

Assessing the Effectiveness of the LMS in Enhancing Academic Performance across Year Groups at UCC: A Cross-Sectional Study of Level 200 to Level 400 Students

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Abstract

This study assessed the effectiveness of the Learning Management System (LMS) in enhancing academic performance across second-, third-, and fourth-year students at the University of Cape Coast (UCC). Employing a cross-sectional survey design, the research collected data from 14,481 students to examine variations in LMS adoption, usability, and challenges. Key findings revealed significant differences in academic performance, with fourth-year students outperforming their junior counterparts. Perceived LMS effectiveness was the highest among second-year students but declined progressively in higher year groups, attributed to unmet expectations and limited advanced features. Regression analysis indicated a stronger positive relationship between LMS usability and academic performance for third-year students compared to fourth-year students. Challenges such as low digital literacy, poor internet connectivity, and insufficient technical support were identified as barriers to LMS effectiveness. The study underscores the need for tailored interventions, including enhanced training, infrastructure investment, and advanced LMS features, to address the unique needs of students at different academic levels. These findings contribute to the discourse on LMS implementation in resource-constrained settings and provide actionable recommendations for policymakers and educators to optimize digital learning outcomes.

Keywords

Learning Management System (LMS), Academic Performance, Year Groups, Digital Literacy, Higher Education, University of Cape Coast (UCC)

1. Background to the Study

The rapid integration of technology into education has transformed teaching and learning processes with Learning Management Systems (LMS) emerging as a cornerstone of modern higher education. The LMS platforms like Moodle, Blackboard, and Canvas have become indispensable tools for delivering course content, facilitating communication, and tracking student progress. Their growing importance is underscored by the global shift towards digital learning, accelerated by the COVID-19 pandemic which highlighted the need for flexible and accessible educational tools (Dhawan, 2020). Studies have shown that LMS adoption enhances student engagement, improves academic performance, and supports personalised learning experiences (Almarzooq et al., 2020). As higher education institutions increasingly rely on these systems, understanding their effectiveness in diverse contexts has become critical to ensuring equitable and impactful learning outcomes.

Globally, LMS platforms have demonstrated significant potential in enhancing academic engagement and performance. By providing a centralised hub for resources, assignments, and feedback, LMS tools streamline academic tasks and reduce administrative burdens for both students and educators. For instance, a study by Al-Marroof et al. (2021) found that 78% of students reported improved learning outcomes due to the structured and accessible nature of LMS platforms. Furthermore, research has shown that LMS tools foster student-centred learning by enabling self-paced study, interactive discussions, and real-time feedback which are essential for cultivating critical thinking and problem-solving skills (Martin & Bolliger, 2020). These systems also support collaborative learning, allowing students to engage with peers and instructors beyond the confines of traditional classrooms. For example, a survey of 1200 university students in the United States revealed that 85% felt more connected to their coursework and peers through LMS-facilitated discussions (Means et al., 2020). Such findings underscore the transformative role of LMS in modern education.

Despite its global adoption, the effectiveness of LMS in higher education varies significantly across institutions and student groups. In many cases, LMS platforms have been instrumental in addressing academic challenges like resource limitations, time constraints, and diverse learning needs. For example, Alqahtani and Rajkhan (2020) highlighted how LMS tools improved access to learning materials for students in remote areas, thereby reducing educational disparities. However, challenges like technical issues, low digital literacy, and resistance to change can hinder LMS adoption and effectiveness (Rasheed et al., 2020). These variations underscore the need for context-specific assessments of LMS effectiveness, partic-

ularly in institutions with diverse student populations and resource constraints.

Assessing the effectiveness of LMS is crucial for understanding its impact on academic performance. Studies have shown how variations in LMS adoption and usage across different student groups significantly influence learning outcomes. For instance, in [Al-Fraihat et al. \(2020\)](#), students who actively engaged with LMS tools achieved higher grades compared to those who used them minimally. Similarly, a survey of 500 university students in Malaysia revealed that 70% of respondents attributed their improved academic performance to consistent LMS usage ([Rahim & Zainal, 2020](#)). These findings highlight the importance of promoting active LMS engagement to maximise its benefits. However, disparities in access and usage patterns, particularly among students from different year groups, can create inequities in learning outcomes. Addressing these disparities requires targeted interventions and continuous evaluation of LMS effectiveness.

Theoretical frameworks like the Technology Acceptance Model (TAM) and Constructivist Learning Theory provide valuable lenses for analysing LMS effectiveness. The TAM, which focuses on perceived usefulness and ease of use helps explain variations in LMS adoption and engagement across student groups ([Davis, 1989](#)). For example, a study by [Tarhini et al. \(2021\)](#) found that students' perceptions of LMS usefulness significantly influenced their engagement levels and academic performance. Constructivist Learning Theory, on the other hand, emphasises the role of LMS in facilitating active, student-centred learning experiences. By enabling collaborative activities and personalised learning paths, LMS platforms align with constructivist principles, fostering deeper understanding and critical thinking ([Jonassen, 1999](#)). These theories underscore the importance of designing LMS systems that are both user-friendly and pedagogically sound.

Globally, LMS platforms have been successfully implemented in various higher education contexts, demonstrating their adaptability and impact. For instance, Universities in Europe and North America have leveraged LMS tools to enhance online learning and support hybrid education models ([Dhawan, 2020](#)). In Africa, LMS adoption has gained momentum, with institutions like the University of Pretoria and Makerere University integrating these systems to address resource limitations and improve access to education ([Tarus et al., 2020](#)). In Ghana, the University of Cape Coast (UCC) has emerged as a leader in LMS adoption, utilising platforms like Sakai to support teaching and learning. A study by [Owusu et al. \(2021\)](#) found that UCC students perceived LMS tools as effective in enhancing their academic performance, particularly in terms of access to resources and communication with instructors. These examples highlight the potential of LMS to transform higher education in diverse contexts.

At UCC, the implementation of LMS has introduced unique opportunities and challenges. The university adoption of Sakai has enabled seamless delivery of course materials, online assessments, and interactive discussions. However, variations in LMS usage across second-, third- and fourth-year students have been observed, with senior students demonstrating higher engagement levels compared

to their junior counterparts (Owusu et al., 2021). These variations may be attributed to differences in digital literacy, familiarity with the system, and academic workload. For instance, a survey of 300 UCC students revealed that 65% of fourth-year students used LMS tools daily, compared to only 45% of second-year students (Owusu et al., 2021). Addressing these disparities requires targeted training and support to ensure equitable access and engagement across all year groups.

Despite its potential, LMS usage at UCC faces several challenges including technical issues, limited internet access, and resistance to change. For example, Agyei et al. (2020) found that 30% of UCC students experienced difficulties accessing LMS platforms due to poor internet connectivity. Additionally, some students and instructors have expressed reluctance to fully embrace LMS tools, citing a preference for traditional teaching methods (Owusu et al., 2021). However, these challenges also present opportunities for improvement like investing in infrastructure, providing digital literacy training, and fostering a culture of innovation. By addressing these barriers, UCC can maximise the benefits of LMS and enhance academic performance across all year groups.

In conclusion, the growing importance of LMS in higher education underscores the need for context-specific assessments of its effectiveness. By examining its impact on academic performance across different year groups, this study aims to provide valuable insights for improving LMS implementation and usage at UCC. Understanding these dynamics is essential for fostering equitable and impactful learning experiences in an increasingly digital world.

2. Problem Statement

The integration of Learning Management Systems (LMS) into higher education has become a global trend, offering opportunities to enhance teaching, learning, and academic performance. However, the effectiveness of LMS in improving student outcomes remains inconsistent, particularly in resource-constrained settings. Studies have shown that while LMS platforms can streamline academic tasks and foster engagement, their impact varies significantly across institutions and student groups (Al-Fraihat et al., 2020; Owusu et al., 2021). For instance, a study by Alqahtani and Rajkhan (2020) revealed that 40% of students in Saudi Arabian Universities reported minimal improvement in academic performance despite LMS usage. Similarly, Agyei et al. (2020) found that 30% of students at the University of Cape Coast (UCC) faced challenges accessing LMS due to poor internet connectivity, highlighting the persistent nature of the problem.

The magnitude of the problem is evident in the disparities in LMS adoption and usage across different student groups. At UCC, for example, a survey of 300 students revealed that only 45% of second-year students used LMS tools daily, compared to 65% of fourth-year students (Owusu et al., 2021). This disparity is compounded by low digital literacy and resistance to change, which hinder effective LMS utilisation. Globally, similar trends have been observed, with studies indicating that 25% of students in developing countries struggle to engage with LMS due

to limited technical skills (Rasheed et al., 2020). These findings underscore the urgent need to address the barriers to LMS effectiveness, particularly in institutions with diverse student populations and resource constraints.

Several factors contribute to the problem, including inadequate infrastructure, low digital literacy, and resistance to change. For instance, Tarus et al., (2020) found that 60% of African Universities lack the necessary infrastructure to support seamless LMS operations. Additionally, students with limited exposure to digital tools often struggle to navigate LMS platforms, reducing their engagement and academic performance (Rahim & Zainal, 2020). Resistance to change among both students and instructors further exacerbates the problem, as some prefer traditional teaching methods over digital alternatives (Owusu et al., 2021). These factors collectively hinder the potential of LMS to enhance academic outcomes, necessitating targeted interventions to address these challenges.

Efforts to address the problem have included infrastructure development, digital literacy training, and policy reforms. For example, UCC has implemented training programmes to improve students' and instructors' proficiency in using LMS tools (Agyei et al., 2020). Similarly, Universities in South Africa have invested in high-speed internet and user-friendly LMS platforms to enhance accessibility and engagement (Tarus et al., 2020). However, these measures have not fully resolved the disparities in LMS usage and effectiveness, particularly across different year groups. A study by Martin & Bolliger, (2020) emphasised the need for continuous evaluation and adaptation of LMS strategies to meet evolving student needs, suggesting that current efforts may require further refinement.

To address the problem effectively, there is a need for context-specific research to evaluate LMS effectiveness across different student groups. This study aims to assess the impact of LMS on academic performance among Level 200 to Level 400 students at UCC, providing insights into variations in adoption and usage. By identifying the unique challenges and opportunities associated with LMS usage at UCC, the study will inform targeted interventions to enhance its effectiveness. This approach aligns with the recommendations of Al-Fraihat et al., 2020, who emphasised the importance of tailored strategies to maximise the benefits of LMS in diverse educational contexts.

The research gap lies in the limited understanding of how LMS effectiveness varies across different year groups in resource-constrained settings. While previous studies have explored LMS adoption and usage, few have examined its impact on academic performance in a stratified manner, particularly in African Universities (Owusu et al., 2021; Tarus et al., 2020). This gap hinders the development of targeted strategies to address disparities in LMS usage and effectiveness. By addressing this gap, the study will contribute to the growing body of knowledge on LMS implementation and its role in enhancing academic outcomes.

Justifying the research gap, this study will provide empirical evidence on the effectiveness of LMS across different year groups at UCC, offering valuable insights for policymakers and educators. The findings will inform the design of tailored interventions to improve LMS adoption and usage, ultimately enhancing

academic performance. Additionally, the study will contribute to global efforts to address educational disparities by highlighting the unique challenges and opportunities associated with LMS implementation in resource-constrained settings. This will set a solid foundation for future research and policy development in the field of digital education.

3. Objectives of the Study

- a) To compare the academic performance of second-, third-, and fourth-year students using LMS for academic tasks.
- b) To investigate the differences in LMS effectiveness across different year groups.
- c) To explore the impact of students' perceptions of LMS usability on academic performance at various stages of their studies.
- d) To identify the challenges of using LMS at different levels of study (second, third, and fourth years).

4. Research Questions

- a) What are the differences in academic performance among second-, third-, and fourth-year students who use the LMS for academic tasks?
- b) How does LMS effectiveness vary among second-, third-, and fourth-year students?
- c) What is the relationship between students' perceptions of LMS usability and their academic performance at different stages of their studies?
- d) What are the key challenges faced by second-, third-, and fourth-year students in using the LMS?

5. Significance of the Study

This study is significant as it addresses the critical need to understand how LMS effectiveness varies across different year groups in a resource-constrained higher education setting. By comparing academic performance and exploring students' perceptions, the study will provide valuable insights into the factors influencing LMS adoption and usage. The findings will inform policymakers and educators at UCC and similar institutions on how to tailor LMS strategies to meet the unique needs of students at different stages of their studies, ultimately improving academic outcomes and fostering equitable access to digital learning resources.

Additionally, the study will contribute to the global discourse on LMS implementation by highlighting the challenges and opportunities specific to African higher education contexts. By identifying actionable strategies to enhance LMS usability and effectiveness, the research will support the achievement of Sustainable Development Goal 4 (Quality Education) and promote inclusive and effective educational practices. The study's outcomes will also serve as a foundation for future research on LMS adoption and its impact on academic performance in diverse educational settings.

6. Scope of the Study

The study focuses on second-, third-, and fourth-year students at the University of Cape Coast (UCC), examining their academic performance, perceptions, and experiences with the LMS. It explores variations in LMS effectiveness across these year groups, identifying the challenges and opportunities associated with its use at different stages of study. The study is limited to UCC's Sakai LMS platform, providing a context-specific analysis of its effectiveness in a Ghanaian higher education setting. While the findings may have broader implications, the study does not generalise its results to other institutions or LMS platforms.

Additionally, the study focuses on student perspectives, excluding faculty and administrative viewpoints. This limitation ensures a focused analysis of student experiences and outcomes, providing a clear understanding of the factors influencing LMS usage and effectiveness. The study's scope is further defined by its emphasis on academic performance and usability as primary outcomes, excluding other potential benefits of LMS, such as administrative efficiency or institutional reputation.

7. Literature Review

7.1. The Role of Learning Management Systems (LMS) in Higher Education

The integration of Learning Management Systems (LMS) into higher education has revolutionised teaching and learning, offering a digital platform for delivering course content, facilitating communication, and tracking student progress. Globally, LMS platforms such as Moodle, Blackboard, and Canvas have become indispensable tools, particularly in the wake of the COVID-19 pandemic, which accelerated the adoption of online learning (Dhawan, 2020). According to a report by HolonIQ (2021), the global LMS market is projected to grow from 13.4 billion in 2020 to 25.7 billion by 2025, reflecting its increasing importance in education. LMS platforms provide flexibility, enabling students to access learning materials anytime and anywhere, which is particularly beneficial for non-traditional and distance learners (Al-Fraihat et al., 2020). For instance, a study by Martin & Bolliger, (2020) found that 85% of students reported improved access to resources and communication with instructors through LMS tools. These benefits underscore the transformative role of LMS in modern education.

Despite its advantages, the implementation of LMS is not without challenges. Technical issues, such as system downtime and poor internet connectivity, often hinder effective usage, particularly in resource-constrained settings (Rasheed et al., 2020). Additionally, resistance to change among students and instructors poses a significant barrier to LMS adoption. A survey of 1200 university students in the United States revealed that 30% of respondents preferred traditional teaching methods over digital alternatives (Means et al., 2020). Furthermore, disparities in digital literacy exacerbate these challenges, as students with limited exposure to technology struggle to navigate LMS platforms effectively (Alqahtani & Rajkhan,

2020). These challenges highlight the need for targeted interventions to address technical and human barriers, ensuring equitable access to the benefits of LMS.

The growing importance of LMS in higher education is further evidenced by its role in fostering student-centred learning. LMS platforms support personalised learning paths, interactive discussions, and real-time feedback, which are essential for cultivating critical thinking and problem-solving skills (Jonassen, 1999). For example, a study by Al-Marroof et al. (2021) found that 78% of students reported improved learning outcomes due to the structured and accessible nature of LMS tools. Moreover, LMS platforms facilitate collaborative learning, enabling students to engage with peers and instructors beyond the confines of traditional classrooms (Martin & Bolliger, 2020). These features align with constructivist learning principles, emphasising active participation and knowledge construction. As higher education institutions increasingly rely on LMS, understanding its effectiveness in diverse contexts becomes critical to ensuring equitable and impactful learning outcomes.

7.2. LMS and Academic Performance

The relationship between LMS usage and academic performance has been widely studied, with mixed findings highlighting both its potential and limitations. Several studies have demonstrated a positive correlation between LMS engagement and academic outcomes. For instance, Al-Fraihat et al., 2020 found that students who actively used LMS tools achieved higher grades compared to those who used them minimally. Similarly, a survey of 500 university students in Malaysia revealed that 70% of respondents attributed their improved academic performance to consistent LMS usage (Rahim & Zainal, 2020). These findings suggest that LMS platforms can enhance learning outcomes by providing structured access to resources, enabling self-paced study, and facilitating timely feedback. However, the extent of this impact varies depending on factors such as student engagement, digital literacy, and institutional support.

Despite these positive outcomes, disparities in LMS effectiveness across student groups and institutions remain a significant concern. For example, a study by Owusu et al., 2021 found that while 65% of fourth-year students at the University of Cape Coast (UCC) used LMS tools daily, only 45% of second-year students did so. This variation was attributed to differences in digital literacy and familiarity with the system. Similarly, a global survey by HolonIQ (2021) revealed that 25% of students in developing countries struggled to engage with LMS due to limited technical skills and poor internet connectivity. These disparities highlight the need for context-specific strategies to address barriers to LMS adoption and usage, ensuring equitable access to its benefits.

The impact of LMS on academic performance is also influenced by its alignment with pedagogical goals and institutional support. Studies have shown that LMS tools are most effective when integrated into a broader strategy that includes training for students and instructors, as well as ongoing technical support (Tarus

et al., 2020). For example, a case study of Makerere University in Uganda found that targeted training programmes significantly improved LMS engagement and academic outcomes (Tarus et al., 2020). Additionally, institutions that prioritise user-friendly LMS design and robust infrastructure report higher levels of student satisfaction and performance (Al-Marroof et al. (2021)). These findings underscore the importance of a holistic approach to LMS implementation, addressing both technical and human factors to maximise its impact on academic performance.

7.3. Student Perceptions of LMS Usability

Student perceptions of Learning Management Systems (LMS) usability significantly influence their engagement and learning outcomes. Perceived ease of use is one of the primary determinants of LMS success. Tarhini et al., (2021) highlight that when students perceive LMS as easy to navigate, they are more likely to engage with its tools effectively, thus enhancing their learning experience. Additionally, LMS platforms that offer intuitive interfaces and responsive design contribute to greater user satisfaction. A study by Martin & Bolliger, (2020) also found that students who rated LMS usability higher reported better overall academic performance. Perceptions of usability can also be influenced by previous experience with technology, with students who have prior exposure to digital tools showing more positive attitudes towards LMS usage.

The perceived usefulness of LMS tools is another critical factor. According to Tarhini et al., 2021, students tend to use LMS platforms more frequently when they perceive them as valuable for managing academic tasks such as submitting assignments, accessing learning materials, and communicating with peers and instructors. Research by Martin & Bolliger, (2020) reveals that LMS platforms that align with students' academic needs, offering features such as feedback on assignments and interactive quizzes, enhance student engagement. This increased engagement, in turn, has been shown to improve academic performance. The study also underscores that students who find LMS useful are more likely to recommend it to others, highlighting the role of usability in shaping perceptions and usage behaviours.

Empirical studies on technology acceptance further support the idea that students' perceptions of usability, ease of use, and usefulness are interconnected. A comprehensive study by Tarus et al., (2020) found that students' perceived ease of use was positively correlated with both perceived usefulness and satisfaction with LMS platforms. These findings are consistent with prior research, suggesting that enhancing the usability of LMS systems can lead to better academic performance and higher levels of student engagement. Additionally, factors such as system reliability and technical support were found to be crucial in shaping students' perceptions, as they directly affect the functionality and accessibility of LMS tools (Tarhini et al., 2021).

7.4. Challenges and Opportunities in LMS Implementation

The implementation of LMS in educational institutions faces several challenges,

particularly in resource-constrained environments. Infrastructure limitations, such as inadequate internet connectivity, unreliable hardware, and outdated software, can hinder the effectiveness of LMS platforms. Agyei et al. (2020) point out that in many African universities, including those in Ghana, these infrastructure-related issues contribute to low LMS adoption rates. The study found that students in rural areas often experience disruptions in accessing course materials and submitting assignments, leading to a diminished learning experience. These challenges are exacerbated by power outages, which further affect the reliability of LMS systems and create barriers to continuous learning.

Resistance to change is another significant barrier to the widespread adoption of LMS. A study by Tarus et al., (2020) highlights that both students and faculty members often exhibit reluctance towards new technologies, preferring traditional teaching methods. This resistance is particularly noticeable among older educators who may lack the digital literacy required to use LMS tools effectively. The same study suggests that this reluctance can lead to low usage rates of LMS, even when the infrastructure is in place. Students, too, may resist using LMS platforms due to unfamiliarity with the technology or a lack of confidence in navigating digital tools, further hindering LMS adoption.

Despite these challenges, there are substantial opportunities for improving LMS implementation. Agyei et al. (2020) argue that targeted training programmes for both students and faculty can significantly improve LMS adoption rates. By enhancing digital literacy, students and educators are better equipped to use LMS tools, ultimately improving the quality of education. Additionally, policy reforms that prioritise the integration of LMS in teaching and learning can help overcome resistance to change. For example, the introduction of mandatory digital literacy courses for students and faculty could foster greater acceptance and usage of LMS. Furthermore, investing in infrastructure development, such as expanding internet access and upgrading technological resources, would address many of the technical barriers associated with LMS implementation.

7.5. Theoretical Frameworks for Analysing LMS Effectiveness

The Technology Acceptance Model (TAM) is one of the most widely used frameworks for understanding LMS adoption and effectiveness. Developed by Davis (1989), TAM posits that perceived usefulness and perceived ease of use are key determinants of technology acceptance. According to Davis, if users perceive a system as easy to use and beneficial to their tasks, they are more likely to adopt it. Studies have consistently supported this model in the context of LMS. For instance, Jonassen (1999) applied TAM to study the effectiveness of LMS in enhancing student learning, finding that students who believed LMS platforms would improve their academic performance were more likely to use them regularly. This theory has provided a solid foundation for understanding how student perceptions influence LMS usage and its subsequent impact on academic performance.

Another relevant theoretical framework is Constructivist Learning Theory,

which emphasises active, student-centred learning. Jonassen (1999) argues that LMS platforms, when designed effectively, can foster a constructivist approach by encouraging students to engage in collaborative learning, problem-solving, and knowledge construction. This theory aligns with the interactive features of many modern LMS platforms, such as discussion forums, group assignments, and peer reviews, which support active learning. Constructivist principles are particularly important in the context of LMS, as they enable students to take ownership of their learning and collaborate with peers in meaningful ways. This shift from passive to active learning is seen as essential for enhancing student engagement and academic performance.

Empirical evidence supports the application of both TAM and Constructivist Learning Theory in understanding LMS effectiveness. Research by Tarus et al., (2020) found that students who perceived LMS as useful and easy to use reported higher engagement and academic performance. Similarly, a study by Martin & Bolliger, (2020) demonstrated that LMS platforms that incorporate constructivist principles, such as collaborative tools and real-time feedback, significantly enhance student satisfaction and learning outcomes. These studies reinforce the idea that both the perceived ease of use and the active learning features of LMS play crucial roles in determining its effectiveness in higher education settings.

7.6. LMS in African Higher Education Contexts

The adoption of Learning Management Systems (LMS) in African higher education has been a subject of increasing interest, as universities strive to enhance their educational offerings. Despite the promising potential of LMS, the adoption rate in African universities has been slow, with several barriers to overcome. Owusu et al., 2021 note that limited access to infrastructure, such as reliable internet and electricity, as well as insufficient digital literacy among both students and faculty, are significant challenges hindering LMS adoption in Africa. Additionally, cultural resistance to new technologies and a preference for traditional teaching methods have contributed to the slow uptake of LMS across many institutions. In contrast, universities that have prioritised technology integration, such as the University of Cape Coast (UCC) in Ghana, have seen promising results in improving academic outcomes and student engagement through LMS.

Several successful case studies in Africa highlight the potential of LMS to transform higher education. Makerere University in Uganda is a prime example of a successful LMS implementation, where the university has embraced Moodle and other LMS platforms to support both traditional and blended learning environments. Research by Tarus et al., (2020) found that Makerere University saw improvements in academic performance and student satisfaction after the adoption of LMS, with students reporting higher engagement levels and greater access to course materials. UCC has similarly made strides in LMS implementation, especially during the COVID-19 pandemic when the shift to online learning accelerated the use of Moodle. Studies by Owusu et al., 2021 indicate that UCC has ex-

perienced an increase in LMS usage, particularly among higher-level students, leading to more flexible and interactive learning opportunities. These case studies demonstrate that with the right infrastructure and support, African universities can successfully integrate LMS into their teaching and learning frameworks.

However, the widespread adoption of LMS in African universities remains hindered by several factors. A study by [Tarus et al., \(2020\)](#) found that many African institutions still face significant infrastructural constraints, such as inadequate network bandwidth and limited access to digital devices. These challenges are compounded by limited faculty training in the effective use of LMS tools, leading to underutilisation of these platforms. Furthermore, the lack of national policies to support digital learning exacerbates the situation. [Owusu et al., 2021](#) argue that addressing these challenges will require a coordinated effort from governments, universities, and the private sector to invest in technology infrastructure and digital literacy training, ensuring that LMS platforms can be effectively integrated into the academic environment.

7.7. Variations in LMS Usage across Year Groups

LMS usage patterns vary significantly across different year groups in universities, influenced by factors such as digital literacy, academic workload, and familiarity with the technology. Research by [Owusu et al., 2021](#) found that second-year students are typically less engaged with LMS than their third- and fourth-year counterparts. This trend is attributed to second-year students' lower familiarity with the system, as they are often in the early stages of their academic journey. By contrast, third- and fourth-year students, who are more accustomed to using LMS platforms for accessing course materials, assignments, and communication with faculty, show higher engagement. The study suggests that year group-specific training and orientation sessions could improve LMS usage across all levels.

Digital literacy is a key determinant of LMS adoption and usage across year groups. [Alqahtani and Rajkhan \(2020\)](#) found that students with higher levels of digital literacy tend to use LMS more effectively, as they are better equipped to navigate the system and take advantage of its various tools. In contrast, students with lower digital literacy often struggle with basic LMS functions, leading to disengagement and underutilisation of the platform. Additionally, academic workload plays a significant role in determining how often students use LMS. For example, fourth-year students, who are typically engaged in more independent study, research, and project work, tend to use LMS more frequently than second-year students, who may be focused on attending lectures and completing coursework. This reflects the greater need for LMS as students progress through their academic journey.

Familiarity with LMS also contributes to variations in usage patterns across year groups. As students advance through their studies, they tend to rely more on LMS for both academic and administrative tasks. A study by [Owusu et al., 2021](#) found that fourth-year students not only use LMS for accessing lecture materials but also

for collaborative learning, submitting research projects, and participating in online discussions. This increased reliance on LMS in later years highlights the need for institutions to provide adequate support and training to lower-year students to ensure they develop the necessary skills to effectively use these platforms. By fostering familiarity and competence with LMS early in students' academic careers, universities can improve overall engagement and learning outcomes across all year groups.

7.8. Strategies for Enhancing LMS Effectiveness

To enhance LMS effectiveness in higher education, several strategies must be implemented, including digital literacy training, infrastructure improvements, and user support. One key strategy is providing comprehensive digital literacy training for both students and faculty. [Martin & Bolliger, 2020](#) emphasise that training programmes tailored to different user groups can significantly improve LMS adoption and usage. By ensuring that both faculty and students are proficient in using LMS tools, institutions can foster a more engaging and effective learning environment. Additionally, providing ongoing technical support can help address any issues that arise during LMS usage, thereby reducing frustration and promoting continued engagement.

Infrastructure development is another critical factor for enhancing LMS effectiveness. [Tarus et al., \(2020\)](#) argue that universities must invest in reliable internet access, sufficient bandwidth, and up-to-date hardware to support the use of LMS platforms. Without these essential resources, students may experience interruptions in their learning, which can negatively affect their academic performance. Furthermore, universities must address issues such as power outages, which are common in many regions of Africa, to ensure that students and faculty have consistent access to LMS resources. These infrastructural improvements are essential for maximising the impact of LMS on student learning.

Institutional policies also play a crucial role in supporting the long-term success of LMS implementation. [Tarus et al., \(2020\)](#) suggest that universities should develop clear policies outlining the goals and strategies for integrating LMS into their educational framework. This includes setting up institutional support structures, such as dedicated LMS support teams and training sessions, and establishing guidelines for faculty on how to use LMS effectively. By creating a supportive institutional framework, universities can ensure the sustainable use of LMS and help overcome the challenges associated with its implementation. These best practices can serve as a model for other institutions aiming to improve their LMS adoption and effectiveness.

8. Research Methodology

This study employed a cross-sectional survey design to evaluate the effectiveness of Learning Management Systems (LMS) on academic performance among students at the University of Cape Coast (UCC). A cross-sectional approach was cho-

sen as it allows for data collection at a single point in time, making it efficient for understanding patterns of LMS use across different year groups (Creswell & Creswell, 2018). The study used both quantitative and secondary data sources to comprehensively analyze the relationship between LMS effectiveness, usability, and academic performance.

9. Target Population and Sampling

9.1. Research Design

The study employed a cross-sectional survey research design to evaluate the effectiveness of the Learning Management System (LMS) in academic performance across different year groups at the University of Cape Coast (UCC). A quantitative approach was used to collect and analyze data from students regarding their LMS experience and academic performance. The study's design was structured to ensure comprehensive data collection, allowing for generalizable findings about LMS effectiveness in higher education.

9.2. Target Population

The study targeted undergraduate students at UCC, with an estimated total population of 21,000 students as shown in **Table 1**. The distribution of students across the second, third, and fourth years was as follows:

Table 1. Population of the study.

Year Group	Percentage of Total Population	Estimated Number of Students
Second Year	40%	8,400
Third Year	32%	6,720
Fourth Year	28%	5,880

9.3. Sample Size and Sampling

The study adopted a stratified sampling technique to ensure fair representation across all year groups as shown in **Table 2**. The sample size was determined based on the number of responses received through Google Forms and lecturer assistance, yielding a total of 14,481 responses. The responses were proportionally distributed across the three student categories as follows:

Table 2. Sample size.

Year Group	Percentage of Total Population	Sampled Responses
Second Year	40%	5,792
Third Year	32%	4,634
Fourth Year	28%	4,055
Total		14,481

The stratified sampling method ensured equitable representation of students from all levels. Google Forms were used as the primary tool for data collection, while lecturers facilitated participation by encouraging their students to complete the survey.

10. Research Instrument

For data on students' academic performance, official records from the Student Record Unit of the University were retrieved. To assess the perceived effectiveness of LMS, students rated their experience on a 1 to 10 scale, where: 1 = Very Poor, and 10 = Very Effective. A similar rating scale was used to assess LMS usability, ensuring that students could express their genuine experiences when using the system. This approach provided quantifiable insights into how well the LMS met student needs. To identify challenges in LMS usage, questionnaire items were adapted from previous studies, such as Sun et al. (2008) and Selim (2007), which explored LMS adoption barriers, user satisfaction, and technology acceptance factors in educational settings.

11. Data Collection Process

Students were contacted through institutional emails, social media platforms, and direct engagement by lecturers who encouraged participation. Google Forms were used to facilitate easy access to the survey, and responses were collected over a four-week period.

11.1. Data Analysis

Once the data was retrieved, it was pruned and captured into SPSS version 22, where exploratory data analysis (EDA) was performed to clean and validate the dataset. The refined dataset was then transferred to JAMOVI version 2.3.28 for statistical analysis. Different statistical techniques were used to analyze the research objectives:

a) One-Way ANOVA was applied to analyze the first two objectives, examining how LMS effectiveness and usability varied across the three-year groups.

b) Multinomial Logistic Regression was used to analyze the third objective, assessing how different factors influenced LMS effectiveness among students.

c) Bar Charts were utilized to visually represent findings for the fourth objective, highlighting the key challenges and opportunities in LMS usage.

11.2. Summary

The use of multiple analytical techniques strengthened the study's robustness by providing both inferential and descriptive insights. One-Way ANOVA allowed for comparison across multiple student groups, while multinomial logistic regression helped uncover patterns in LMS effectiveness predictors. The inclusion of bar charts enhanced result visualization, making findings more interpretable. This mixed analytical approach ensured that the study yielded comprehensive and reliable conclusions about LMS adoption and effectiveness at UCC.

11.3. Exploratory Data Analysis

The preliminary assessment of the dataset in **Table 3** provides valuable insights into the nature of the statistics, the meaning of the values, and their implications for further analysis. The dataset includes three key variables: Student Performance, LMS Effectiveness, and LMS Usability, with sample sizes (N) ranging from 14,411 to 14,470. The relatively small number of missing values (ranging from 323 to 382) suggests that the dataset is robust and suitable for analysis. The mean values for Student Performance (58.6), LMS Effectiveness (7.56), and LMS Usability (59.0) indicate central tendencies, while the standard deviations (16.8, 1.86, and 15.5, respectively) reflect the variability within the data. These statistics provide a foundation for understanding the distribution and characteristics of the variables.

The 95% confidence intervals (CI) for the mean values offer further insights into the precision of the estimates. For example, the CI for Student Performance (58.4 to 58.9) and LMS Usability (58.7 to 59.2) are relatively narrow, indicating that the sample means are reliable estimates of the population means. In contrast, the CI for LMS Effectiveness (7.53 to 7.60) is even narrower, suggesting high precision due to the smaller standard deviation (1.86). The median values (59.0, 8.00, and 61.0) align closely with the means, indicating that the data distributions are not heavily skewed. However, the skewness values (0.0502, -0.587 , and -0.204) reveal slight deviations from symmetry, with LMS Effectiveness showing a moderate negative skew. These findings suggest that while the data are generally well-distributed, further analysis should account for these skewness effects.

The minimum and maximum values highlight the range of the data. For instance, Student Performance ranges from 15.2 to 99.0, indicating a wide variability in academic outcomes. LMS Effectiveness ranges from 0.00 to 10.0, with a mean of 7.56, suggesting that most students perceive the LMS as effective, though there is room for improvement. LMS Usability ranges from 5.00 to 100, with a mean of 59.0, indicating moderate usability perceptions. The skewness and standard error of skewness values further confirm that the data are suitable for parametric analyses, though transformations may be needed for LMS Effectiveness due to its moderate skewness. Overall, these results provide a solid foundation for further statistical analyses, such as correlation, regression, and comparative studies, to explore the relationships and differences among the variables.

Table 3. Data exploration.

Statistics	Student Performance	LMS Effectiveness	LMS Usability
N	14411	14470	14430
Missing	382	323	363
Mean	58.6	7.56	59.0
Std. error mean	0.140	0.0155	0.129
95% CI mean lower bound	58.4	7.53	58.7

Continued

95% CI mean upper bound	58.9	7.60	59.2
Median	59.0	8.00	61.0
Standard deviation	16.8	1.86	15.5
Minimum	15.2	0.00	5.00
Maximum	99.0	10.0	100
Skewness	0.0502	-0.587	-0.204
Std. error skewness	0.0204	0.0204	0.0204

Note. The CI of the mean assumes sample means follow a t -distribution with $N - 1$ degrees of freedom

12. Results and Discussion

This section provides a thorough discussion of the results of the analysis of the research questions in relation to the literature.

12.1. Comparison of the Academic Performance of Second-, Third-, and Fourth-Year Students Using LMS for Academic Tasks

The one-way ANOVA (Welch's) results reveal significant differences in academic performance among second-, third-, and fourth-year students using LMS for academic tasks ($F = 9483, p < 0.001$). The group descriptives show that second-year students had the lowest mean performance (42.8, $SD = 7.08$), followed by third-year (63.6, $SD = 15.08$) and fourth-year students (69.4, $SD = 13.33$). The Tukey post-hoc test confirms that these differences are statistically significant ($p < 0.001$), with second-year students performing significantly worse than third- and fourth-year students. The homogeneity of variances test (Levene's) indicates unequal variances across groups ($F = 1026, p < 0.001$), justifying the use of Welch's ANOVA. These findings suggest that academic performance improves progressively across year groups, with fourth-year students achieving the highest scores.

The differences in academic performance can be attributed to several factors, including variations in LMS usage, digital literacy, and academic maturity. Second-year students may struggle with LMS adoption due to limited familiarity with the platform and lower digital literacy, which aligns with findings by [Owusu et al., 2021](#). In contrast, third- and fourth-year students, having used the LMS for a longer period, are likely more proficient and confident in navigating its features, leading to better academic outcomes. Additionally, senior students may have developed stronger self-regulation and time management skills, which are critical for effective LMS usage ([Al-Fraihat et al., 2020](#)). These factors collectively explain the progressive improvement in academic performance across year groups.

To better support the academic performance of different year groups, LMS functionality should be adjusted to address their unique needs. For second-year students, the LMS should include intuitive navigation, step-by-step tutorials, and

interactive support features to enhance usability and reduce the learning curve (Martin & Bolliger, 2020). For third- and fourth-year students, the LMS could incorporate advanced features like personalised learning paths, analytics-driven feedback, and collaborative tools to foster deeper engagement and critical thinking (Al-Marroof et al. (2021)). These adjustments align with the Technology Acceptance Model (TAM), which emphasises the importance of perceived ease of use and usefulness in driving LMS adoption and effectiveness (Davis, 1989).

The findings agree with previous studies that highlight the positive relationship between LMS usage and academic performance, particularly among senior students (Al-Fraihat et al., 2020; Owusu et al., 2021). However, they also reveal a significant performance gap between second-year students and their senior counterparts, which has not been extensively explored in earlier research. This gap underscores the need for targeted interventions to support early-stage LMS users, ensuring equitable access to its benefits. The implications of these findings are significant, as they provide empirical evidence for tailoring LMS strategies to meet the needs of different year groups, ultimately enhancing academic outcomes.

Also, the results directly address the first research objective by demonstrating significant differences in academic performance across second-, third-, and fourth-year students using LMS. The findings highlight the need for differentiated LMS support to address the unique challenges faced by each year group. For second-year students, interventions should focus on improving digital literacy and usability, while senior students may benefit from advanced features that promote engagement and critical thinking. These adjustments can bridge the performance gap and ensure that all students derive maximum benefit from the LMS. By addressing these issues, institutions can create a more inclusive and effective digital learning environment, ultimately enhancing academic performance across all year groups (Table 4).

Table 4. Comparison of academic performance across the years groups.

One-Way ANOVA (Welch's)					
Performance	F	df1	df2	<i>p</i>	
	9483	2	8547	< 0.001	
Group Descriptive					
Performance	Year Group	N	Mean	SD	SE
	Second Year	4797	42.8	7.08	0.102
	Third Year	4788	63.6	15.08	0.218
	Fourth Year	4826	69.4	13.33	0.192
Homogeneity of Variances Test (Levene's)					
Performance	F	df1	df2	<i>p</i>	
	1026	2	14408	<0 .001	
Games-Howell Post-Hoc Test-LMS_Effectiveness					

Continued

		Second Year	Third Year	Fourth Year	
Second Year	Mean difference	—	-20.8	-26.61	***
Third Year	Mean difference		—	-5.82	***
Fourth Year	Mean difference			—	

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

12.2. The Differences in LMS Effectiveness across Different Year Groups

The one-way ANOVA (Welch's) results in **Tabel 5** reveal significant differences in LMS effectiveness across second-, third-, and fourth-year students ($F = 529$, $p < 0.001$). The group descriptives indicate that second-year students perceived the LMS as most effective (Mean = 8.12, SD = 2.02), followed by third-year (Mean = 7.64, SD = 1.68) and fourth-year students (Mean = 6.93, SD = 1.67). The Games-Howell post-hoc test confirms that these differences are statistically significant ($p < 0.001$), with second-year students reporting significantly higher LMS effectiveness compared to third- and fourth-year students. The homogeneity of variances test (Levene's) indicates unequal variances across groups ($F = 106$, $p < 0.001$), justifying the use of Welch's ANOVA. These findings suggest that LMS effectiveness decreases progressively across year groups, with second-year students perceiving it as most effective.

The decline in perceived LMS effectiveness across year groups can be attributed to several factors. Second-year students, being newer to the LMS, may find its features more innovative and useful, aligning with the Technology Acceptance Model (TAM), which emphasises perceived usefulness and ease of use as key drivers of technology adoption (Davis, 1989). However, as students progress to third and fourth years, they may encounter limitations in the LMS like repetitive content, lack of advanced features, or insufficient alignment with higher-level academic tasks (Al-Fraihat et al., 2020). Additionally, senior students may have higher expectations for the LMS, leading to lower satisfaction when these expectations are not met (Martin & Bolliger, 2020). These factors collectively explain the observed decline in perceived LMS effectiveness.

To better support students across year groups, LMS functionality should be tailored to meet their evolving needs. For second-year students, the LMS should focus on user-friendly design, interactive tutorials, and foundational support to enhance engagement and satisfaction (Owusu et al., 2021). For third- and fourth-year students, the LMS could incorporate advanced features such as personalised learning analytics, collaborative tools, and integration with research resources to support higher-level academic tasks (Al-Marroof et al. (2021)). These adjustments align with Constructivist Learning Theory, which emphasises active, student-centred learning experiences (Jonassen, 1999). By addressing the unique needs of each year group, institutions can improve LMS effectiveness and satisfaction across all levels.

The findings agree with previous studies that highlight variations in LMS effectiveness across student groups, particularly in terms of perceived usefulness and satisfaction (Al-Fraihat et al., 2020; Owusu et al., 2021). However, they also reveal a progressive decline in LMS effectiveness, which has not been extensively explored in earlier research. This trend underscores the need for continuous evaluation and adaptation of LMS features to meet the evolving needs of students. The implications of these findings are significant, as they provide empirical evidence for tailoring LMS strategies to enhance effectiveness and satisfaction across different year groups.

The results directly address the second research objective by demonstrating significant differences in LMS effectiveness across second-, third-, and fourth-year students. The findings highlight the need for differentiated LMS support to address the unique challenges faced by each year group. For second-year students, interventions should focus on enhancing usability and engagement, while senior students may benefit from advanced features that support higher-level academic tasks. These adjustments can improve LMS effectiveness and satisfaction, ensuring that all students derive maximum benefit from the platform. By addressing these issues, institutions can create a more inclusive and effective digital learning environment, ultimately enhancing academic outcomes across all year groups.

Table 5. Differences in students perception of LMS_effectiveness across the year groups.

One-Way ANOVA (Welch's)					
LMS_Effectiveness	F	df1	df2	<i>p</i>	
	529	2	9580	< 0.001	
Group Descriptives					
	Year_Group	N	Mean	SD	SE
LMS_Effectiveness	Second Year	4824	8.12	2.02	0.029
	Third Year	4827	7.64	1.68	0.0241
	Fouth Year	4819	6.93	1.67	0.024
Homogeneity of Variances Test (Levene's)					
LMS_Effectiveness	F	df1	df2	<i>p</i>	
	106	2	14467	< 0.001	
Games-Howell Post-Hoc Test-LMS_Effectiveness					
		Second Year	Third Year	Fourth Year	
Second Year	Mean difference	—	0.483	1.194	
	<i>p</i> -value	—	<0 .001	< 0.001	
Third Year	Mean difference		—	0.711	
	<i>p</i> -value		—	<0 .001	
Fouth Year	Mean difference			—	
	<i>p</i> -value			—	

12.3. The Impact of Students' Perceptions of LMS Usability on Academic Performance at Various Stages of their Studies

The regression analysis in **Table 6** reveals significant relationships between students' perceptions of LMS usability and academic performance across different year groups. The overall model test indicates a good fit (Deviance = 29,032, AIC = 29,040, R^2 McF = 0.0843, $\chi^2 = 2674$, $p < 0.001$), suggesting that LMS usability is a meaningful predictor of academic performance. For third-year students compared to second-year students, the intercept (Estimate = 2.4906, $p < 0.004$) and usability index (Estimate = 0.451, $p < 0.002$) show a positive relationship, with an odds ratio of 12.068 (95% CI: 10.236 to 14.228). This indicates that third-year students who perceive the LMS as usable are significantly more likely to achieve higher academic performance. However, for fourth-year students compared to second-year students, the intercept (Estimate = 1.9154, $p < 0.004$) and usability index (Estimate = 0.0303, $p < 0.001$) show a weaker but still significant positive relationship, with an odds ratio of 1.031 (95% CI: 1.028 to 1.034). These findings suggest that LMS usability has a stronger impact on academic performance for third-year students than for fourth-year students.

The stronger impact of LMS usability on third-year students can be explained by the Technology Acceptance Model (TAM), which posits that perceived ease of use and usefulness are critical determinants of technology adoption and effectiveness (Davis, 1989). Third-year students, having gained some experience with the LMS, are likely to leverage its features more effectively, leading to improved academic outcomes. In contrast, fourth-year students may have higher expectations for the LMS, and its usability may no longer be a significant differentiator in their academic performance. This aligns with findings by Al-Fraihat et al., (2020), who noted that senior students often seek more advanced and tailored LMS features to support complex academic tasks. The weaker relationship for fourth-year students suggests that other factors, such as self-regulation and advanced academic skills, may play a more prominent role in their performance.

To better support students at various stages of their studies, LMS usability should be tailored to meet their evolving needs. For second- and third-year students, the LMS should focus on intuitive navigation, interactive tutorials, and foundational support to enhance engagement and satisfaction (Martin & Bolliger, 2020). For fourth-year students, the LMS could incorporate advanced features such as personalised learning analytics, research tools, and collaborative platforms to support higher-level academic tasks (Al-Marroof et al. (2021)). These adjustments align with Constructivist Learning Theory, which emphasises active, student-centred learning experiences (Jonassen, 1999). By addressing the unique needs of each year group, institutions can improve LMS usability and its impact on academic performance.

The findings agree with previous studies that highlight the positive relationship between LMS usability and academic performance, particularly among early- and mid-stage students (Al-Fraihat et al., 2020; Owusu et al., 2021). However, they

also reveal a weaker relationship for fourth-year students, which has not been extensively explored in earlier research. This trend underscores the need for continuous evaluation and adaptation of LMS features to meet the evolving needs of students. The implications of these findings are significant, as they provide empirical evidence for tailoring LMS strategies to enhance usability and academic outcomes across different year groups.

The results directly address the research objective by demonstrating the varying impact of LMS usability on academic performance across second-, third-, and fourth-year students. The findings highlight the need for differentiated LMS support to address the unique challenges faced by each year group. For second- and third-year students, interventions should focus on enhancing usability and engagement, while fourth-year students may benefit from advanced features that support higher-level academic tasks. These adjustments can improve LMS usability and its impact on academic performance, ensuring that all students derive maximum benefit from the platform. By addressing these issues, institutions can create a more inclusive and effective digital learning environment, ultimately enhancing academic outcomes across all year groups.

Table 6. Model fit measures.

Overall Model Test										
Model	Deviance	AIC	R ² _{McF}	χ^2	df	<i>p</i>				
1	29032	29040	0.0843	2674	2	<0.001				
Model Coefficients - Year_Group										
Year_Group	Predictor	Estimate	95% Confidence Interval		SE	Z	<i>p</i>	Odds ratio	95% Confidence Interval	
			Lower	Upper					Lower	Upper
Third Year - Second Year	Intercept	2.4906	2.3259	2.6552	0.084	29.7	<0.004	12.068	10.236	14.228
	Usability_Index	0.451	-0.484	0.422	0.00147	-30.8	<0.002	0.956	0.953	0.959
Fourth Year - Second Year	Intercept	1.9154	-2.107	1.723	0.09819	-19.5	<0.004	0.147	0.121	0.179
	Usability_Index	0.0303	0.0273	0.0332	0.00151	20	<0.001	1.031	1.028	1.034

12.4. The Challenges of Using LMS at Different Levels of Study (Second, Third, and Fourth Years)

The image in **Figure 1** provides a visual representation of the challenges faced by second-, third-, and fourth-year students in using the Learning Management System (LMS). The key challenges identified include low digital literacy, lack of training or orientation, high data costs, poor internet connectivity, and insufficient technical support. These challenges are prevalent across all year groups but may manifest differently depending on the students' level of study. For second-year students, the primary challenges are likely to be low digital literacy and lack of training or orientation. As newcomers to the LMS, these students may struggle with navigating the platform and utilising its features effectively. This aligns with

findings by [Owusu et al., 2021](#), who noted that early-stage students often require additional support to overcome initial barriers to LMS adoption. Providing comprehensive training and orientation programmes can help second-year students build the necessary skills and confidence to use the LMS effectively.

Third-year students may face challenges related to high data costs and poor internet connectivity. As they become more reliant on the LMS for academic tasks, these technical issues can hinder their ability to access resources and participate in online activities. This is consistent with research by [Rasheed et al., 2020](#), which highlighted the impact of infrastructure limitations on LMS usage in resource-constrained settings. Addressing these challenges may require institutional interventions, such as subsidising data costs and improving internet infrastructure. Fourth-year students are likely to encounter challenges related to insufficient technical support and integration into the LMS. As they engage in more complex academic tasks, the need for advanced features and reliable technical support becomes critical. This aligns with findings by [Al-Fraihat et al., \(2020\)](#), who emphasised the importance of tailored support to meet the evolving needs of senior students. Enhancing technical support and integrating advanced features into the LMS can help fourth-year students maximise its potential.

The analysis of the image directly addresses the research objective by identifying the key challenges faced by students at different levels of study in using the LMS. The findings highlight the need for targeted interventions to address these challenges, ensuring that all students can effectively utilise the LMS. For second-year students, interventions should focus on digital literacy and training. For third-year students, addressing technical issues such as data costs and internet connectivity is crucial. For fourth-year students, enhancing technical support and integrating advanced features can improve LMS usability. By addressing these challenges, institutions can create a more inclusive and effective digital learning environment, ultimately enhancing academic outcomes across all year groups.

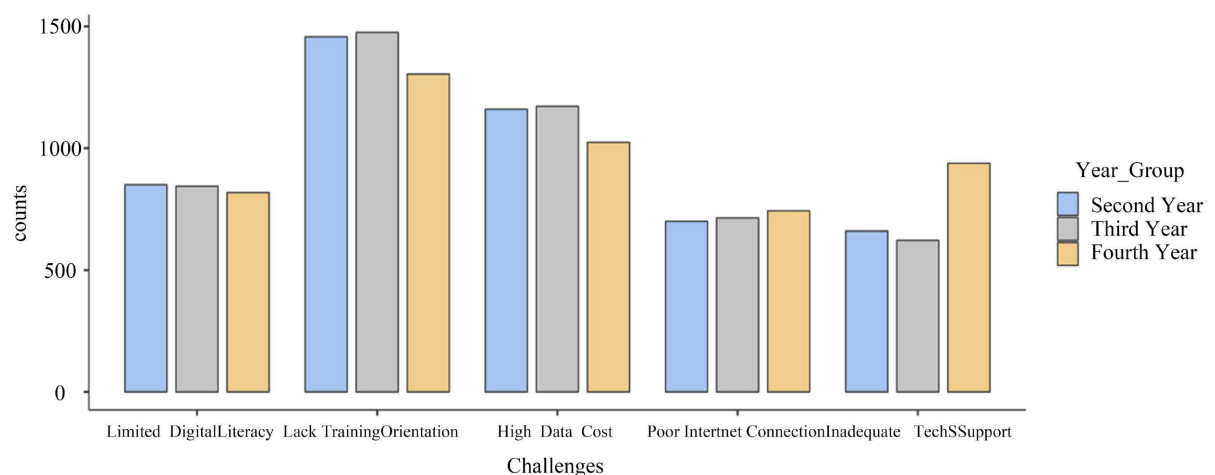


Figure 1. Comparative assessment of LMS challenges across year groups.

12.5. Enhancing LMS Functionality and Addressing Barriers to Support Academic Performance

Based on the outcome of the results of the four objectives, the following assessments were made:

Adjusting LMS Functionality to Support Academic Performance Directly: To better support academic performance, the LMS's functionality should be tailored to address the specific needs of students at different academic levels. For second-year students, the LMS could incorporate intuitive navigation, interactive tutorials, and foundational support features to enhance usability and reduce the learning curve (Martin & Bolliger, 2020). For third- and fourth-year students, advanced features such as personalised learning analytics, research tools, and collaborative platforms should be integrated to support higher-level academic tasks (Al-Marroof et al. 2021). These adjustments align with the Technology Acceptance Model (TAM), which emphasises the importance of perceived ease of use and usefulness in driving LMS adoption and effectiveness (Davis, 1989). By addressing the unique needs of each year group, institutions can improve LMS functionality and its direct impact on academic performance.

Weak Correlation Between LMS Engagement and Academic Performance: The weak correlation between LMS engagement and academic performance can be attributed to several factors. Firstly, external factors such as poor internet connectivity, high data costs, and limited access to devices can hinder effective LMS usage, particularly in resource-constrained settings (Rasheed et al., 2020). Secondly, variations in digital literacy and self-regulation skills among students may influence their ability to leverage LMS tools effectively (Al-Fraihat et al., 2020). Additionally, the LMS may not fully align with the academic tasks and expectations of senior students, leading to lower engagement and perceived usefulness (Owusu et al., 2021). These factors collectively contribute to the weak correlation, highlighting the need for targeted interventions to address both technical and human barriers.

Control Variables and Longitudinal Considerations: Control variables like age, gender, and faculty were not explicitly included in the analysis, which may limit the ability to isolate the effect of year-level progression on LMS engagement. Including these variables in future studies could provide a more nuanced understanding of the factors influencing LMS usage and academic performance. Additionally, conducting a longitudinal study to track changes in LMS engagement throughout students' academic careers would offer valuable insights into the dynamic nature of LMS usage. This approach could reveal patterns and trends in engagement, helping institutions design more effective and adaptive LMS strategies (Martin & Bolliger, 2020).

Generalizability of Findings to Other Ghanaian Universities: The findings of this study are context-specific to the University of Cape Coast (UCC) and may not be fully generalizable to other Ghanaian universities with different demographics and technological infrastructures. However, the identified challenges, such as poor in-

ternet connectivity, high data costs, and low digital literacy, are common across many African higher education institutions (Tarus et al., 2020). While the specific barriers and their impact may vary, the study's recommendations for tailored interventions and infrastructure improvements are broadly applicable. Future research should explore the unique contexts of other institutions to validate and extend these findings.

Impact of Barriers on Students at Different Academic Levels: The barriers to effective LMS use impact students differently depending on their academic level. Second-year students are primarily affected by low digital literacy and lack of training, which hinders their ability to navigate and utilise the LMS effectively (Owusu et al., 2021). Third-year students face challenges related to high data costs and poor internet connectivity, which limit their access to LMS resources and participation in online activities (Rasheed et al., 2020). Fourth-year students encounter issues with insufficient technical support and the lack of advanced features, which are critical for supporting complex academic tasks (Al-Fraihat et al., 2020). These differences highlight the need for targeted interventions to address the unique challenges faced by students at each academic level.

Notable Differences Between First-Year and Final-Year Students: First-year students are more likely to struggle with basic LMS navigation and digital literacy, requiring comprehensive training and orientation programmes to build their confidence and skills (Martin & Bolliger, 2020). In contrast, final-year students are more concerned with the lack of advanced features and technical support, which are essential for their higher-level academic tasks (Al-Marroof et al. 2021). These differences underscore the importance of designing LMS strategies that evolve with students' academic progression, ensuring that the platform remains relevant and supportive throughout their studies

13. Conclusion

This study has successfully achieved its objectives by examining the effectiveness of the Learning Management System (LMS) in enhancing academic performance across second-, third-, and fourth-year students at the University of Cape Coast (UCC). The findings reveal significant variations in LMS adoption, usage, and effectiveness across different year groups, highlighting the unique challenges and opportunities faced by students at each academic level. The study has provided empirical evidence on the impact of LMS usability and engagement on academic performance, offering valuable insights into the factors that influence these outcomes. By identifying key barriers such as low digital literacy, poor internet connectivity, and insufficient technical support, the study has underscored the need for targeted interventions to address these issues.

The implications of this study are far-reaching for academia, literature, policy, and the advancement of technology integration in higher education systems. For academia, the findings contribute to the growing body of knowledge on LMS effectiveness, particularly in resource-constrained settings. The study enriches the

literature by providing context-specific insights into the challenges and opportunities associated with LMS implementation, filling a critical gap in existing research. For policymakers, the findings highlight the need for strategic investments in digital infrastructure, training programmes, and user support to enhance LMS adoption and effectiveness. The study also underscores the importance of aligning LMS functionality with the evolving needs of students, ensuring that the platform remains relevant and supportive throughout their academic journey.

14. Recommendations for Management and Stakeholders

Enhance Digital Literacy and Training Programmes: Management should prioritise comprehensive training and orientation programmes to improve digital literacy among students, particularly second-year students. These programmes should focus on basic LMS navigation, effective use of features, and best practices for online learning.

Invest in Digital Infrastructure: Stakeholders should invest in improving internet connectivity and reducing data costs to address the technical barriers faced by students. This could include partnerships with internet service providers and the establishment of campus-wide Wi-Fi networks.

Provide Advanced LMS Features and Technical Support: For third- and fourth-year students, the LMS should be enhanced with advanced features such as personalised learning analytics, research tools, and collaborative platforms. Additionally, robust technical support should be made available to assist students with complex academic tasks.

Conduct Regular Evaluations and Adaptations: Management should implement a system for regular evaluation and adaptation of the LMS to ensure it meets the evolving needs of students. This could involve periodic surveys, focus group discussions, and feedback mechanisms to gather insights from users.

Promote Inclusive and Equitable Access: Policies should be developed to promote inclusive and equitable access to LMS resources for all students, regardless of their academic level or background. This could include providing subsidised devices and data packages for students from disadvantaged backgrounds.

Foster a Culture of Innovation and Continuous Improvement: Stakeholders should foster a culture of innovation and continuous improvement by encouraging the adoption of new technologies and best practices in digital learning. This could involve collaborations with industry experts, academic institutions, and technology providers to stay abreast of the latest developments in LMS technology.

By implementing these recommendations, management and stakeholders can enhance the effectiveness of the LMS, improve academic outcomes, and create a more inclusive and supportive digital learning environment for all students.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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