engagement-enhancing strategies proves essential to fully exploit the potential of digital learning platforms. The effectiveness of advanced digital tools remains limited without sufficient student engagement which drives academic performance. A deep understanding of how engagement functions as a mediator produces important information for digital education strategy development and execution.

Hypothesis 2: Learning engagement mediates the relationship between digital learning platforms and students' academic performance.

Digital Literacy as a Moderator

Digital literacy describes the competence needed to operate digital tools and evaluate their use for educational purposes. Digital literacy holds critical importance in shaping how digital learning platforms impact academic performance (Mehrvarz, 2021). The increasing presence of technology in education makes digital literacy a fundamental skill for students who need to access, interpret, and apply digital information effectively (Anurogo et al, 2023). The ongoing integration of digital technologies within educational settings requires students to master digital literacy skills to fully benefit from online learning environments.

Research indicates that students who have advanced digital literacy skills excel at utilizing digital learning platforms and collaborate effectively while critically evaluating online content. The study by Kumi-Yeboah et al. (2020) demonstrates that students with strong digital skills efficiently operate online learning systems, use digital resources with effectiveness, and engage actively in

virtual discussions. Students possessing advanced digital literacy levels achieve superior academic results compared to their peers who have poor digital skills. Students who lack digital literacy face difficulties when using digital platforms which results in frustration and disengagement that negatively impact their academic performance (Prasetya, 2024).

The connection between student participation in learning and academic success becomes stronger when students possess digital literacy skills. According to Alt et al. (2020), students who possess higher digital literacy skills demonstrate improved engagement with learning resources which leads to better understanding and problem-solving skills. Students who develop digital literacy skills can access educational content more easily and improve their critical thinking which results in better academic performance.

The research by Temirkhanova et al. (2024) demonstrated that educational curricula which incorporate digital literacy training produce better learning outcomes for students and boost their confidence while using digital platforms. Through digital literacy instruction students learn to effectively use digital learning platforms and assess online resource credibility while mastering virtual classroom interactions. Educational institutions need to develop specific digital literacy programs so students can effectively use digital learning tools for their academic success.

The importance of digital literacy remains clear yet students from disadvantaged backgrounds continue to experience significant gaps in this essential skill. The gap in technological access creates additional educational disparities by providing unequal opportunities for students to learn through digital means. Students from low socioeconomic backgrounds commonly face challenges in accessing high-speed internet and personal computers and receive insufficient digital training which prevents them from fully utilizing digital learning platforms (Chikwe et al., 2024). Targeted digital literacy training programs alongside improved technological infrastructure and inclusive technology policies are necessary steps to fully realize digital education advantages. Educators who improve digital literacy skills can connect students at different digital proficiency levels and help them use digital platforms to succeed academically. Digital literacy stands as the essential component that determines how effectively digital learning environments operate while serving as a vital element to achieve education that is both equitable and inclusive.

Hypothesis 3: Digital literacy moderates the relationship between digital learning platforms and students' academic performance, such that students with higher digital literacy will experience greater benefits.

Literature Gap

The expanding research on digital learning platforms has yet to address multiple essential gaps in the academic literature. Numerous studies have investigated digital learning platforms' impact on academic performance yet few have analyzed how student engagement and digital literacy together shape learning results. While current research highlights the benefits of digital learning platforms, it fails to fully explore the elements that influence their effectiveness across different educational contexts.

The importance of student engagement in digital learning success receives wide acceptance but empirical research remains scarce on how engagement types behavioral, emotional, and cognitive function with digital tools to impact academic performance. Numerous studies examine student engagement as a general idea yet do not sufficiently distinguish its complex effects on learning

results. Developing targeted digital learning interventions requires a thorough understanding of these nuanced elements.

The moderating effects of digital literacy on digital learning platforms has not received adequate research attention. The current research landscape acknowledges digital literacy as a key element in student success but lacks comprehensive analysis on how diverse digital proficiency levels impact student engagement with online educational resources. The current body of research on digital learning does not sufficiently explore how the digital divide affects students from various socioeconomic statuses. Studies frequently overlook technological access disparities and internet connectivity gaps which serve as fundamental obstacles to fair educational opportunities.

The majority of previous research takes place in developed nations which benefit from advanced digital infrastructure systems. It is essential to expand research efforts in developing regions to investigate the functionality of digital learning platforms within settings that experience restricted technological resources and fluctuating internet access. Research tailored to specific contexts must be conducted to discern the impact of socio-cultural elements on digital literacy and engagement across various educational environments.

The research literature lacks longitudinal studies that evaluate the enduring effects of digital learning platforms on student performance. The majority of current research takes a cross-sectional approach which captures student experiences at just one time period. Longitudinal research would illuminate the developmental progress of digital literacy and engagement and reveal their lasting impacts on academic success. Research has examined digital learning platforms through student experiences but does not adequately address how instructors contribute to digital engagement. Educator pedagogical methods together with their technological skills and integration abilities into learning demand additional research attention. Developing a comprehensive framework to optimize digital learning outcomes requires addressing existing research gaps. Upcoming studies need to investigate how digital learning environments interact with student engagement and digital literacy while evaluating the impact of socioeconomic and contextual factors on educational outcomes. Educational institutions and policymakers will be able to develop inclusive evidence-based methods to improve digital education for diverse learners when they address these existing research gaps.

Methodology

This research follows the positivist research philosophy as defined by Saunders et al. (2019) which holds that reality exists objectively and empirical data can measure it. Positivism proves effective for research that depends on quantitative data gathering and statistical techniques to identify variable relationships. This study applies a positivist approach for an impartial analysis of digital learning platforms' effects on student academic performance while using learning engagement as a mediating factor and digital literacy as a moderating factor. The deductive research approach tests specified hypotheses which have been developed based on established theories and previous research studies. This research examines student academic performance outcomes related to digital learning platforms through established theoretical frameworks using a structured hypothesis testing approach that utilizes quantitative data. Surveys serve as a widely used research tool in educational and behavioral studies due to their structured approach to collecting extensive data from numerous participants. The study collected data from students about their digital learning platform use alongside their academic performance and digital literacy through a structured questionnaire.

Utilizing a single quantitative method enables researchers to perform statistical analysis while testing hypotheses to achieve results which are both objective and quantifiable. The research uses a cross-sectional time horizon (Saunders et al., 2019) which involves collecting data at one specific point in time. The research employs cross-sectional methodology because it takes a momentary view of students' digital learning platform usage and their academic performance perceptions. The researchers selected convenience sampling because it allowed them to connect with students who frequently use digital learning platforms. This approach does not produce random results but enables researchers to efficiently identify study participants who fulfill the required criteria. This study gathered primary data through structured questionnaires. Students across digital platforms and academic institutions received 500 questionnaires for distribution. From 400 returned questionnaires 300 were both complete and accurate so they were used in the data analysis. The study's variables are measured through different sections in the questionnaire. The Digital Learning Platforms Usage variable questionnaire draws from Alqurni's (2023) study on how university students use e-learning software. The Student Academic Performance variable questionnaire derives from Delima's (2024) research about how e-learning platforms affect student engagement and academic performance in Bangladesh's higher education institutions. The Learning Engagement variable comes from Jaya and Nurqamarani's 2023 study which explored student engagement within hybrid learning environments through digital literacy and academic self-efficacy analysis. Jaya and Nurqamarani's 2023 research about student engagement in hybrid learning served as the basis for the Digital Literacy of Students questionnaire by examining how digital literacy interacts with student engagement. The questionnaire measured each variable with Likert scale responses between 1 (Strongly Disagree) and 5 (Strongly Agree). The Likert scale format allows participants to express different levels of agreement or disagreement which enables researchers to perform an in-depth quantitative examination of the data. Descriptive statistics showed the demographics of the respondents and the general trends while correlation and regression analyses investigated how digital learning platforms connected with learning engagement and digital literacy to affect student academic performance. SPSS and Smart PLS were employed to conduct statistical analysis which supported precise hypothesis testing. The research team guaranteed participants that their responses would remain confidential and anonymous. Researchers received informed consent from each participant before beginning data collection to guarantee voluntary participation. The research followed institutional ethical standards which allowed data usage only for research objectives. The research achieves reliability and validity through its positivist philosophy and deductive approach combined with survey strategy, mono-method quantitative choice, cross-sectional time horizon and convenience sampling. Through the application of a carefully designed questionnaire which builds upon previous research the study establishes a robust framework to analyze how digital learning platforms alongside learning engagement and digital literacy influence student academic achievements.

Findings

Measurement Model

In structural equation modeling (SEM), the measurement model serves as an essential element because it validates and confirms the reliability of the study's constructs. The research evaluates the measurement model through construct reliability and validity assessments including convergent and discriminant validity by employing different statistical methods (Hair et al., 2019; Henseler et al., 2016). This study determines construct reliability through the use of Cronbach’s

Alpha alongside rho_A and Composite Reliability (CR). According to Nunnally & Bernstein (1994) Cronbach's Alpha functions as an internal consistency indicator where scores above 0.7 demonstrate acceptable reliability. The reliability of constructs is confirmed when rho_A and Composite Reliability (CR) values exceed 0.7 according to Fornell & Larcker (1981). The Cronbach's Alpha scores for Academic Performance (0.821), Digital Learning Platform (0.706), and Learning Engagement (0.799) demonstrate acceptable internal consistency according to the data presented. The rho_A values of 0.829, 0.712, and 0.803 demonstrate the stability of these constructs. The Composite Reliability scores show Academic Performance at 0.874 while Learning Engagement and Digital Learning Platform stand at 0.861 and 0.819 respectively. further validate the constructs' reliability as shown in figure 2 and table 1.

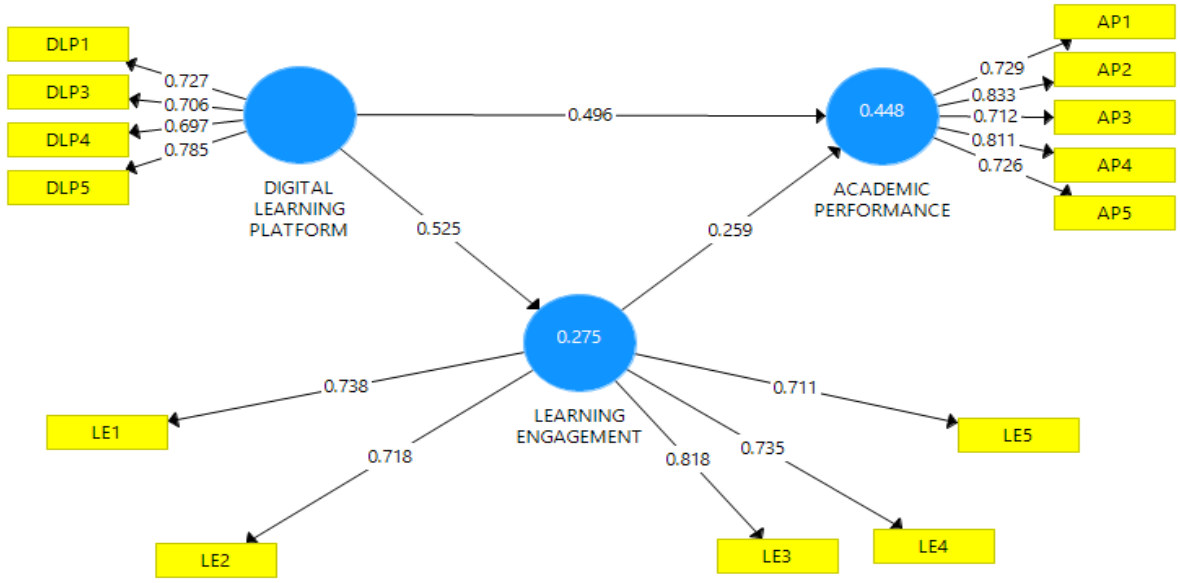

Figure 2: Measurement model

Table 1: Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Academic Performance	0.821	0.829	0.874	0.583
Digital Learning Platform	0.706	0.712	0.819	0.532
Learning Engagement	0.799	0.803	0.861	0.555

The Average Variance Extracted (AVE) serves as the measurement for convergent validity. When AVE values reach beyond 0.5 they demonstrate that the construct accounts for more than half of the variance in its indicators which shows strong convergent validity according to Hair et al. (2019). The AVE metrics for Academic Performance at 0.583, Digital Learning Platform at 0.532, and Learning Engagement at 0.555 surpass the threshold level which shows effective representation of measurement items for their respective constructs. Discriminant validity verifies that each construct maintains its uniqueness without overlapping with other constructs. This study applies two methods to evaluate discriminant validity: This study examines discriminant validity

using both the Fornell-Larcker Criterion alongside the Heterotrait-Monotrait Ratio (HTMT) which appear in table 2 and table 3.

Table 2: Fornell-Larcker

	Academic Performance	**Digital Learning Platform**	**Learning Engagement**
Academic Performance	0.764		
Digital Learning Platform	0.632	0.729	
Learning Engagement	0.520	0.525	0.745

Table 3: Heterotrait-Monotrait Ratio HTMT

	Academic Performance	**Digital Learning Platform**	**Learning Engagement**
Academic Performance			
Digital Learning Platform	0.817		
Learning Engagement	0.630	0.694	

According to the Fornell-Larcker Criterion the square root of AVE for every construct must exceed its correlation values with other constructs. Academic Performance demonstrates a square root of AVE at 0.764 which stands above both its correlation with Digital Learning Platform at 0.632 and Learning Engagement at 0.520. The square root of AVE for Digital Learning Platform is 0.729 which exceeds its correlation with Learning Engagement at 0.525. Learning Engagement demonstrates a 0.745 AVE square root value which surpasses its correlation coefficients with other constructs. The analysis demonstrates that all constructs maintain clear distinctions between each other.

The HTMT ratio detailed in table 2 serves as an additional discriminant validity measure because values below 0.85 demonstrate adequate construct differentiation according to Henseler et al. (2015). The HTMT values for Academic Performance with Digital Learning Platform at 0.817 and Digital Learning Platform with Learning Engagement at 0.694 along with Academic Performance and Learning Engagement at 0.630 meet the discriminant validity criteria by remaining under the suggested threshold.

Structural Model

Evaluating the structural model serves as an essential step to examine relationships between constructs while confirming research hypotheses. The study evaluates each proposed relationship's significance through an examination of path coefficients (β), standard deviation (STDEV), t-statistics, and p-values according to Hair et al. (2021). Model assessment results deliver empirical validation for digital learning platforms' impact on academic performance while also identifying mediating and moderating influences detailed in table 4.

Table 4: Structural model: Mediation and Moderation

Hypothesis	Pathway	Beta	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Decision
H1	Digital Learning Platform -> Academic Performance	0.495	0.054	9.157	0.000	Accepted
H2	Digital Learning Platform -> Learning Engagement -> Academic Performance	0.121	0.037	3.320	0.001	Accepted
H3	Dls*Dlp->Ap -> Academic Performance	0.062	0.032	2.021	0.044	Accepted

Hypothesis H1 examines the direct correlation between Digital Learning Platform usage and academic Performance outcomes. The analysis shows a substantial positive impact with a path coefficient of $\beta = 0.495$ and standard deviation (STDEV) of 0.054 alongside a t-statistic of 9.157 which exceeds the critical value of 1.96 needed for 5% significance as noted by Hair et al., 2019. The p-value results at 0.000 demonstrate statistical significance which leads to the acceptance of H1. The study aligns with previous research demonstrating that digital learning tools boost academic performance through enhanced accessibility, flexibility, and engagement (Chiu., 2023). The variety of multimedia resources along with interactive features and real-time feedback provided by digital learning platforms boosts student learning outcomes according to Rafiq et al. (2024).

Hypothesis H2 investigates how Learning Engagement (LE) mediates the Digital Learning Platform's indirect impact on Academic Performance. The structural model shows that the β value reached 0.121 while the STDEV stood at 0.037 with a t-statistic of 3.320 which confirms statistical significance at $p = 0.001$. The research findings imply that learning engagement partially mediates how digital learning platforms affect academic performance. This indirect effect shows how crucial student engagement is within digital learning settings because it leads to improved motivation and active involvement while deepening cognitive understanding which together boost academic results (Lasekan et al., 2024). According to Simamora (2020) digital learning tools alone fail to achieve desired educational outcomes without active student engagement in learning processes.

Hypothesis three investigates how Digital Learning Style and Digital Learning Platform together influence Academic Performance. The statistical analysis reveals a positive but weak interaction effect with $\beta = 0.062$, STDEV = 0.032, t-statistic = 2.021, and a p-value of 0.044 which shows statistical significance at the 5% level. Students' learning styles affect the capability of digital learning platforms to improve academic performance which matches findings from previous research that advocates for adaptive learning technologies (Martin, 2020). The level of academic improvement students receive from digital learning platforms changes depending on their learning preferences (visual, auditory, kinesthetic), which indicates personalized educational methods boost learning outcomes (Villegas et al., 2024). The R-Square (R^2) values demonstrate how well independent variables account for variation in dependent variables. The model demonstrates that Academic Performance has an R^2 value of 0.448 which shows that Digital Learning Platform (DLP), Learning Engagement (LE), and their interaction effect (DLS * DLP → AP) factors

together explain 44.8% of its variance. The findings indicate that digital learning environments make significant contributions to academic results yet acknowledge that external factors including individual learning preferences, teaching quality, and institutional backing have additional impacts. Learning Engagement has an R^2 value of 0.275 which indicates that 27.5% of Learning Engagement variation is accounted for by the Digital Learning Platform. Digital tools play an important role in student engagement but additional factors such as course design, interactive material and peer collaboration also impact engagement levels. Models with Q^2 values greater than zero show predictive relevance as presented in table 6 while those nearing 0.25 demonstrate moderate predictive power. The Academic Performance model shows moderate prediction accuracy with a Q^2 value of 0.256 which demonstrates that the variables used as predictors contribute effectively to academic results. The Learning Engagement Q^2 value stands at 0.149 which shows limited predictive power and indicates that digital platforms affect engagement but unmeasured elements like motivation and instructor guidance also play roles. The results demonstrate that digital learning platforms significantly affect learning engagement and academic performance but to better predict results we must include additional variables. Subsequent research should incorporate elements like digital literacy and motivation together with pedagogical strategies to boost the model's explanatory capabilities. The current moderate predictive strength of the model shows digital learning environments work well but additional academic achievements can be reached by refining engagement approaches and adaptive learning technologies.

Table 5: R Square

	R Square
Academic Performance	0.448
Learning Engagement	0.275

Table 6: Q2

	SSO	**SSE**	**Q^2 (=1-SSE/SSO)**
Academic Performance	1530.000	1138.323	0.256
Digital Learning Platform	1224.000	1224.000	
Dls*Dlp->Ap	306.000	306.000	
Digital Literacy Of Students	1530.000	1530.000	
Learning Engagement	1530.000	1301.997	0.149

Conclusion

This research demonstrates how Digital Learning Platforms (DLP) contribute to Academic Performance (AP) through direct enhancement and by increasing Learning Engagement (LE). The structural model analysis demonstrated Digital Learning Platforms have a positive impact on Academic Performance ($\beta = 0.495$, $p = 0.000$) which confirms that digital tools substantially improve student learning outcomes. Learning Engagement acts as a partial mediator between DLP and AP with a beta value of 0.121 and statistical significance at $p = 0.001$ which shows that student participation in digital platforms contributes to improved academic achievements. The significant moderation effect of Digital Learning Style (DLS) on the DLP to AP relationship ($\beta = 0.062$, $p = 0.044$) demonstrates that student-specific learning preferences affect how effectively digital education tools operate. The model demonstrates moderate explanatory power with R^2 values at 0.448 for Academic Performance and 0.275 for Learning Engagement, which suggests

that further variables can enhance its explanatory strength. The Q^2 metrics (0.256 for AP and 0.149 for LE) demonstrate that the model has predictive relevance which supports the importance of digital learning technologies in current educational practices. The research results are consistent with earlier studies which demonstrate that academic achievement benefits from technology-enhanced learning through enhanced student engagement and motivation as well as interactive educational experiences (Kowitlawakul, 2022). The analysis indicates that elements such as self-regulation capabilities, instructional design, and digital literacy levels might act as mediators or moderators for digital learning platform effectiveness.

Recommendations

The study's results lead to multiple recommendations aimed at improving digital learning platforms for educational uses.

1. To boost engagement and motivation in digital learning spaces institutions need to implement interactive elements including gamification, discussion forums and AI-driven personalized learning tools.
2. Digital platforms need to implement adaptive learning algorithms that address different learning styles so that students with visual, auditory, and kinesthetic preferences can use the system effectively.
3. Educators need training to efficiently utilize digital tools through teaching approaches that integrate traditional and digital teaching methods to enhance student learning outcomes.
4. Universities need to establish digital literacy programs that prepare students with essential technical abilities for successful participation in online educational platforms.
5. A dependable IT infrastructure is fundamental to guarantee uninterrupted access to digital learning platforms which becomes essential in areas with restricted connectivity.

Limitations

Despite its contributions, this study has several limitations that should be addressed in future research:

1. The research focused on one educational setting which limits its broader application across different cultural and institutional environments.

2. The research methodology was based on a cross-sectional design which collected data from one specific moment in time.

3. The model excluded external factors like motivation and institutional support which may account for academic performance differences and future research needs to analyze these additional explanatory variables.

4. The accuracy of reported engagement levels from self-reported survey responses may suffer from social desirability bias therefore future research should use learning analytics data to ensure validity.

Managerial Implications

This study provides important managerial implications for stakeholders such as educational institutions and digital learning platform developers as well as policymakers and HR and training

managers. Universities and colleges must adopt learning management systems (LMS) that utilize data analytics for tracking student engagement while delivering immediate feedback to enhance educational results. Educational institutions need to establish faculty development programs which teach instructors online teaching techniques so they can utilize digital learning tools proficiently. EdTech companies developing digital learning platforms must focus on creating AI-based personalized learning solutions that adapt to various student requirements. By catering to different learning styles personalization methods lead to better student engagement and improved academic results. The user interface and accessibility features of educational platforms need enhancements to support students with disabilities and create inclusive digital learning environments. Governments must direct resources towards digital education initiatives in underserved communities to eliminate the digital divide and create fair access to quality education for everyone. All students deserve access to digital education, which requires investments in technological infrastructure alongside internet connectivity and digital literacy programs (Al-Maroof et al., 2021). HR and training managers should implement digital engagement strategies when their organizations adopt e-learning platforms to improve knowledge retention and skill development for employees. Employees maintain their engagement levels and achieve better learning results through interactive learning modules alongside gamification and AI-powered progress tracking. Stakeholders who address managerial implications will improve digital learning platforms which provide high-quality digital education experiences to students and professionals.

Future Research Directions

Future research needs to investigate more mediators, moderators, independent variables (IVs), and dependent variables (DVs) to better understand the impact of digital learning platforms on academic performance. Future research could benefit from examining mediating factors that clarify the mechanisms through which digital learning platforms influence academic performance. The mediating role of motivation emerges from its essential influence on student learning because both intrinsic and extrinsic motivation determine student engagement levels together with learning quality. Self-regulated learning (SRL) which involves time management and metacognitive strategies serves as a potential mediator between digital learning tools and academic success. Students who feel confident in their technological abilities tend to show higher engagement and improved academic results because technology self-efficacy functions as a mediator in this process.

Subsequent studies should assess moderating factors that determine how strong these relationships are. The instructor presence functions as a moderating factor because when instructors deliver interactive and timely feedback students become more engaged and achieve better learning results. The effectiveness of digital learning tools may be influenced by cognitive load because too much cognitive demand can impair students' information processing and retention capacities. Future research should explore how various gamification mechanisms like leaderboards and badges affect student engagement and academic achievement. AI-powered learning analytics stands out as a promising research frontier because machine learning algorithms evaluate student performance data to generate tailored recommendations that improve learning outcomes. Future research on dependent variables (DVs) should focus on measuring knowledge retention to determine how digital learning tools affect students' long-term retention and application of academic concepts beyond their immediate assessments. Research can measure employability skills as a dependent variable to explore how digital learning platforms build students' career readiness and enhance their critical thinking abilities and practical skills. When future research integrates psychological aspects with pedagogical approaches and technological advancements it will generate

comprehensive insights into how digital learning platforms can achieve their highest potential for academic success and career progression. Future research that builds on these identified areas will advance digital education strategies and improve the effectiveness of online learning environments across multiple educational and professional contexts.

References

1. Ahmad, E. A. (2024). Revolutionizing learning: leveraging social media platforms for empowering open educational resources. *International Journal of e-Learning and Higher Education (IJELHE)*, *19*(1), 83-106.
2. Ahmed, I. (2023). *Modeling and Supporting Middle School Mathematics Collaboration using Student Motivation across Different Digital Learning Platforms* (Doctoral dissertation, University of Pittsburgh).
3. Alt, D., & Raichel, N. (2020). Enhancing perceived digital literacy skills and creative self-concept through gamified learning environments: Insights from a longitudinal study. *International Journal of Educational Research*, *101*, 101561.
4. Anurogo, D., La Ramba, H., Putri, N. D., & Putri, U. M. P. (2023). Digital Literacy 5.0 to enhance multicultural education. *Multicultural Islamic Education Review*, *1*(2), 109-179.
5. Bender, T. (2023). *Discussion-based online teaching to enhance student learning: Theory, practice and assessment*. Taylor & Francis.
6. Chikwe, C. F., Dagunduro, A. O., Ajuwon, O. A., & Ediae, A. A. (2024). Sociological barriers to equitable digital learning: A data-driven approach. *Research and Reviews in Multidisciplinary Studies*, *2*(01), 027-034.
7. Conrad, C., Deng, Q., Caron, I., Shkurska, O., Skerrett, P., & Sundararajan, B. (2022). How student perceptions about online learning difficulty influenced their satisfaction during Canada's Covid-19 response. *British Journal of Educational Technology*, *53*(3), 534-557.
8. D'Agustino, S. (2024). Social Reproduction and Equity Challenges in Learning Management Systems (LMS) Within Online Education. In *Digital Literacy at the Intersection of Equity, Inclusion, and Technology* (pp. 20-48). IGI Global.
9. Das, M. K. (2024). *Teacher education with ICT tools and techniques*. Academic Guru Publishing House.
10. Delima, P. (2024). The Impact of E-learning Platforms on Student Engagement and Academic Performance. *Smartify: Journal of Smart Education and Pedagogy*, *1*(1), 231-240.
11. Firdausi, A. R. (2024). Analyzing the Impact of Learning Technology on the Quality of Education in Schools: Potential and Risks. *J. Pedagog*, *1*, 124-131.
12. Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1), 39. https://doi.org/10.2307/3151312
13. Francis, D. V., & Weller, C. E. (2022). Economic inequality, the digital divide, and remote learning during COVID-19. *The Review of Black Political Economy*, *49*(1), 41-60.
14. Gopinathan, S., Kaur, A. H., Veeraya, S., & Raman, M. (2022). The role of digital collaboration in student engagement towards enhancing student participation during COVID-19. *Sustainability*, *14*(11), 6844.
15. Hair, J. F., Sarstedt, M., & Ringle, C. M. (2019). Rethinking some of the rethinking of partial least squares. European Journal of Marketing, 53(4), 566–584. https://doi.org/10.1108/EJM-10-2018-0665

16. Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable operations and computers*, *3*, 275-285.
17. Henseler, J., Ringle, C. M., & Sarstedt, M. (2016). Testing measurement invariance of composites using partial least squares. *International Marketing Review*, *33*(3), 405–431. https://doi.org/10.1108/IMR-09-2014-0304
18. Jaya, F., & Nurqamarani, A. S. (2023). Understanding Student Engagement in Hybrid Learning: An Analysis Impact Digital Literacy and Academic Self-Efficacy. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran dan Pembelajaran*, *9*(3), 833-845.
19. Kostaki, D., & Karayianni, I. (2022). Houston, we have a pandemic: Technical difficulties, distractions and online student engagement. *Student Engagement in Higher Education Journal*, *4*(2), 105-127.
20. Kowitlawakul, Y., Tan, J. J. M., Suebnukarn, S., Nguyen, H. D., Poo, D. C. C., Chai, J., ... & Devi, K. (2022). Utilizing educational technology in enhancing undergraduate nursing students' engagement and motivation: a scoping review. *Journal of Professional Nursing*, *42*, 262-275.
21. Kumi-Yeboah, A., Kim, Y., Sallar, A. M., & Kiramba, L. K. (2020). Exploring the use of digital technologies from the perspective of diverse learners in online learning environments. *Online Learning*, *24*(4), 42-63.
22. Kuteesa, K. N., Akpuokwe, C. U., & Udeh, C. A. (2024). Theoretical perspectives on digital divide and ICT access: comparative study of rural communities in Africa and the United States. *Computer Science & IT Research Journal*, *5*(4), 839-849.
23. Kwakye, I., & Kibort-Crocker, E. (2021). Facing Learning Disruption: Examining the Effects of the COVID-19 Pandemic on K-12 Students. Education Insights. *Washington Student Achievement Council*.
24. Lai, H. M., Hsieh, P. J., Uden, L., & Yang, C. H. (2021). A multilevel investigation of factors influencing university students' behavioral engagement in flipped classrooms. *Computers & Education*, *175*, 104318.
25. Lasekan, O. A., Pachava, V., Godoy Pena, M. T., Golla, S. K., & Raje, M. S. (2024). Investigating factors influencing students' engagement in sustainable online education. *Sustainability*, *16*(2), 689.
26. Lee, J., Park, T., & Davis, R. O. (2022). What affects learner engagement in flipped learning and what predicts its outcomes?. *British Journal of Educational Technology*, *53*(2), 211-228.
27. Mark N.K. Saunders, Philip Lewis and Adrian Thornhill (2019) Research Methods for Business Students. 8th edn. Pearson Education. Available at: https://www.dawsonera.com/abstract/9781292208794 (Accessed: 13 July 2020
28. Martin, F., Chen, Y., Moore, R. L., & Westine, C. D. (2020). Systematic review of adaptive learning research designs, context, strategies, and technologies from 2009 to 2018. *Educational Technology Research and Development*, *68*(4), 1903-1929.
29. McGuire Sr, S. M. (2024). *Educational Inequities: Impact of Technology and Internet Access on Online Learning in Title I Schools* (Doctoral dissertation, National University).
30. Mehrvarz, M., Heidari, E., Farrokhnia, M., & Noroozi, O. (2021). The mediating role of digital informal learning in the relationship between students' digital competence and their academic performance. *Computers & Education*, *167*, 104184.
31. Monica, J. A., Malar, J. H., Arun, C., Sharmila, L., & Arif, M. (2025). Leveraging technology and universal design for inclusive and engaging learning in Indian higher

education. In *Educational Philosophy and Sociological Foundation of Education* (pp. 177-212). IGI Global.
32. Nikou, S., De Reuver, M., & Mahboob Kanafi, M. (2022). Workplace literacy skills—how information and digital literacy affect adoption of digital technology. *Journal of Documentation*, *78*(7), 371-391.
33. Nkomo, L. M., Daniel, B. K., & Butson, R. J. (2021). Synthesis of student engagement with digital technologies: a systematic review of the literature. *International Journal of Educational Technology in Higher Education*, *18*, 1-26.
34. Nunnally, J. C. (1978). Psychometric theory (2nd ed.). New York, NY: McGraw-Hill.
35. Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3rd ed.). New York, NY: McGraw-Hill.
36. Oliveira, G., Grenha Teixeira, J., Torres, A., & Morais, C. (2021). An exploratory study on the emergency remote education experience of higher education students and teachers during the COVID-19 pandemic. *British Journal of Educational Technology*, *52*(4), 1357-1376.
37. Ong, S. G. T., & Quek, G. C. L. (2023). Enhancing teacher–student interactions and student online engagement in an online learning environment. *Learning environments research*, *26*(3), 681-707.
38. 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.
39. Prasetya, R. E. (2024). Unreadiness in the Student-Centered English Language Learning Context in the Age of Online Learning. *Journal of English Teaching, Literature, and Applied Linguistics*, *8*(2), 124-137.
40. Rafiq, S., Iqbal, S., & Afzal, A. (2024). The Impact of Digital Tools and Online Learning Platforms on Higher Education Learning Outcomes. *Al-Mahdi Research Journal (MRJ)*, *5*(4), 359-369.
41. Raihan, M. M., Subroto, S., Chowdhury, N., Koch, K., Ruttan, E., & Turin, T. C. (2024). Dimensions and barriers for digital (in) equity and digital divide: A systematic integrative review. *Digital Transformation and Society*.
42. Rana, D. K. (2024). Quality Education for Underrepresented Groups: Bridging the Gap.
43. Rof, A., Bikfalvi, A., & Marques, P. (2022). Pandemic-accelerated digital transformation of a born digital higher education institution. *Educational Technology & Society*, *25*(1), 124-141.
44. Serrano, D. R., Dea-Ayuela, M. A., Gonzalez-Burgos, E., Serrano-Gil, A., & Lalatsa, A. (2019). Technology-enhanced learning in higher education: How to enhance student engagement through blended learning. *European Journal of Education*, *54*(2), 273-286.
45. Simamora, R. M. (2020). The Challenges of online learning during the COVID-19 pandemic: An essay analysis of performing arts education students. *Studies in Learning and Teaching*, *1*(2), 86-103.
46. Einas Azher, Sadia Javed, Hafiz Muhammad Ahmed Siddiqui, Farrukh Zafar, Osama Ahmed. Exploring the Impact of Digital Supply Chain Integration on the Firm's Performance with Mediation and Moderation Role of Knowledge Sharing and Environmental Turbulence - Vol. 3 No. 1 (2025): ISSN Online: 3006-4708, ISSN Print: 3006-4694. https://policyjournalofms.com/index.php/6/article/view/341 Social Science Review Archives
47. Muniza Syed, Osama Ahmed, Einas Azher, Shah Salman, Hafiz Muhammad Ahmed Siddiqui, Sadia Javed. The Impact of Influencer Marketing on Consumer Purchase Intention: The Mediating Role of Trust, Content, Consumer Engagement, and Popularity -

Vol (03), NO. 1 (2025), Page # 147-166, ISSN Online 3006-2500 & ISSN Print 3006-2497. https://assajournal.com/index.php/36/article/view/134 Advance Social Science Archives Journal.

48. Sh. M. Fakhre Alam Siddiqui, Tureshna Kumari, Hammad Zafar, Hafiz Muhammad Ahmed Siddiqui and Muhammad Faseeh Ullah Khan. Analyzing the Impact of CSR on Corporate Performance Using PLS-SEM: Exploring the Mediating Roles of Human Resource Management and Customer Satisfaction in Pakistan's Food and Beverage Manufacturing Sector - Vol (13), NO. 3 (2024), p-ISSN 2788-452X & e-ISSN 2304-375X - https://poverty.com.pk/index.php/Journal/article/view/862 - Journal of Asian Development Studies.
49. Mavara Siddiqui, Hafiz Muhammad Ahmed Siddiqui, Salman Hussain, Dr. Muhammad Faseeh Ullah Khan, Syed Faraz Ali, Muhammad Ahsan Hayat. Interaction of Financial Literacy In Impulsive Buying Behavior Theory - Vol. 09, NO. (3), pp-780-802, ISSN: 2059-6588(print), ISSN: 2059-6596 (online) 2024 - https://remittancesreview.com/article-detail/?id=2059 - Remittances Review. https://doi.org/10.5281/zenodo.13294643
50. Hussain, F., Siddiqui, H. M. A., Zafar, F., & Ullah, M. F. (2024). Effectiveness of Online shopping characteristics and well-designed website on customer satisfaction to purchase Online: Evidence from Textile industry of Hyderabad. Vol (03) No. 07 (2024) - https://pjlaw.com.pk/index.php/Journal/article/view/v3i7-58-71 - Pakistan Journal of Law, Analysis and Wisdom (PJLAW)
51. Farhan Hussain, Hafiz Muhammad Ahmed Siddiqui, Dr. Muhammad Faseeh Ullah, Farrukh Zafar, Fatima Liaquat, Seema Dero .Relevance of Consumer Generated Content in Food Industry Of Pakistan - Vol. 21 NO. S11 (2024): ISSN 1741-8992, 1741-8984. https://migrationletters.com/index.php/ml/article/view/10896 - Migration Letters.
52. Farrukh Zafar, Rabia Sabri, Hafiz Muhammad Ahmed Siddiqui, Iraj Masood. Emerging Issues in Management Accounting: Digital Technologies, Governance, and Sustainability - - Vol (13) No. 1 (2024)- https://bbejournal.com/BBE/article/view/711 - Bulletin of Business and Economics (BBE)
53. Hafiz Muhammad Ahmed Siddiqui, Farrukh Zafar, Asma Bano. Exploring the Effects of Audit Committee Size, Board Size, Female Directors, and Tax Aggressiveness on Firm Profitability - Vol. (3) No. (3) 2023 - https://gjmif.com/index.php/GJMIF/article/view/77/44 - GISRAS Journal of Management & Islamic Finance
54. Hafiz Muhammad Ahmed Siddiqui, Farrukh Zafar. Riding the Waves of COVID-19: How the Pandemic Shook Up Financial Assets like Bitcoin, Crude Oil, Gold, and S&P500 - Vol. (16) No. (4) 2023 - https://kasbitoric.com/index.php/kbj/article/view/358 - Kasbit Business Journal
55. Hafiz Muhammad Ahmed Siddiqui, Farrukh Zafar, M. Faseeh Ullah Khan. A Study on Critical Success Factor, Challenges and Obstacles in Talent Management - Vol. (5) No. (3) 2022 http://pjia.com.pk/index.php/pjia/article/view/627 - Pakistan Journal of International Affairs, https://doi.org/10.52337/pjia.v5i3.627
56. Stewart, R. (2025). *High School Teachers' Perspectives on Implementing Self-Regulated Instruction in eLearning Environments* (Doctoral dissertation, Walden University).
57. Temirkhanova, M., Abildinova, G., & Karaca, C. (2024, October). Enhancing digital literacy skills among teachers for effective integration of computer science and design education: a case study at Astana International School, Kazakhstan. In *Frontiers in Education* (Vol. 9, p. 1408512). Frontiers Media SA.
58. Vetrivel, S. C., Arun, V. P., Maheswari, R., & Saravanan, T. P. (2024). Technology Integration in Online Learning Platforms: Blended Learning Gamification.

In *Transdisciplinary Teaching and Technological Integration for Improved Learning: Case Studies and Practical Approaches* (pp. 219-247). IGI Global.

59. Villegas-Ch, W., García-Ortiz, J., & Sánchez-Viteri, S. (2024). Personalization of learning: Machine learning models for adapting educational content to individual learning styles. *IEEE Access*.
60. Wang, S., Bao, J., Liu, Y. and Zhang, D., 2024. The impact of online learning engagement on college students' academic performance: The serial mediating effect of inquiry learning and reflective learning. *Innovations in Education and Teaching International*, *61*(6), pp.1416-1430.
61. Zen, Z., & Ariani, F. (2022). Academic achievement: the effect of project-based online learning method and student engagement. *Heliyon*, *8*(11).