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Examining the Impact of Online Learning Platforms on Undergraduate Academic Performance: Insights from the University of Ilorin

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Abstract

This study explores the impact of Online Learning Platforms (OLPs) on undergraduate academic performance at the University of Ilorin, Nigeria. Employing a descriptive survey design, the study targeted all undergraduates, with a simple random sampling technique selecting 200 respondents from various faculties. Data were analyzed using descriptive statistics for frequency counts and mean scores, while hypotheses were tested using ANOVA and t-tests at a 0.05 significance level. Key findings revealed that a majority of students (51.9%) did not utilize several available OLPs, reflecting significant gaps in platform integration. Nevertheless, OLPs positively influenced academic performance, with a grand mean score of 3.21, demonstrating enhanced engagement and resource accessibility. Challenges such as inadequate internet connectivity and limited instructor guidance (mean score 3.08) hindered effective utilization. No significant differences were observed in OLP usage across gender (p=0.822) or specialization (p = 0.613), highlighting their inclusivity. The study concludes that OLPs hold considerable potential to improve learning outcomes but require improved integration, infrastructure, and user training to address identified challenges. Recommendations include regular evaluations of platform effectiveness, tailored interventions to meet discipline-specific needs, and investments in digital infrastructure to bridge accessibility gaps. These measures will ensure that OLPs maximize their impact as equitable and effective educational tools.

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INTRODUCTION

Background and Context

Information and Communication Technologies (ICT) have advanced rapidly over the past few decades, reshaping education on a global scale. The integration of ICT into educational systems has transformed the way knowledge is disseminated, acquired, and applied, marking a fundamental shift in pedagogical practices (Suleman et al., 2017). This shift is most evident in higher education, where universities have increasingly adopted ICT tools, including Online Learning Platforms (OLPs), to enhance both teaching and learning experiences (Comi et al., 2017). These platforms have grown in importance, especially following the COVID-19 pandemic, which forced educational institutions worldwide to transition to online and remote learning to maintain educational continuity (Dimulescu, 2023).

Universities across the globe have incorporated OLPs, recognizing their potential to deliver courses, support student engagement, and streamline administrative processes (Gebremariam & Mulugeta, 2025). Platforms such as Google Classroom, Blackboard, and Zoom have become integral to academic settings, providing flexible learning environments that allow students to access materials from any location (Müller & Mildenberger, 2021). These platforms offer various features, including video lectures, discussion forums, and automated assessments, all designed to facilitate both synchronous and asynchronous learning (Buabeng-Andoh, 2012; Lawrence & Tar, 2018). Their capacity to centralize learning activities and resources has positioned OLPs as critical tools in the modern education landscape, providing a dynamic alternative to traditional face-to-face instruction.

In the Nigerian higher education system, the University of Ilorin has embraced this digital transformation by integrating ICT into its teaching, research, and administrative functions. The widespread use of OLPs at the University of Ilorin exemplifies how ICT is leveraged to promote student-centered learning environments. These platforms enable students to engage with academic content in more flexible and accessible ways, contributing to improved learning outcomes (Irele, 2021; Ugwu & Ugwuanyi, 2024). The flexibility offered by OLPs is particularly advantageous for students with varying learning preferences and schedules, allowing them to manage their studies alongside other commitments.

However, while the adoption of OLPs is widespread, their impact on student performance is not uniform. The use of these platforms varies significantly across different academic disciplines. STEM (Science, Technology, Engineering, and Mathematics) fields, which often require complex problem-solving and hands-on experimentation, tend to have higher levels of OLP engagement due to the nature of the coursework and the availability of digital resources that support interactive learning (Tytler, 2020). In contrast, students in the humanities and social sciences may use OLPs primarily for accessing reading materials and submitting assignments, which limits the interactive potential of these platforms (Vodă et al., 2022).

The global COVID-19 pandemic has further accelerated the reliance on OLPs, necessitating a deeper understanding of their effectiveness in various educational settings (Gebremariam & Mulugeta, 2025). The transition to online learning, while ensuring educational continuity, also exposed numerous challenges, particularly in regions where digital infrastructure and access to the internet are limited (Sato et al., 2024). In Nigeria, where internet penetration and digital literacy rates remain relatively low compared to more developed regions, the effectiveness of OLPs in improving educational outcomes requires critical examination (Ajani, 2022; Itasanmi & Ajani, 2023).

Moreover, the digital divide, particularly in rural areas, exacerbates existing inequalities in access to education. Students from disadvantaged socio-economic backgrounds often lack the necessary resources, such as stable internet connections and devices, to fully engage with OLPs (Ye & Yang, 2020). These challenges highlight the need for targeted strategies to ensure equitable access to digital learning tools and resources, particularly in developing countries like Nigeria, where infrastructure gaps remain a significant barrier to education (Rios-Campos et al., 2021).

Given the transformative potential of OLPs and their increasing prominence in higher education, understanding their role in enhancing academic performance is essential. While OLPs have the capacity to provide flexible, personalized learning experiences that can improve student outcomes, their efficacy in achieving these goals is highly dependent on the context in which they are implemented. For universities like the University of Ilorin, which serves a diverse student population, the challenge lies in ensuring that these platforms are

accessible, effective, and inclusive, addressing the varying needs of students across different disciplines and socio-economic backgrounds.

Thus, while the adoption of OLPs in Nigerian higher education is widespread, there is a critical need to assess their effectiveness in improving academic performance, particularly in light of the infrastructural and socio-economic challenges faced by students. This assessment is crucial for informing policy decisions on the future of digital learning in Nigerian universities and for maximizing the potential of OLPs to contribute to sustainable educational development.

Research Gap, Novelty, and Objective

Despite the global shift towards digital learning platforms, particularly following the COVID-19 pandemic, there is limited empirical research evaluating the specific impact of Online Learning Platforms (OLPs) on academic performance within the Nigerian context. While studies have explored the technological and logistical aspects of OLPs in developed countries, far fewer have rigorously examined their effectiveness in improving student outcomes in African universities, where socio-economic and infrastructural challenges present unique barriers to successful ICT integration (Ajani, 2022; Rios-Campos et al., 2021). One of the most significant research gaps lies in understanding how OLPs affect different student demographics, particularly in terms of gender and academic specialization. Existing studies tend to generalize the impact of OLPs without considering how these platforms may be more or less effective depending on the student's field of study or their gender. For instance, students in STEM disciplines may benefit more from the interactive and practical tools offered by OLPs, while those in the humanities may find less value in these platforms for their typically less hands-on academic activities (Hiğde & Aktamış, 2022; Walsham, 2017). Additionally, there is limited research on whether OLPs contribute equally to the academic performance of male and female students, or whether they inadvertently reinforce existing gender disparities in education (Galsanjigmed & Sekiguchi, 2023; Parajuli & Thapa, 2017).

Another critical gap is the lack of longitudinal studies that track the sustained impact of OLP use on student outcomes. Most existing research provides only a snapshot of the immediate effects of OLPs, without examining how these platforms influence long-term academic performance, student retention, and career readiness (Mkhize et al., 2016). This gap is particularly relevant in the context of Nigerian universities, where infrastructure, internet access, and digital literacy levels can vary significantly, potentially affecting the long-term sustainability and effectiveness of OLPs. The novelty of this study lies in its focus on the Nigerian context, where the adoption of OLPs has been rapid but uneven, and where the socio-economic conditions present unique challenges to effective implementation. By examining the impact of OLPs on student performance at the University of Ilorin, this study aims to contribute to the growing body of literature on digital learning in developing countries, offering insights that are directly applicable to higher education institutions in similar contexts. Furthermore, by exploring the moderating effects of gender and academic specialization, this research seeks to provide a more nuanced understanding of how OLPs can be tailored to meet the diverse needs of students.

The objective of this study is to assess the impact of OLPs on undergraduate students' academic performance at the University of Ilorin. Specifically, it aims to:

1. Examine whether the use of OLPs significantly improves academic performance across different fields of study.
2. Investigate whether gender influences the effectiveness of OLPs in enhancing academic performance.

3. Identify the challenges and barriers that affect the successful use of OLPs among Nigerian university students.

Literature Review

Online Learning Platforms in Higher Education

Online Learning Platforms (OLPs) have transformed the landscape of higher education, offering an array of digital tools that facilitate both synchronous and asynchronous learning. These platforms, including well-known systems such as Google Classroom, Blackboard, and Moodle, serve as centralized hubs for course content, assessments, and communication between students and instructors (Alomari, 2024; Zamiri & Esmaeili, 2024). Their flexibility allows students to access learning materials from anywhere, thereby accommodating diverse learning styles and schedules, particularly for non-traditional students such as working professionals (Darkwa & Antwi, 2021).

Research has shown that OLPs contribute positively to student engagement, with interactive features such as discussion forums, quizzes, and virtual simulations enhancing the learning experience (Lawrence & Tar, 2018). For instance, previous studies found that students who actively participated in OLP-based discussions and utilized digital resources were more likely to perform better academically compared to those who did not engage as frequently (Gillies, 2019; Liu et al., 2024). The ability of OLPs to provide immediate feedback, either through automated quizzes or real-time interaction with instructors, also contributes to improved learning outcomes by allowing students to correct mistakes and deepen their understanding of the material (Cavalcanti et al., 2021; Chen et al., 2018).

Despite their benefits, the effectiveness of OLPs is not uniformly distributed across different academic disciplines. Studies have indicated that STEM students are more likely to benefit from OLPs due to the availability of interactive digital tools such as virtual labs, coding platforms, and mathematical modeling software, which are well-suited to the practical and problem-solving nature of these subjects (Brown & Wilson, 2018). In contrast, students in the humanities and social sciences may not fully utilize the interactive capabilities of OLPs, as their academic activities often revolve around reading, writing, and critical analysis, which can be less dependent on digital tools (Lavidas et al., 2024; Z. Li et al., 2023). This disparity highlights the need for tailored OLP designs that meet the specific needs of different fields of study.

Gender and OLP Usage

While OLPs are often considered gender-neutral tools, research has shown that gender can influence how students engage with these platforms. Schultz-Jones et al. (2021) found no significant gender differences in the overall usage of OLPs; however, they observed that male and female students tended to favor different features of these platforms. Male students, for instance, were more likely to use OLPs for independent study and problem-solving activities, while female students showed a preference for collaborative and social learning environments, such as discussion forums and group projects (Feng et al., 2023).

These differences in usage patterns may reflect broader trends in gendered learning preferences. Research has suggested that female students are more likely to benefit from pedagogical strategies that emphasize communication, collaboration, and peer support, whereas male students may be more inclined towards self-directed learning and competition (Almasri, 2022). Understanding these dynamics is critical for designing OLPs that cater to the diverse needs of both male and female students, ensuring that both groups can equally benefit from digital learning environments.

Challenges of OLP Implementation in Developing Countries

The implementation of OLPs in developing countries, particularly in Africa, presents a unique set of challenges that can hinder their effectiveness. One of the most significant barriers is the digital divide, which refers to the unequal access to digital technologies such as the internet and computers (Raihan et al., 2024). In Nigeria, internet penetration remains low, particularly in rural areas, which limits students' ability to fully engage with OLPs (Ajani, 2022). This digital divide is further exacerbated by socio-economic disparities, as students from low-income backgrounds are less likely to own the devices necessary for online learning (Rios-Campos et al., 2021).

Another challenge is the lack of digital literacy among both students and instructors. While younger students may be more familiar with using smartphones and social media, they often lack the skills needed to navigate more complex educational platforms such as Blackboard or Moodle (Raihan et al., 2024). This issue is compounded by the fact that many instructors in Nigerian universities are not adequately trained in the use of digital teaching tools, which can result in suboptimal utilization of OLPs and reduced student engagement (Mkhize et al., 2016).

Additionally, OLPs require significant infrastructural support, including reliable electricity and internet access, which are often lacking in many parts of Nigeria (Itasanmi & Ajani, 2023; Lambrechts & Sinha, 2019; Lynn et al., 2022). These infrastructural deficiencies not only limit students' ability to access online learning resources but also pose challenges for the sustainability of OLPs in the long term. For OLPs to be effective in improving academic performance in Nigerian universities, these infrastructural and logistical challenges must be addressed.

Longitudinal Impact of OLPs on Academic Performance

Most studies examining the impact of OLPs on academic performance have focused on short-term outcomes, such as exam scores or course grades, without considering the long-term effects of OLP use on student retention, graduation rates, or career readiness (Mkhize et al., 2016). However, longitudinal research is critical for understanding how sustained engagement with OLPs influences academic trajectories over time. For instance, a study by Ullah et al. (2023) found that students who regularly used OLPs in their first year of university were more likely to graduate on time and report higher levels of career satisfaction compared to those who relied primarily on traditional classroom instruction.

In the Nigerian context, where infrastructural challenges and socio-economic disparities can hinder consistent OLP engagement, longitudinal studies are particularly important for assessing the long-term sustainability of these platforms. Such research would provide valuable insights into the institutional frameworks needed to support the ongoing use of OLPs and ensure that they contribute meaningfully to student success beyond immediate academic outcomes.

METHOD

Research Design

The study adopted a descriptive survey research design to investigate the impact of online learning platforms (OLPs) on undergraduate academic performance at the University of Ilorin. A descriptive survey design was chosen because it allows for the systematic collection, analysis, and interpretation of data to provide an accurate representation of respondents' characteristics and experiences. This approach is particularly effective in educational research, where the focus is on describing trends, behaviors, and challenges

associated with technology integration in learning environments (Makole et al., 2023). The survey method also enables the researcher to gather original data from a diverse and large population, ensuring the findings are relevant and applicable to broader contexts (Zhang, 2022).

Population and Sampling

The target population for this study consisted of undergraduate students enrolled in various faculties at the University of Ilorin, Nigeria. These students represent a wide array of academic disciplines, providing a rich context for analyzing the use and impact of OLPs. Simple random sampling was employed to select the respondents, ensuring every student in the population had an equal chance of being included. This sampling method minimizes selection bias and enhances the representativeness of the findings (Astalini et al., 2021). To further ensure proportional representation across disciplines, the population was stratified into seven faculties, from which the sample was drawn. The final sample size consisted of 200 students, deemed sufficient for statistical analysis and generalizability (Wang et al., 2021).

Instrumentation

The primary instrument for data collection was a researcher-designed questionnaire titled "Impact of Online Learning Platforms on Undergraduates' Academic Performance in University of Ilorin." This questionnaire was meticulously developed to align with the study's objectives and research questions. It consisted of four sections: demographic information, availability and use of OLPs, influence of OLPs on academic performance, and challenges associated with OLP usage. Demographic questions provided context for analyzing differences across gender and specialization, while the other sections incorporated Likert scales and dichotomous responses to measure respondents' perceptions and experiences. The use of Likert scales is widely recognized for capturing nuanced attitudes and behaviors, as highlighted by Roy and Al-Absy (2022), and facilitates reliable comparisons across groups (Nagalingam et al., 2020).

The questionnaire underwent a rigorous validation process to ensure content accuracy and clarity. Face and content validation were conducted by a panel of experts, including the researcher's supervisor and three lecturers from the Educational Technology Department. Their feedback informed necessary modifications, ensuring the instrument comprehensively addressed the study's constructs. Reliability testing was performed using Cronbach's alpha, yielding high coefficients of 0.87 for platform availability, 0.84 for academic performance, and 0.87 for challenges. These results indicate strong internal consistency, aligning with reliability benchmarks in educational research (Nejatdarabi et al., 2018).

Data Collection Procedure

The data collection process was carefully structured to ensure ethical compliance and maximize response rates. Approval was obtained through an introductory letter from the head of the Educational Technology Department, which was presented to the relevant authorities within the sampled faculties. After securing institutional consent, the researcher distributed questionnaires directly to students with the assistance of a trained research assistant. The process included clear communication about the study's purpose, emphasizing that participation was voluntary, confidential, and anonymous. Respondents were assured that their data would be used solely for academic purposes, in line with ethical standards for educational research (Santos-Díaz et al., 2019).

Efforts were made to address common challenges in survey-based data collection, such as low response rates and participant engagement. Questionnaires were distributed during

periods of minimal academic stress to encourage participation. Familiar platforms were used to enhance accessibility, ensuring students could complete the survey with ease (Gevertz et al., 2017). Anonymity and confidentiality were safeguarded through the use of coded responses and secure data storage, mitigating concerns that might deter participation (W. Li et al., 2016).

Data Analysis

The data collected were analyzed using both descriptive and inferential statistical methods, with SPSS (Version 24.0) employed to ensure accurate computations. Descriptive statistics, including frequency counts, percentages, and mean scores, provided an overview of respondent characteristics and summarized key trends in OLP usage, academic performance, and associated challenges. This step is vital in survey research as it helps identify general patterns and contextualize findings within the broader educational landscape (Makole et al., 2023).

Inferential statistics were used to test the study's hypotheses. An Analysis of Variance (ANOVA) was conducted to examine whether differences in specialization influenced OLP usage, while a t-test was employed to assess gender-based differences in the impact of OLPs on academic performance. These statistical tests were chosen because they are well-suited for comparing means across groups and establishing the significance of observed differences (Apaydinli, 2023; Loewen et al., 2020). Results were presented through comprehensive tables and visualizations, facilitating clear interpretation and communication of findings (Priatna & Sari, 2022).

Ethical Considerations

The study adhered to stringent ethical guidelines to protect participants' rights and ensure the integrity of the research process. Informed consent was obtained from all respondents, who were provided with a detailed explanation of the study's objectives and their rights, including the ability to withdraw at any stage without penalty. Measures were implemented to maintain confidentiality and anonymity, such as secure data handling and the use of anonymized codes for responses (Hamasha et al., 2024). By fostering trust and transparency, these practices aligned with ethical standards in educational research and contributed to the study's credibility.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

The demographic characteristics of the respondents provide foundational context for analyzing the study's findings. Table 1 illustrates the gender distribution among the 200 participants, showing that 96 (48.0%) were male and 104 (52.0%) were female. This relatively balanced representation aligns with typical gender enrollment trends at the University of Ilorin, ensuring that the findings reflect the experiences and perceptions of both genders equitably. Gender balance is significant in studies assessing the impact of educational technologies, as it ensures inclusivity and mitigates bias that might arise from over-representation of one gender. Previous studies, such as those by Ikram et al. (2021), have similarly noted that diverse gender representation strengthens the reliability of findings regarding online learning platform (OLP) usage.

Table 2 presents the distribution of respondents across seven academic specializations. The largest group of participants was from Education, with 39 respondents (19.5%), followed closely by Sciences (34 respondents, 17.0%) and Arts and Humanities (32 respondents, 16.0%). Conversely, the smallest representation came from Medicine (21 respondents, 10.5%) and

Engineering (23 respondents, 11.5%). Table 2 reflect a deliberate sampling strategy aimed at achieving proportional representation across the university's faculties, enabling a comprehensive analysis of how specialization influences OLP utilization. Including students from diverse academic backgrounds enriches the dataset by capturing variations in the nature of coursework, instructional delivery, and technology integration across disciplines (Wang et al., 2021).

Table 1. Distribution of the paticipants based on gender

Gender	Frequency	Percentage	Cumulative Percent
Male	96	48.0	48.0
Female	104	52.0	100.0
Total	**200**	**100.0**	

The stratified distribution also facilitates the examination of potential discipline-specific trends in OLP usage. Disciplines like Education and Sciences often integrate digital tools and online resources extensively, which may enhance familiarity and engagement with OLPs. On the other hand, fields requiring substantial hands-on or clinical training, such as Medicine and Engineering, might face unique challenges in adapting to OLPs. This observation is consistent with the findings of Gheshlagh et al. (2022), who highlighted that medical students reported barriers in fully utilizing OLPs due to the limitations of virtual environments in simulating practical experiences.

Table 2. Distribution of the participants based on specialization

Specialization	Frequency	Percentage (%)	Cumulative
Arts and Humanities	32	16.0	16.0
Business Management	26	13.0	29.0
Education	39	19.5	48.5
Engineering	23	11.5	60.0
Medicine	21	10.5	70.5
Social Sciences	25	12.5	83.0
Sciences	34	17.0	100.0
Total	**200**	**100.0**	

Furthermore, the demographic data set the stage for examining whether gender or specialization significantly influences students' engagement with and perceptions of OLPs. While the study's inferential statistics later reveal no significant gender-based differences in the impact of OLPs, the balanced gender representation ensures the validity of this conclusion. This finding aligns with Ikram et al. (2021), who noted gender-neutral patterns in OLP usage and benefits, emphasizing that the effectiveness of online platforms often depends more on individual learning styles and preferences than on gender.

Similarly, the stratification by specialization allows for a nuanced exploration of discipline-specific needs and challenges. For instance, students in theoretical disciplines, such as Arts and Humanities, may have a different interaction with OLPs compared to students in applied disciplines like Medicine and Engineering. This is supported by Gumasing and Castro (2023), who found that motivation and course design significantly influenced student engagement with OLPs, varying by academic context. Such findings underscore the importance of tailoring OLP features and support services to address the unique requirements of diverse academic disciplines.

Overall, the demographic characteristics of the respondents provide a robust framework for analyzing the findings of the study. The balanced gender distribution ensures inclusivity, while the stratification by specialization captures the diversity of academic experiences at the University of Ilorin. This comprehensive representation strengthens the study's conclusions and supports the development of targeted interventions to enhance OLP utilization across different student groups.

Availability and Utilization of Online Learning Platforms

The availability and utilization of online learning platforms (OLPs) by undergraduate students at the University of Ilorin are critical to understanding their impact on academic performance. Table 3 provides a detailed breakdown of the frequency and percentage of OLP usage among the 200 respondents. The results indicate that while some platforms were widely used, others were significantly underutilized, highlighting varying levels of familiarity, accessibility, and integration into the academic environment.

Table 3. Frequency and percentage of the online learning platforms available for learning in University of Ilorin

S/N	Items	Used (%)	Not Used (%)
1.	Google Classroom	162(81.0)	38(19.0)
2	Google Meet	149(74.5)	51(25.5)
3	Blackboard	59(29.5)	141(70.5)
4	Telegram	65(32.5)	135(67.5)
5	Zoom	149(74.5)	51(25.5)
6	Skype	102(51.0)	98(49.0)
7	Webex	37(18.5)	163(81.5)
8	Anymeeting	101(50.5)	99(49.5)
9	Goto meeting	77(38.5)	123(61.5)
10	Safari	61(30.5)	139(69.5)
	Average Percentage (%)	**962(48.1)**	**1,038(51.9)**

Key: A = Available, NA = Not Available; Decision Value (%): Used = 50 -100%, Not Used = 1- 49.9%

Prominent platforms such as Google Classroom (81.0%), Google Meet (74.5%), and Zoom (74.5%) demonstrated high utilization rates. These platforms are widely recognized for their accessibility, user-friendly interfaces, and versatile features that support virtual lectures, resource sharing, and collaborative learning (Wairooy et al., 2023). Their extensive adoption can be attributed to institutional endorsements during the shift to online education, particularly during the COVID-19 pandemic, which necessitated remote learning solutions (Yang, 2024). Conversely, platforms like Webex (18.5%) and Blackboard (29.5%) showed much lower usage rates. These findings align with Van Schalkwyk et al. (2021), who noted that the underutilization of certain OLPs often results from inadequate institutional support, lack of promotion, or insufficient training for students and faculty.

An average of 51.9% of respondents reported not using the listed platforms, reflecting significant gaps in OLP integration at the university. This underutilization may stem from a variety of factors, including technical challenges, limited internet access, or a preference for traditional teaching methods. As suggested by Nichuhovska et al. (2024), disparities in digital access, often exacerbated in developing regions, can hinder the widespread adoption of educational technologies. Additionally, the absence of a centralized platform strategy at the

institutional level may contribute to fragmented usage patterns, with students relying on a mix of platforms based on individual course requirements or instructor preferences.

The data also highlight the importance of user experience in driving platform adoption. Platforms with intuitive interfaces and diverse features—such as interactive tools, video conferencing, and content-sharing capabilities—tend to attract more users. This is consistent with findings by Z. Li et al. (2023), who emphasized that platforms integrating interactive elements enhance student engagement and academic performance. Conversely, platforms that are perceived as less user-friendly or that lack institutional support often fail to gain traction among students, as observed with Webex and Blackboard.

The variation in OLP usage also reflects the importance of contextual factors. Disciplines with greater reliance on multimedia resources, collaborative projects, or synchronous communication, such as Education and Sciences, are more likely to adopt platforms like Google Meet and Zoom. In contrast, students in fields requiring hands-on or practical applications, such as Engineering and Medicine, may find these platforms less suited to their needs. This observation aligns with Gheshlagh et al. (2022), who noted that medical students often face challenges in adapting OLPs for practical training.

To address these gaps, institutions like the University of Ilorin must adopt a more cohesive approach to integrating OLPs. This includes investing in training programs for both students and faculty, enhancing digital infrastructure, and promoting the benefits of underutilized platforms through awareness campaigns (Van Schalkwyk et al., 2021). Moreover, user feedback mechanisms can be instrumental in identifying barriers to adoption and tailoring platforms to better meet students' academic and technological needs (Hwang, 2020).

In summary, while widely used platforms such as Google Classroom, Google Meet, and Zoom demonstrate the potential of OLPs to support learning, significant gaps in utilization remain. Addressing these challenges requires a strategic focus on accessibility, user experience, and targeted support to maximize the benefits of OLPs across diverse academic disciplines.

Influence of Online Learning Platforms on Academic Performance

The influence of online learning platforms (OLPs) on students' academic performance at the University of Ilorin was assessed using ten items rated on a Likert scale, as summarized in Table 4. The overall grand mean score of 3.21 (on a 4-point scale) indicates a positive perception among respondents regarding the role of OLPs in enhancing their academic achievements. This finding underscores the platforms' potential to provide a conducive learning environment that fosters improved understanding, engagement, and performance.

One of the highest-rated items, "*Online learning has increased my motivation to study and actively participate in academic activities*" ($\bar{x}$ =3.40), highlights the platforms' ability to engage students and promote self-directed learning. This aligns with Yang (2024), who found that the integration of e-learning platforms significantly boosts student motivation by providing flexible and interactive learning environments. Similarly, the item *"Access to online resources such as lectures, e-books, and multimedia materials has improved my academic performance"* ($\bar{x}$=3.39) reflects the platforms' ability to enhance access to diverse educational resources. These results corroborate the findings of Wairooy et al. (2023), who emphasized that the accessibility of digital learning tools contributes to better academic outcomes by accommodating various learning styles and needs.

Table 4. Frequency and mean score of online learning influence on students' academic performance in University of Ilorin

S/N	Item	SA	A	D	SD	Mean
1.	Online learning platforms have positively influenced my understanding of course materials and academic concepts.	65	89	35	11	3.04
2.	I believe online learning platforms enhance my ability to engage with complex academic topics effectively.	65	78	41	16	2.96
3.	Online discussions and forums on learning platforms contribute significantly to my learning experience.	85	88	20	7	3.26
4.	Access to online resources such as lectures, e-books, and multimedia materials has improved my academic performance.	101	75	24	0	3.39
5.	Online learning has increased my motivation to study and actively participate in academic activities.	108	64	27	1	3.40
6.	Interactive features on online platforms, such as quizzes and group projects, have positively impacted my learning outcomes.	82	71	33	14	3.11
7.	Online learning platforms have improved my time management skills, allowing me to balance academic tasks effectively.	102	63	27	8	3.30
8.	I believe online learning has enhanced my critical thinking and problem-solving abilities in academic contexts.	105	59	28	8	3.31
9.	Online learning platforms have facilitated collaborative projects, fostering teamwork and communication skills among students.	58	108	21	13	3.06
10.	I am confident that online learning positively contributes to my overall academic performance	85	82	27	6	3.23
	Grand Mean (X)					**3.21**

Key: SD = Strongly Disagree, D= Disagree, A = Agree, SA = Strongly Agree; Decision Value: Negative=0.00-2.44, Positive = 2.45-4.00

Interactive features were another area where OLPs positively influenced academic performance. For example, *"Interactive features on online platforms, such as quizzes and group projects, have positively impacted my learning outcomes"* ($\bar{x}$ =3.11) indicates that tools fostering collaboration and engagement can enhance comprehension and retention. Z. Li et al. (2023) similarly reported that the inclusion of interactive elements in online platforms improves students' learning enthusiasm and critical thinking skills.

However, the lowest-rated item, *"I believe online learning platforms enhance my ability to engage with complex academic topics effectively"* ($\bar{x}$ =2.96), highlights a notable gap in the platforms' effectiveness for higher-order learning. While OLPs are effective for resource access and basic engagement, their ability to support deeper, analytical learning may require

enhancements. Gumasing and Castro (2023) observed that such gaps could stem from insufficient instructional design or lack of training for educators in maximizing platform functionalities.

The findings also suggest that the perceived benefits of OLPs are influenced by their design and implementation. Platforms offering structured content delivery, instant feedback, and collaborative tools are more likely to support academic success. For instance, the item *"Online discussions and forums on learning platforms contribute significantly to my learning experience"* ($\bar{x}$ =3.26) underscores the importance of peer interaction in enhancing comprehension and problem-solving abilities. These features align with the recommendations of Hwang (2020), who advocated for integrating student feedback mechanisms to refine platform functionalities and foster engagement.

Nevertheless, the effectiveness of OLPs can vary across disciplines and individual preferences. Students in theoretical fields such as Arts and Humanities may benefit more from OLPs' resource-sharing capabilities, while those in applied fields like Engineering may find them less effective for practical training. Tailoring platform features to specific academic needs could further enhance their impact (Gheshlagh et al., 2022).

The positive influence of OLPs on academic performance is evident in the improved access to resources, increased motivation, and enhanced collaboration they provide. However, addressing limitations in their support for complex academic tasks and ensuring discipline-specific customization are essential for maximizing their potential. Institutions must invest in training, interactive tools, and tailored content delivery to align OLPs with the diverse needs of students and educators.

Challenges in Using Online Learning Platforms

The challenges faced by students while using online learning platforms (OLPs) at the University of Ilorin were examined using ten items rated on a Likert scale, as shown in Table 5. The grand mean score of 3.08 indicates that respondents generally acknowledged encountering significant challenges that hindered the effective utilization of these platforms. These findings shed light on the barriers that must be addressed to enhance the efficacy and adoption of OLPs in higher education.

One of the most prominent challenges was *"Difficulty in accessing supplementary learning resources such as library materials and textbooks online"* ($\bar{x}$ =3.39). This issue reflects infrastructural limitations, such as a lack of integrated digital libraries or insufficiently curated online resources. Nichuhovska et al. (2024) highlights that the absence of robust digital infrastructure is a common barrier in developing countries, where resource disparities exacerbate educational inequities. Addressing this challenge requires institutional investments in digitizing academic resources and integrating them into OLPs, as well as partnerships with global e-library providers.

Another significant challenge was *"Lack of clear instructions and guidance from instructors"* ($\bar{x}$ =3.24). Students frequently struggle with unclear course expectations or insufficient support from educators, which negatively impacts their learning experience. Gumasing and Castro (2023) observed that the success of OLPs is closely tied to the quality of instructor training and the clarity of instructional design. Institutions must therefore prioritize professional development for educators, equipping them with the skills to create structured and engaging content and to provide timely feedback.

Technical issues, such as slow internet connectivity and platform glitches, also emerged as critical barriers, with a mean score of 3.08. This finding aligns with Mahundu (2023), who reported that unreliable internet access remains a pervasive issue in many regions, limiting

the effectiveness of online learning. Unstable connectivity not only disrupts live sessions but also hampers students' ability to access and engage with asynchronous materials. To mitigate this issue, universities should explore offline-compatible platform features and partnerships with internet service providers to offer affordable and stable connectivity for students.

Table 5. Frequency and mean score of the challenges faced in the use of online learning platform in University of Ilorin

S/N	Item	SA	A	D	SD	Mean
1.	Technical issues such as slow internet connectivity and platform glitches affect my online learning experience.	65	97	27	11	3.08
2.	Lack of clear instructions and guidance from instructors hampers my understanding of online course materials.	78	99	15	8	3.24
3.	Limited interaction with instructors and peers on online platforms affects my ability to seek help and collaborate effectively.	71	93	15	21	3.07
4.	Difficulty in accessing supplementary learning resources such as library materials and textbooks online poses a challenge.	100	82	13	5	3.39
5.	Inadequate feedback and assessment methods on online platforms hinder my progress and learning experience.	106	59	17	18	3.27
6.	Feeling of isolation and lack of social interaction due to online learning affects my motivation and engagement.	47	74	30	49	2.60
7.	Challenges in managing my time effectively between online classes and personal responsibilities impact my learning outcomes.	77	69	20	34	2.95
8.	Limited access to real-time discussions and Q&A sessions with instructors affects my ability to clarify doubts and concerns promptly.	46	78	38	38	2.66
9.	Issues related to online platform security and privacy concerns impact my confidence in using these platforms for learning.	83	96	11	10	3.26
10.	The lack of personalized learning experiences and individual attention in online classes affects my overall learning satisfaction.	87	83	22	8	3.25
	Grand Mean (X)					**3.08**

Key: SD = Strongly Disagree, D= Disagree, A = Agree, SA = Strongly Agree; Decision Value: Negative=0.00-2.44, Positive = 2.45-4.00

"Feeling of isolation and lack of social interaction due to online learning" received the lowest mean score ($\bar{x}$ =2.60), indicating that while some students experienced reduced motivation and engagement, this was not a universal challenge. This finding suggests that OLPs may be reasonably effective in fostering a sense of community, especially when interactive features like discussion forums and collaborative projects are utilized. However, as Kuliukas et al. (2021) emphasized, even minor perceptions of isolation can contribute to mental health

challenges, highlighting the need for platforms to incorporate more robust social interaction features, such as real-time peer-to-peer engagement tools.

Another noteworthy challenge was *"Inadequate feedback and assessment methods on online platforms"* ($\bar{x}$ =3.27). Students expressed concerns about the limited opportunities to receive meaningful feedback on their progress, which is essential for self-regulated learning. Z. Li et al. (2023) underscored the importance of real-time feedback in enhancing learning outcomes and recommended incorporating automated and instructor-led feedback mechanisms within OLPs. Additionally, institutions must train educators to design assessments that are both rigorous and reflective of the skills required in a digital learning environment.

Finally, privacy concerns were also highlighted as a barrier, with *"Issues related to online platform security and privacy concerns impact my confidence in using these platforms"* scoring a mean of 3.26. Students may feel hesitant to fully engage with platforms if they perceive their data to be at risk. Zhao et al. (2022) suggested that robust data protection policies, transparent communication regarding data usage, and the adoption of secure platforms can alleviate such concerns and foster trust among users.

The challenges identified in this study ranging from technical and infrastructural issues to instructional and privacy concerns, underscore the multifaceted nature of barriers to effective OLP utilization. Institutions must adopt a holistic approach that includes investments in infrastructure, training for educators, enhanced platform features, and robust support systems. By addressing these challenges, universities can create a more inclusive and efficient online learning environment, enabling students to fully leverage the potential of OLPs.

Influence of Specialization on OLP Utilization

The influence of students' areas of specialization on the utilization of online learning platforms (OLPs) was assessed using an Analysis of Variance (ANOVA). The results, summarized in Table 6, indicate no statistically significant difference in OLP usage across specializations ($F(6,193) = 0.747$, $p = 0.613$). This finding suggests that students across diverse academic disciplines engage with OLPs in similar ways, despite variations in the nature of their coursework and pedagogical needs.

Table 6. The influence of specialization area on the use of online learning platforms in University of Ilorin

Sources of Variance	Sum of Squares	Df	Mean Square	F	Sig.	Remark
Between Groups	97.281	6	16.21	.747	.613	Not Reject
Within Groups	4189.594	193	21.71			
Total	**4286.875**	**199**				

The lack of significant differences in platform utilization among specializations might reflect the university's consistent approach to integrating OLPs across faculties. Regardless of their field of study, students likely encounter similar opportunities and barriers in accessing these platforms. This is consistent with findings from Gumasing and Castro (2023), who emphasized that institutional policies and access to digital resources play a critical role in shaping OLP engagement. For instance, if the university uniformly promotes platforms like Google Classroom and Zoom for all faculties, students from various disciplines may exhibit comparable usage patterns.

While the data reveal uniformity in usage, it is important to acknowledge the unique demands of different specializations that could influence the effectiveness of OLPs. Practical-

based disciplines, such as Medicine and Engineering, often require hands-on training and interactive simulations, which may not be fully supported by traditional OLPs. Gheshlagh et al. (2022) noted that medical students faced specific challenges in adapting to online environments due to the limited ability of virtual platforms to replicate clinical and laboratory settings. Similarly, Engineering students may rely heavily on specialized software and physical equipment, making it challenging to integrate these needs into standard OLP frameworks.

In contrast, theoretical disciplines, such as Arts and Humanities, may find OLPs more suitable for their academic needs. These fields often emphasize reading, writing, and discussion-based learning, which align well with the capabilities of platforms designed for content delivery and collaboration. For example, tools like discussion forums, e-libraries, and multimedia resources can effectively support students in these disciplines. This differentiation highlights the importance of tailoring OLP features to accommodate the specific requirements of various fields of study.

Furthermore, while the study found no significant differences in utilization, prior research suggests that specialization-specific factors such as course design, instructor preferences, and access to discipline-specific digital tools could influence perceptions of platform effectiveness. For example, in their study of student engagement, Hwang (2020) highlighted that disciplines employing multimedia-rich resources and interactive tools often report higher satisfaction with OLPs. The absence of such features in some fields could result in underutilization or lower perceived benefits, even if overall usage rates remain consistent across specializations.

To address the diverse needs of different academic disciplines, institutions must adopt a flexible approach to OLP integration. This includes offering customizable platform features, such as virtual labs for practical disciplines and advanced annotation tools for theoretical fields. Additionally, providing discipline-specific training for educators can enhance the design and delivery of digital content tailored to the pedagogical needs of each specialization (Z. Li et al., 2023). Collaborative efforts between faculty and technology developers can further ensure that OLPs effectively support learning objectives across a wide range of academic contexts.

While the uniformity in OLP utilization across specializations suggests equitable access, it also underscores the need for a more nuanced understanding of how these platforms align with the unique requirements of various fields. By addressing these specialization-specific challenges and opportunities, universities can optimize the impact of OLPs and enhance their relevance and effectiveness for all students.

Gender and Academic Performance Impact

The impact of gender on the academic performance of students using online learning platforms (OLPs) was analyzed using a t-test. As summarized in Table 7, the results showed no statistically significant difference between male and female students ($t = -0.225$; $p = 0.822$), suggesting that gender does not play a decisive role in influencing the effectiveness of OLPs on academic outcomes at the University of Ilorin. This finding aligns with research by Ikram et al. (2021), which concluded that male and female students generally exhibit similar engagement levels and benefits when using online learning technologies.

The mean scores of male ($\bar{x}$ =31.95) and female ($\bar{x}$ =32.10) respondents further support this gender-neutral trend. The slight variation in mean values is negligible and does not suggest any meaningful disparity in how OLPs influence academic performance between genders. This reflects broader global findings indicating that OLPs offer equitable

opportunities for learning, provided students have comparable access and support (Wang et al., 2021).

Table 8. The impact of online learning platforms on undergraduates' academic performance based on gender

Gender	N	X	SD	Df	T	Sig.(2-tailed)	Decision
Male	96	31.95	4.90	198	-.225	.822	Not Rejected
Female	104	32.10	4.41				
Total	**200**						

Gender neutrality in the impact of OLPs can be attributed to the inherent flexibility and adaptability of these platforms. Features such as asynchronous learning, multimedia resources, and interactive tools cater to diverse learning styles and individual preferences, transcending traditional gendered perceptions of academic engagement. This adaptability allows both male and female students to personalize their learning experiences, thereby fostering equal academic benefits (Hwang, 2020).

Despite the absence of significant differences in academic performance, it is essential to acknowledge potential variations in learning preferences that might influence individual experiences with OLPs. For instance, some studies have suggested that female students may exhibit a preference for collaborative and social learning environments, while male students may lean toward independent, self-paced learning (Gumasing & Castro, 2023). These differences are not inherently tied to academic performance but can inform the design of OLPs to ensure they address diverse user needs.

Furthermore, the gender-neutral impact observed in this study may reflect the University of Ilorin's efforts to provide equitable access to digital resources and training opportunities. Institutions that prioritize inclusivity in their digital strategies often report fewer disparities in OLP usage and outcomes across demographic groups (Van Schalkwyk et al., 2021). However, achieving true equity extends beyond platform access; it also requires addressing socio-cultural factors, such as stereotypes about technology usage, that may influence students' perceptions and comfort with online learning environments.

Another critical consideration is the potential influence of technical and infrastructural barriers, which may disproportionately affect male or female students depending on their socio-economic backgrounds. Mahundu (2023) emphasized that in contexts with limited digital infrastructure, disparities in access to devices or stable internet connections can overshadow the otherwise equitable potential of OLPs. Therefore, institutions must continually assess and address these external factors to ensure that all students can fully leverage online learning technologies.

The findings also align with Gumasing and Castro (2023), who argued that individual motivation and course design play a more substantial role in shaping OLP effectiveness than demographic factors like gender. This underscores the importance of creating engaging, inclusive, and well-structured digital learning experiences that appeal to all students. Incorporating features such as interactive assessments, real-time feedback, and collaborative projects can further enhance the platforms' effectiveness, regardless of gender.

The absence of significant gender-based differences in the impact of OLPs on academic performance at the University of Ilorin highlights the platforms' potential to provide equitable learning opportunities. However, institutions must continue to refine OLP design and implementation to cater to diverse learning preferences and address external barriers to

access. By doing so, universities can maximize the inclusivity and effectiveness of these platforms for all students.

Synthesis and Implications

The findings from this study provide valuable insights into the utilization, benefits, and challenges associated with online learning platforms (OLPs) at the University of Ilorin. Synthesizing these results reveals key themes that inform institutional strategies to optimize OLP adoption and enhance student outcomes. This subsection discusses the broader implications of these findings and proposes actionable recommendations for stakeholders in higher education.

One significant observation is the underutilization of certain OLPs, as reflected by the data showing that 51.9% of the listed platforms were not actively used by students. This suggests a misalignment between the availability of platforms and their integration into academic workflows. As Van Schalkwyk et al. (2021) noted, the effectiveness of OLPs depends heavily on their alignment with curricular goals and institutional support. Poor integration may stem from limited awareness, insufficient training, or a lack of institutional endorsement for specific platforms. To address this, universities must prioritize cohesive digital strategies that promote the consistent use of preferred OLPs. For instance, conducting workshops to familiarize students and faculty with platform functionalities can significantly boost engagement.

The study also highlights the positive influence of OLPs on academic performance, with a grand mean score of 3.21 indicating that students generally perceive these platforms as beneficial. Features such as access to digital resources, interactive tools, and collaborative opportunities enhance learning outcomes by accommodating diverse learning styles and fostering engagement (Z. Li et al., 2023). However, as some students reported challenges in engaging with complex academic topics via OLPs, institutions must explore ways to optimize platform capabilities for higher-order learning. This could include incorporating adaptive learning technologies and virtual labs tailored to specific disciplines (Gumasing & Castro, 2023).

Challenges identified in this study, such as inadequate technical infrastructure and lack of instructor guidance, underscore the need for a holistic approach to OLP implementation. Mahundu (2023) emphasized that addressing infrastructural barriers, such as unstable internet connectivity, is critical to ensuring equitable access. Additionally, providing comprehensive professional development for educators can empower them to effectively utilize OLPs, thereby enhancing the overall quality of digital education.

The absence of significant differences in OLP utilization across gender and specializations reflects the inclusivity of these platforms, but it also highlights opportunities for further refinement. While the uniform usage patterns indicate equitable access, they may also mask discipline-specific or gender-related preferences that could inform platform customization. For example, integrating virtual labs for STEM fields or enhancing collaborative tools for disciplines that emphasize group work could improve the relevance and effectiveness of OLPs (Gheshlagh et al., 2022).

Moreover, the findings underscore the importance of institutional support in fostering a culture of innovation and adaptability. Universities must adopt proactive measures to continuously evaluate the effectiveness of OLPs and address emerging challenges. Hwang (2020) recommended implementing feedback mechanisms to gather user insights, which can guide iterative improvements in platform design and functionality. Regular assessments of

digital tools and their alignment with pedagogical goals are essential for maintaining their relevance and impact.

The implications of this study extend beyond the University of Ilorin, providing lessons for higher education institutions globally. OLPs have the potential to bridge gaps in access to quality education, especially in resource-limited settings. However, realizing this potential requires addressing systemic barriers, such as the digital divide and socio-economic disparities. Nichuhovska et al. (2024) emphasized that targeted policies, including subsidized internet access and device distribution programs, can help mitigate these challenges.

The findings highlight both the promise and the challenges of integrating OLPs into higher education. By addressing technical, instructional, and infrastructural barriers, and by tailoring platform features to diverse academic needs, institutions can enhance the accessibility, effectiveness, and equity of online learning. These insights are pivotal for policymakers, educators, and technology developers aiming to maximize the transformative potential of OLPs in education.

CONCLUSION

This study highlights the intricate dynamics of online learning in higher education, shedding light on both its advantages and limitations. While online learning platforms (OLPs) have proven to positively influence academic performance by improving resource accessibility, fostering engagement, and enhancing student motivation, significant barriers to their full utilization remain. A large portion of available platforms was underutilized, primarily due to inadequate promotion, insufficient training for both students and educators, and infrastructural constraints. These challenges indicate that while OLPs possess substantial unrealized potential, achieving widespread adoption and effectiveness requires deliberate institutional effort.

The research further reveals that the impact of OLPs is largely independent of gender and academic specialization, underlining their inclusivity as tools that can cater to diverse student populations. However, ensuring that these platforms meet the unique needs of different academic disciplines remains a critical consideration. For example, practical-based fields often require specialized tools such as virtual labs or simulation features, while theoretical disciplines may benefit more from collaboration-enhancing functionalities. These findings emphasize the importance of developing comprehensive, context-sensitive strategies for integrating OLPs into higher education settings to maximize their effectiveness and ensure equitable access.

RECOMMENDATION

To address the barriers identified and to harness the full potential of OLPs, institutions must adopt a holistic approach to their implementation and support. Improving the integration of OLPs within academic frameworks is essential, starting with consistent adoption and targeted promotion of key platforms across all faculties. Raising awareness through structured workshops and training sessions for both students and faculty can foster familiarity and competence with platform functionalities, enhancing their usage and perceived value. Institutions should also prioritize investing in robust digital infrastructure to mitigate common technical challenges such as unreliable internet connectivity and limited access to devices. Collaborations with internet service providers to offer affordable connectivity solutions and incorporating offline-compatible platform features can significantly enhance accessibility, particularly in underserved areas.

Equally important is the professional development of educators, who play a pivotal role in maximizing the benefits of OLPs. Tailored training programs should focus on equipping faculty with the skills to design engaging, interactive, and discipline-specific content using platform tools. This is particularly crucial for practical-based disciplines that require specialized virtual environments to replicate hands-on learning experiences. Simultaneously, platform developers and institutions should work collaboratively to customize OLP features to meet the unique demands of different academic fields, ensuring that all students receive a learning experience aligned with their discipline's pedagogical needs.

Addressing inequities in access to online education is another pressing priority. Initiatives such as subsidized internet packages, device distribution programs, and targeted outreach to disadvantaged student populations can help bridge the digital divide and promote inclusivity. Furthermore, continuous assessment of OLP effectiveness through user feedback and regular evaluations can guide iterative improvements in platform design and functionality. Such adaptive measures ensure that platforms remain relevant and responsive to evolving educational and technological landscapes. By addressing these critical areas, educational institutions can overcome existing challenges, unlock the transformative potential of OLPs, and create a more equitable and effective learning environment for all students.

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Declaration of Interest

The authors declare no conflict of interest.

REFERENCES

Ajani, O. A. (2022). Exploring the Teacher Professional Development Activities: Perspectives of Nigerian High School Teachers. *International Journal of Learning, Teaching and Educational Research*, *21*(6), Article 6. https://ijlter.org/index.php/ijlter/article/view/5217

Almasri, F. (2022). The impact of e-learning, gender-groupings and learning pedagogies in biology undergraduate female and male students' attitudes and achievement. *Education and Information Technologies*, *27*(6), 8329–8380. https://doi.org/10.1007/s10639-022-10967-z

Alomari, A. M. (2024). Perceptions of Faculty Members on Using Moodle as a Learning Management System in Distance Education. *International Journal of Technology in Education and Science*, *8*(1), Article 1. https://doi.org/10.46328/ijtes.507

Apaydinli, K. (2023). Content analysis of music education studies related to augmented reality technology. *Journal of Educational Technology and Online Learning*, *6*(2), 447–481. https://doi.org/10.31681/jetol.1243501

Astalini, A., Darmaji, D., Kurniawan*, D. A., & Chen, D. (2021). Investigating Student Perceptions Based on Gender Differences Using E-Module Mathematics Physics in

Multiple Integral Material. *Jurnal Pendidikan Sains Indonesia*, *9*(4), 602–619. https://doi.org/10.24815/jpsi.v9i4.21297

Brown, N. C. C., & Wilson, G. (2018). Ten quick tips for teaching programming. *PLOS Computational Biology*, *14*(4), e1006023. https://doi.org/10.1371/journal.pcbi.1006023

Buabeng-Andoh, C. (2012). Factors Influencing Teachers' Adoption and Integration of Information and Communication Technology into Teaching: A Review of the Literature. *International Journal of Education and Development Using Information and Communication Technology*, *8*(1), 136–155.

Cavalcanti, A. P., Barbosa, A., Carvalho, R., Freitas, F., Tsai, Y.-S., Gašević, D., & Mello, R. F. (2021). Automatic feedback in online learning environments: A systematic literature review. *Computers and Education: Artificial Intelligence*, *2*, 100027. https://doi.org/10.1016/j.caeai.2021.100027

Chen, X., Breslow, L., & DeBoer, J. (2018). Analyzing productive learning behaviors for students using immediate corrective feedback in a blended learning environment. *Computers & Education*, *117*, 59–74. https://doi.org/10.1016/j.compedu.2017.09.013

Comi, S. L., Argentin, G., Gui, M., Origo, F., & Pagani, L. (2017). Is it the way they use it? Teachers, ICT and student achievement. *Economics of Education Review*, *56*, 24–39. https://doi.org/10.1016/j.econedurev.2016.11.007

Darkwa, B. F., & Antwi, S. (2021). From Classroom to Online: Comparing the Effectiveness and Student Academic Performance of Classroom Learning and Online Learning. *OALib*, *08*(07), 1–22. https://doi.org/10.4236/oalib.1107597

Dimulescu, C. (2023). E-Learning Platform Usage and Acceptance of Technology after the COVID-19 Pandemic: The Case of Transilvania University. *Sustainability*, *15*(22), Article 22. https://doi.org/10.3390/su152216120

Feng, Q., Luo, H., Li, W., Chen, T., & Song, N. (2023). Effects of gender diversity on college students' collaborative learning: From individual gender to gender pairing. *Heliyon*, *9*(6), e16237. https://doi.org/10.1016/j.heliyon.2023.e16237

Galsanjigmed, E., & Sekiguchi, T. (2023). Challenges Women Experience in Leadership Careers: An Integrative Review. *Merits*, *3*(2), Article 2. https://doi.org/10.3390/merits3020021

Gebremariam, H. T., & Mulugeta, Z. A. (2025). In-service language teachers' engagement with online learning platforms after the emergence of Covid-19. *Ampersand*, *14*, 100215. https://doi.org/10.1016/j.amper.2024.100215

Gevertz, J. L., Kim, P. S., & Wares, J. R. (2017). Mentoring Undergraduate Interdisciplinary Mathematics Research Students: Junior Faculty Experiences. *PRIMUS*, *27*(3), 352–369. https://doi.org/10.1080/10511970.2016.1191571

Gheshlagh, R. G., Ahsan, M., Jafari, M., & Mahmoodi, H. (2022). Identifying the challenges of online education from the perspective of University of Medical Sciences Students in the COVID-19 pandemic: A Q-methodology-based study. *BMC Medical Education*, *22*(1), 895. https://doi.org/10.1186/s12909-022-03980-w

Gillies, R. M. (2019). Promoting academically productive student dialogue during collaborative learning. *International Journal of Educational Research*, *97*, 200–209. https://doi.org/10.1016/j.ijer.2017.07.014

Gumasing, Ma. J. J., & Castro, F. M. F. (2023). Determining Ergonomic Appraisal Factors Affecting the Learning Motivation and Academic Performance of Students during Online Classes. *Sustainability*, *15*(3), 1970. https://doi.org/10.3390/su15031970

Hamasha, M. M., Alomari, A. J., & Bani-Irshid, A. H. (2024). The effect of the COVID-19 pandemic crisis on the Jordanian higher education system. *PLOS ONE*, *19*(4), e0299531. https://doi.org/10.1371/journal.pone.0299531

Hiğde, E., & Aktamış, H. (2022). The effects of STEM activities on students' STEM career interests, motivation, science process skills, science achievement and views. *Thinking Skills and Creativity*, *43*, 101000. https://doi.org/10.1016/j.tsc.2022.101000

Hwang, C. S. (2020). Using Continuous Student Feedback to Course-Correct during COVID-19 for a Nonmajors Chemistry Course. *Journal of Chemical Education*, *97*(9), 3400–3405. https://doi.org/10.1021/acs.jchemed.0c00808

Ikram, A., Yousaf, F. N., & Safdar, R. (2021). Cultural Barriers and Gender Differences: A Qualitative Study of Issues Associated with Online Education in Pakistan. *International Journal of Distance Education and E-Learning*, *6*(2), 121–130. https://doi.org/10.36261/ijdeel.v6i2.1867

Irele, A. O. (2021). Digital Integration into the Nigerian Educational System: Challenges and Prospects. *Texila International Journal of Academic Research*, 17–23. https://doi.org/10.21522/TIJAR.2014.SE.21.01.Art003

Itasanmi, S. A., & Ajani, A. O. (2023). Technology Self-Efficacy and Digital Literacy Among ODL Students: The Moderating Role of Gender. *International Journal of Innovative Technologies in Social Science*, *3(39)*. https://doi.org/10.31435/rsglobal_ijitss/30092023/8030

Kuliukas, L., Hauck, Y., Sweet, L., Vasilevski, V., Homer, C., Wynter, K., Wilson, A., Szabo, R., & Bradfield, Z. (2021). A cross sectional study of midwifery students' experiences of COVID-19: Uncertainty and expendability. *Nurse Education in Practice*, *51*, 102988. https://doi.org/10.1016/j.nepr.2021.102988

Lambrechts, W., & Sinha, S. (2019). Limitations of Last Mile Internet Access in Developing Countries. In W. Lambrechts & S. Sinha, *Last Mile Internet Access for Emerging Economies* (Vol. 77, pp. 41–69). Springer International Publishing. https://doi.org/10.1007/978-3-030-20957-5_2

Lavidas, K., Voulgari, I., Papadakis, S., Athanassopoulos, S., Anastasiou, A., Filippidi, A., Komis, V., & Karacapilidis, N. (2024). Determinants of Humanities and Social Sciences Students' Intentions to Use Artificial Intelligence Applications for Academic Purposes. *Information*, *15*(6), Article 6. https://doi.org/10.3390/info15060314

Lawrence, J. E., & Tar, U. A. (2018). Factors that influence teachers' adoption and integration of ICT in teaching/learning process. *Educational Media International*, *55*(1), 79–105. https://doi.org/10.1080/09523987.2018.1439712

Li, W., Meng, X., Xu, Z., Yu, Q., Shi, J., Yu, Y., D'Arcy, C., Huang, Y., & Kou, C. (2016). Prevalence, correlates of major depression: A mental health survey among undergraduates at a mainland C hinese university. *Asia-Pacific Psychiatry*, *8*(3), 206–214. https://doi.org/10.1111/appy.12202

Li, Z., Lou, X., Chen, M., Li, S., Lv, C., Song, S., & Li, L. (2023). Students' online learning adaptability and their continuous usage intention across different disciplines. *Humanities and Social Sciences Communications*, *10*(1), 1–10. https://doi.org/10.1057/s41599-023-02376-5

Liu, Z., Tang, Q., Ouyang, F., Long, T., & Liu, S. (2024). Profiling students' learning engagement in MOOC discussions to identify learning achievement: An automated configurational approach. *Computers & Education*, *219*, 105109. https://doi.org/10.1016/j.compedu.2024.105109

Loewen, S., Gönülal, T., Isbell, D. R., Ballard, L., Crowther, D., Lim, J., Maloney, J., & Tigchelaar, M. (2020). How Knowledgeable are Applied Linguistics and SLA

Researchers about Basic Statistics?: Data from North America and Europe. *Studies in Second Language Acquisition*, *42*(4), 871–890. https://doi.org/10.1017/S0272263119000548

Lynn, T., Rosati, P., Conway, E., Curran, D., Fox, G., & O'Gorman, C. (2022). Infrastructure for Digital Connectivity. In T. Lynn, P. Rosati, E. Conway, D. Curran, G. Fox, & C. O'Gorman, *Digital Towns* (pp. 109–132). Springer International Publishing. https://doi.org/10.1007/978-3-030-91247-5_6

Mahundu, F. G. (2023). Challenges of e-learning during the COVID-19 lockdown: A survey of undergraduate students at Mwalimu Nyerere Memorial Academy, Tanzania. *International Journal of Research Publication and Reviews*, *4*(8), 2668–2674. https://doi.org/10.55248/gengpi.4.823.51636

Makole, K. R., Ntshangase, B. A., & Msosa, S. K. (2023). Organizational culture and management practices at technical vocational education and training colleges. *International Journal of Evaluation and Research in Education (IJERE)*, *12*(4), 2021. https://doi.org/10.11591/ijere.v12i4.25340

Mkhize, P., Mtsweni, E. S., & Buthelezi, P. (2016). Diffusion of Innovations Approach to the Evaluation of Learning Management System Usage in an Open Distance Learning Institution. *The International Review of Research in Open and Distributed Learning*, *17*(3). https://doi.org/10.19173/irrodl.v17i3.2191

Müller, C., & Mildenberger, T. (2021). Facilitating flexible learning by replacing classroom time with an online learning environment: A systematic review of blended learning in higher education. *Educational Research Review*, *34*, 100394. https://doi.org/10.1016/j.edurev.2021.100394

Nagalingam, V., Ibrahim, R., & Che, R. (2020). EDUGXQ: User Experience Instrument for Educational Games' Evaluation. *International Journal of Advanced Computer Science and Applications*, *11*(1). https://doi.org/10.14569/IJACSA.2020.0110170

Nejatdarabi, H., Amini, M., Yarahmadi, J., Bikineh, P., Kaveh, M., & Gholampoor, H. (2018). Validity and reliability of the Persian version of WATCH questionnaire in assessing the clinical learning environment. *Biomedical Research*, *29*(17). https://doi.org/10.4066/biomedicalresearch.29-18-1023

Nichuhovska, L., Nikolenko, L., Bondarenko, Z., Motorina, V., & Prykhodko, T. (2024). Challenges and prospects of online education in the context of barrier-free access. *Multidisciplinary Reviews*, *6*, 2023spe020. https://doi.org/10.31893/multirev.2023spe020

Parajuli, M., & Thapa, A. (2017). Gender Differences in the Academic Performance of Students. *Journal of Development and Social Engineering*, *3*(1), 39–47. https://doi.org/10.3126/jdse.v3i1.27958

Priatna, N., & Sari, R. M. M. (2022). Analyzing Students' Mathematical Spatial Literacy Using a Project-Based Blended Learning Model. *Kreano, Jurnal Matematika Kreatif-Inovatif*, *13*(1), 78–87. https://doi.org/10.15294/kreano.v13i1.34995

Raihan, M. M. H., 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*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/DTS-04-2024-0054

Rios-Campos, C., Campos, P. R., Delgado, F. C., Ramírez, I. M., Hubeck, J. A., Fernández, C. J., Vega, Y. C., & Méndez, M. C. (2021). Covid-19 and Universities in Latin America. *South Florida Journal of Development*, *2*(1), 577–585. https://doi.org/10.46932/sfjdv2n1-041

Roy, R., & Al-Absy, M. S. M. (2022). Impact of Critical Factors on the Effectiveness of Online Learning. *Sustainability*, *14*(21), Article 21. https://doi.org/10.3390/su142114073

Santos-Díaz, S., Hensiek, S., Owings, T., & Towns, M. H. (2019). Survey of Undergraduate Students' Goals and Achievement Strategies for Laboratory Coursework. *Journal of Chemical Education*, *96*(5), 850–856. https://doi.org/10.1021/acs.jchemed.8b00984

Sato, S. N., Condes Moreno, E., Rubio-Zarapuz, A., Dalamitros, A. A., Yañez-Sepulveda, R., Tornero-Aguilera, J. F., & Clemente-Suárez, V. J. (2024). Navigating the New Normal: Adapting Online and Distance Learning in the Post-Pandemic Era. *Education Sciences*, *14*(1), Article 1. https://doi.org/10.3390/educsci14010019

Schultz-Jones, B., Ledbetter, C., & Bishop, J. (2021). Investigating Differences Between Male and Female Students' Perceptions of School Library Learning Environments. *IASL Annual Conference Proceedings*. https://doi.org/10.29173/iasl7867

Suleman, Q., Hussain, I., Din, D. M. N. ud, & Shafique, F. (2017). Effects of Information and Communication Technology (ICT) on Students' Academic Achievement and Retention in Chemistry at Secondary Level. *Journal of Education and Educational Development*, *4*(1), Article 1. http://jmsnew.iobmresearch.com/index.php/joeed/article/view/187

Tytler, R. (2020). STEM Education for the Twenty-First Century. In J. Anderson & Y. Li (Eds.), *Integrated Approaches to STEM Education* (pp. 21–43). Springer International Publishing. https://doi.org/10.1007/978-3-030-52229-2_3

Ugwu, J. N., & Ugwuanyi, I. P. (2024). Overcoming Distance Education Challenges in Nigeria: A Call for Collaborative ICT Integration. *IDOSR Journal of Arts and Management*, *9*(1), 22–24. https://doi.org/10.59298/IDOSRJAM/2024/9.1.222489

Ullah, M. S., Hoque, Md. R., Aziz, M. A., & Islam, M. (2023). Analyzing students' e-learning usage and post-usage outcomes in higher education. *Computers and Education Open*, *5*, 100146. https://doi.org/10.1016/j.caeo.2023.100146

Van Schalkwyk, M. C., Maani, N., Cohen, J., Mckee, M., & Petticrew, M. (2021). Our Postpandemic World: What Will It Take to Build a Better Future for People and Planet? *The Milbank Quarterly*, *99*(2), 467–502. https://doi.org/10.1111/1468-0009.12508

Vodă, A. I., Cautisanu, C., Grădinaru, C., Tănăsescu, C., & De Moraes, G. H. S. M. (2022). Exploring Digital Literacy Skills in Social Sciences and Humanities Students. *Sustainability*, *14*(5), 2483. https://doi.org/10.3390/su14052483

Wairooy, I. K., Reynard, A., Octodhia, M. R., Andanu, W. M., Suri, P. A., & Syahputra, M. E. (2023). The Impactful Effect of E-Learning Study Method Towards Students Academic Achievements in General. *Engineering, MAthematics and Computer Science (EMACS) Journal*, *5*(1), 11–14. https://doi.org/10.21512/emacsjournal.v5i1.9309

Walsham, G. (2017). ICT4D research: Reflections on history and future agenda. *Information Technology for Development*, *23*(1), 18–41. https://doi.org/10.1080/02681102.2016.1246406

Wang, T., Lin, C.-L., & Su, Y.-S. (2021). Continuance Intention of University Students and Online Learning during the COVID-19 Pandemic: A Modified Expectation Confirmation Model Perspective. *Sustainability*, *13*(8), Article 8. https://doi.org/10.3390/su13084586

Yang, H. (2024). E-learning platforms in ideological and political education at universities: Students' motivation and learning performance. *BMC Medical Education*, *24*(1), 628. https://doi.org/10.1186/s12909-024-05572-2

Ye, L., & Yang, H. (2020). From Digital Divide to Social Inclusion: A Tale of Mobile Platform Empowerment in Rural Areas. *Sustainability*, *12*(6), Article 6. https://doi.org/10.3390/su12062424

Zamiri, M., & Esmaeili, A. (2024). Methods and Technologies for Supporting Knowledge Sharing within Learning Communities: A Systematic Literature Review. *Administrative Sciences*, *14*(1), Article 1. https://doi.org/10.3390/admsci14010017

Zhang, J. (2022). Influence of the Affordance of Online Learning Platform Technology on the Entrepreneurial Behaviors of Students in Engineering and Technology Universities. *International Journal of Emerging Technologies in Learning (iJET)*, *17*(22), 202–215. https://doi.org/10.3991/ijet.v17i22.35361

Zhao, X., Shao, M., & Su, Y.-S. (2022). Effects of Online Learning Support Services on University Students' Learning Satisfaction under the Impact of COVID-19. *Sustainability*, *14*(17), 10699. https://doi.org/10.3390/su141710699