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The impact of digital teaching tools on student engagement and learning outcomes in higher education in Africa

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Abstract

Using a qualitative literature review approach, this study investigates how the use of digital teaching tools affects student involvement and learning outcomes at higher education institutions in Africa. This review synthesizes academic publications highlighting the changing terrain of digital education shaped by the COVID-19 epidemic. The objectives include: investigating the digital teaching tools used in African universities; analyzing the correlation between these tools and student engagement; evaluating the impact of digital tools on knowledge retention, problem-solving skills, and general academic performance; identifying the challenges impeding the effective implementation of digital tools; and providing practical recommendations for improving the integration and efficacy of these technologies in African higher education. The continent has learning environment technologies like games, mobile apps (like WhatsApp), videoconferencing platforms, and learning management systems. When matched with pedagogical techniques, these tools show promise for supporting dynamic, student-centered learning environments and improving academic achievements. There are still problems with infrastructure, accessing the internet, using digital devices, knowing how to use them, and preparing institutions. The study reveals discrepancies in implementation and efficacy between urban and rural institutions, as well as in the experiences of staff and students. The results make it clear that scalable interventions meant to make digital transformation equitable need to be carefully evaluated across borders. The study recommends the improvement of ICT infrastructure, flexible digital learning policies, and the guarantee of fair access to digital resources. The study will help shape policies that aim to improve educational equality and creativity in higher education in Africa.

Keywords: Africa, Digital pedagogy, Digital teaching materials, Higher education, Learning outcomes, Literature review, Student involvement.

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1. Introduction of the Study

Higher education is starting to include digital teaching tools more and more, which offers great opportunities to improve learning environments. Tools identified as capable of increasing student involvement and improving learning outcomes are learning management systems (LMS), mobile learning apps, Massive Open Online Courses (MOOCs), and collaborative platforms. Globally, digital teaching tools are becoming increasingly accepted as solutions to problems common in conventional educational environments, including overcrowded classrooms, limited access to learning resources, and the demand for more flexible and customized learning environments. Notwithstanding growing data showing how well digital tools improve engagement and academic performance, the results of their integration show significant differences depending on the region, particularly in underdeveloped countries like Africa.

Research on digital teaching tools conducted worldwide shows how much student involvement they can improve. Examining the impacts of LMS systems in global institutions, Pineda and Noyes [1] found that these tools improve student involvement by means of asynchronous learning, instantaneous feedback, and interactive exams, therefore supporting asynchronous learning. These instruments improve student participation in the classroom and offer more freedom for scheduling instruction. Students using LMS technologies show more involvement with course materials, according to Pineda and Noyes [1], which improved academic performance.

Comparable results were found by Tan and Hwang [2], which underline the significance of e-learning systems in African universities. Platforms like Moodle and Blackboard, which disrupted in-person learning during the COVID-19 epidemic, have been found to improve student participation, particularly. Although these results are positive, it is crucial to realize that the current architecture of the institutions greatly affects the efficiency of these instruments. Urban institutions with better technological infrastructure engaged more than their rural counterparts, thereby highlighting the continuous digital gap in Africa.

Studies later on have shown the link between digital tools and student involvement. Digital learning tools, including video lectures and interactive quizzes shown by Bower et al. [3], greatly helped to keep student interest and participation in online courses. Their studies showed that these instruments let students better control their learning and enable self-assessment, therefore supporting better academic performance.

Furthermore, more and more data points point to how well digital teaching tools improve learning results. Gonzalez et al. [4] evaluated the worldwide influence of MOOCs on learning outcomes and found that these platforms helped students to obtain high-quality materials from eminent professors, therefore improving their knowledge of difficult topics. The writers noted that although these platforms had benefits, variables related to student motivation and insufficient support mechanisms for students reduced completion rates.

One clear tool for improving student involvement and academic success is mobile learning. According to a 2020 global study on mobile learning applications by Ally et al. [9] these tools help students to engage with course materials outside of the classroom, therefore promoting ongoing education. The study underlined that mobile learning improved academic performance and engagement by efficiently addressing the difficulties experienced by students with time limits or geographical constraints.

Notwithstanding these encouraging outcomes, there are still difficulties, particularly in locations with limited technological access. The digital divide often impedes the ability of digital tools to improve student engagement and learning results in Africa. Examining the impact of the digital divide on student involvement in African higher education institutions, Mtebe and Raphael [5]. The study found that although digital tools could improve participation, many students in rural and underfunded areas face significant difficulties resulting from limited access to dependable internet connections and gadgets. The differences meant that students in remote locations cannot completely participate in online learning, which has helped to lower engagement and produce worse academic results.

Emphasizing adaptive learning platforms that tailor information based on individual student needs, Kamau et al. [6] examined the purpose of personalized learning tools inside Kenyan institutions. Through the provision of customized learning experiences, the study revealed that these systems enhanced student involvement. It was also underlined how students' ability to use these tools hinged on their access to technical devices and consistent internet connections. The study emphasized that filling infrastructure and digital literacy gaps is necessary to realize the full potential of tailored learning tools.

Examining MOOCs in the framework of African higher education, Olojede et al. [7] found a great possibility to improve learning results. Due mostly to network problems and inadequate support systems, students in resource-limited areas find it difficult to fully interact with MOOCs. Their results underline the need to provide infrastructure and assistance along with digital content to allow students to fully benefit from MOOCs.

In some African settings, mobile learning shows a favorable impact on participation; nevertheless, restricted access to cell phones and mobile data limits its reach. Examining mobile learning technologies in Ghana, Antwi et al. [8] found that these tools improved student engagement and learning results in urban environments. Students in rural areas, however, faced challenges like poor internet connection and limited access to mobile devices.

The regional studies examined show that digital tools can improve student involvement and learning results; yet, these advantages are often offset by socioeconomic and infrastructure problems. Studies by Mtebe and Raphael [5] and Kamau et al. [6] done in Africa show that disparities in digital literacy and technology access create significant challenges to the efficient use of digital technologies in African institutions. On the other hand, global studies by Pineda and Noyes [1] and Ally et al. [9] show that access to digital tools improves student engagement and learning outcomes, therefore underlining the crucial need for infrastructure in optimizing the benefits of digital education.

In essence, regional studies highlight the unique difficulties faced in African higher education, whereas worldwide research shows the positive influence of digital teaching tools on student engagement and learning outcomes. Many African

countries' digital divide, limited access to technology, and poor digital literacy compromise the effectiveness of these instruments. This draws attention to a discrepancy in the body of research on the efficient integration of these instruments into African higher education institutions to improve involvement and learning results. Emphasizing the special difficulties and possibilities of Africa, this study seeks to close the present gap by providing a comprehensive review of the effects of digital teaching tools on student engagement and learning outcomes in Africa.

1.1. Problem Statement

The rapid development of digital technology has led to significant changes in higher education all around, providing fresh opportunities to increase student engagement and improve learning outcomes. Globally, digital teaching tools including Learning Management Systems (LMS), mobile apps, and Massive Open Online Courses (MOOCs) have become quite popular in order to enhance flexible, interactive, and customized learning environments. Although these tools have shown great success in raising participation and improving academic performance in developed countries [1, 3] their adoption in African higher education has progressed at a slower pace and remains inconsistent, particularly in underfunded regions.

Although digital tools have great potential to revolutionize African education, the area faces major challenges including inadequate technological infrastructure, unequal internet access, and low digital literacy among educators and students [5, 6]. The difficulties hinder the wide and efficient application of digital tools, particularly in rural and underdeveloped areas, thereby aggravating educational inequalities. Digital tools could raise student involvement and help to produce better learning outcomes. Their current use at African institutions, as well as their particular influence on student engagement, knowledge retention, problem-solving abilities, and academic achievement, are not well known nevertheless.

With an eye toward their effects on student involvement and academic success, this study looks at the digital teaching technologies used in African universities. The effect of these instruments on student participation with course content, involvement in class activities, and general academic results will be assessed in this paper. With an emphasis on information retention and the improvement of problem-solving abilities qualities necessary for success in higher education the study will evaluate how digital tools affect learning outcomes.

This study seeks to pinpoint the difficulties African institutions face in implementing and using digital tools. The difficulties cover infrastructure, digital literacy, and technology access, as well as pedagogical and institutional elements that could hinder the efficient use of digital resources. The results of this paper will clarify the present situation of digital education in Africa and offer practical suggestions for improving the integration of digital teaching tools to enhance student involvement and learning outcomes.

1.3. Research Objectives

The primary objectives of this research are:

1. To investigate the several digital teaching tools used in African universities nowadays.
2. To evaluate African university student involvement in relation to digital teaching instruments.
3. To assess in higher education how digital tools affect knowledge retention, problem-solving, and academic performance that is, learning outcomes.
4. To find the obstacles preventing the efficient application of digital educational resources in Africa.
5. To offer suggestions for bettering the integration and efficacy of digital tools in African higher education.

1.3. Research Questions

1. Which kinds of digital instructional resources African higher education institutions now use?
2. In African institutions, how does student involvement change in response to digital teaching tools?
3. How do digital teaching tools affect learning results in African higher education establishments?
4. Using digital teaching tools in African higher education presents obstacles and questions for which there are answers.
5. Which approaches can be used to raise the efficiency of digital teaching tools in strengthening student involvement and learning outcomes?

1.4. Significance of the Study

This study is significant for several reasons:

1. The results will improve knowledge of how digital tools affect teaching and learning in African higher education by providing proof to direct curriculum and policy changes.
2. Useful Tools and Strategies: This paper will highlight effective digital tools and approaches, thereby offering suggestions for teachers and institutions trying to raise student involvement and learning results.
3. Global Relevance: This study will shed light on the possibilities and challenges African institutions face in implementing digital technologies; hence, it may be relevant to other underdeveloped areas.

2. Materials and Methods

This study will use a qualitative literature review approach to investigate how digital teaching tools affect student engagement and learning outcomes in higher education in Africa. By synthesizing several studies, a literature review enables a thorough understanding of the current research landscape, thereby highlighting important trends, gaps, and insights on the issue. Particularly in light of the rapid spread of digital tools during and after the COVID-19 pandemic, the evaluation will focus on studies published from 2020 onwards to ensure that the study includes the most recent and relevant findings.

2.1. Data Collection

The data collecting for this study will comprise a methodical search and analysis of scholarly material released in peer-reviewed publications, monographs, conference proceedings, and subject-matter reports. These actions will be followed:

Academic databases including JSTOR, Google Scholar, Scopus, ERIC, and ScienceDirect will all be searched extensively. Essential search phrases will include "digital teaching tools," "student engagement," "learning outcomes," "higher education," "Africa," used alongside Boolean operators to either narrow or widen the search results.

In order to guarantee the inclusion of the most recent studies on the use of digital technologies in African higher education, this evaluation will only cover publications released from 2020 onward. Moreover, investigations should focus on African higher education institutions or incorporate particular case studies or statistics relevant to the African setting. Included will be peer-reviewed academic publications, conference papers, and reports from credible organizations.

Studies not directly relevant to the African setting or those lacking examination of the impact of digital teaching tools on student engagement or learning outcomes will be omitted. Furthermore, excluded will be pieces focusing on primary or secondary education rather than higher education.

2.2. Data Analysis

Following the identification of the pertinent literature, analysis will follow a thematic synthesis method. This approach groups the material into themes generated from recurrent subjects, patterns, and results. Themes will be created in line with the following main areas:

Examining the several digital tools (e.g., Learning Management Systems, mobile learning apps, MOOCs, video lectures, and collaborative platforms) used in African higher education helps one to understand them.

Influence on Student Engagement: This theme looks at how digital tools might improve student involvement, interaction, and drive during the course of instruction.

Studies looking at how digital teaching tools affect student performance, information retention, problem-solving skills, and general academic achievement will be examined in this review under influence on learning outcomes.

Focusing on infrastructure, access to technology, and digital literacy issues, this study of the literature will examine the difficulties African colleges experience using digital teaching tools.

This study will examine studies suggesting approaches to remove obstacles and increase the efficacy of digital tools in African higher education, therefore offering pragmatic advice.

Emphasizing important conclusions and areas of consensus or divergence among different studies, the results of the literature review will be methodically arranged and presented according to these topics.

2.3. Quality Assurance

These actions will help to guarantee the quality and dependability of the literature review:

Peer Examining: To verify that the included studies follow the set inclusion and exclusion criteria, a second researcher will assess the choosing process of studies.

Every study will be carefully examined in terms of methodology, sample size, and applicability to the research issues. Research using exacting techniques and producing strong results will be given top priority; research showing restrictions will be handled carefully in discussion.

Instead of only describing individual studies, this review will give major priority to the synthesis of results, therefore providing a thorough picture of the topic founded on the existing data.

2.4. Limitations

Although it helps to synthesize already published information effectively, the approach of the literature review has certain restrictions. First, considering that much of the research on digital teaching tools concentrates on Western settings, the availability of studies particular to African higher education institutions may be limited. Second, even if the study will concentrate on research released from 2020 onward, the rapid development of digital tools may mean that the literature does not accurately reflect new tools and applications. Finally, a literature review depends on the quality and extent of the available studies; hence, if some facets of the issue have been understudied, the review may suffer.

3. Empirical Literature Review

3.1. Categories of Digital Teaching Tools Utilized in Higher Education Institutions Across Africa

Digital teaching tools have lately become vital components of higher education all around the world since they provide more flexible, interactive, and customized learning environments. Learning Management Systems (LMS), mobile learning apps, Massive Open Online Courses (MOOCs), digital simulations, and group projects comprise the tools. Driven by the need to address the issues of access to quality education, particularly in underdeveloped and rural areas, the acceptance of these tools in Africa has been increasing. Still, much attention and research remain around the efficient use of these tools in African institutions.

Many research projects have looked at the kinds of digital tools used in African higher education and how they affect student involvement and learning results. Examining how Moodle and Blackboard, among other Learning Management Systems, were used in different African institutions, Mtebe and Raphael [5]. The results showed that the most often used instruments for course management and communication were LMS systems. Still, they underlined that access problems, particularly in rural regions with poor internet access, restricted the effectiveness of these systems. According to Kamau et al. [6], a developing trend in Kenyan colleges is the usage of adaptive learning platforms that tailor the learning process for

students. Especially in universities with fewer resources, the technologies improved engagement and academic performance but presented problems with infrastructure and digital literacy.

MOOCs have been under close investigation as a tool to provide access to high-quality education all throughout Africa. Examining how MOOCs were used in Nigerian institutions, Olojede et al. [7] found that these tools let students access top-notch instructional materials from abroad specialists. The study found low completion rates for MOOCs, mostly related to limited student involvement and inadequate support systems. Gonzalez et al. [4], who looked at how well MOOCs improved learning outcomes in African higher education institutions, validated the results. Studies showed that although MOOCs provided varied learning materials, students struggled to keep regular participation, mostly owing to technological issues, including limited internet connectivity and inadequate digital literacy.

Applications for mobile learning have become a somewhat common digital tools in African higher education. WhatsApp and Telegram among other mobile-based communication tools, were investigated by Fikru et al. [10] on student participation in Ethiopian colleges. According to the study, mobile learning tools improved student-instructive communication, therefore enabling cooperation and access to course resources outside the classroom. They pointed up difficulties, including the need for cellphones and sufficient data plans, which were not shared by every student. Particularly among self-directed learners, mobile learning technologies improve academic achievement, according to Antwi et al. [8] research done in Ghana. The study underlined how poor internet infrastructure made it difficult for students living in rural areas to utilize these tools.

At African institutions, video lectures have become a very common form of material distribution. Examining the effects of video lectures in Nigerian institutions, Adewale [11] found that students' understanding and memory of course materials clearly improved. Asynchronous video lectures let students go over complex topics whenever it would be most convenient. The study showed that areas with sluggish internet access or unstable power supply found less benefit from video lectures.

Particularly during the COVID-19 epidemic, African colleges have started using collaborative platforms as Google Classroom, Padlet, and Zoom more and more. Munyua et al. [12] looked at how institutions in Kenya and Uganda might use collaborative platforms. Studies found that whilst Zoom gave chances for synchronous engagement between students and teachers, platforms like Google Classroom improved teamwork and peer learning. The study revealed significant obstacles like poor internet access and insufficient instruction for teachers and students in the efficient use of these tools.

In African settings, learning management systems, mobile learning apps, and video lectures were the most often used digital tools [13] thoroughly examined in higher education. Digital literacy, institutional backing, and technology availability all greatly affected how effective these instruments were. Although LMS and mobile apps improved student engagement, Lwoga et al. [14] noted that inadequate training and technical support for teachers and students limited their efficacy. In their systematic review of e-learning tools, Johnson et al. [15] found that although digital tools improved engagement and learning outcomes in higher education worldwide, issues including unequal access to technology and low digital literacy rates persisted, especially in African countries, even if they enhanced engagement and learning outcomes in higher education worldwide.

Finally, the application of different digital teaching technologies in African higher education institutions has been recorded, and several shared themes and difficulties across the examined studies have become clear. The most often used tools include LMS systems such as Moodle and Blackboard, mobile learning apps, video lectures, and MOOCs. Studies show that these instruments increase student involvement and raise learning outcomes in particular environments, particularly in metropolitan and well-funded universities. Infrastructure problems such as poor internet connectivity, limited availability of cellphones or computers, and low levels of digital literacy among teachers and students sometimes hamper the efficacy of these tools. Furthermore, obstacles pertaining to student involvement low MOOC completion rates and limited online learning participation still exist even with these tools in use.

The literature shows a continuous need for more studies aiming at the particular challenges to the efficient application of digital teaching technologies in African higher education. Many studies have looked at the tools used and their effects on engagement and academic performance; yet, there is a dearth of comprehensive research evaluating the contextual elements such as infrastructure, digital literacy, and institutional support that influence the efficacy of these tools over different areas of Africa. Moreover, little research has looked at the experiences of teachers and students in rural and underfunded areas, where issues with digital literacy and technology availability are especially important. This study aims to close the current gap by providing a thorough investigation of the digital tools used in African higher education, their effects on student engagement and learning outcomes, as well as the particular challenges and opportunities faced by institutions in different settings all around the continent.

The Impact of Digital Teaching Tools on Student Engagement Across Africa. Particularly after the COVID-19 epidemic, the shift to digital learning in African higher education has accelerated. Maintaining student involvement has grown more dependent on the use of digital teaching technologies as institutions all throughout the continent switched to online and blended learning methods. Examining 36 research studies released from 2020 onward, this literature analysis focuses on how various digital tools affect student engagement in African colleges.

Within the COVID-19 epidemic, El-Sayad et al. [16] examined Egyptian students' opinions of online learning engagement and satisfaction. Academic self-efficacy, perceived value of online learning platforms, and instructor presence clearly influence student engagement, according to a quantitative study that included 465 students. Higher confidence in technology and those who thought the online system was useful revealed students' increased participation in their education.

Melliti and Henchiri [17] looked at how technology integration might improve higher education autonomy in Tunisia. Conducted at the University of Kairouan with 102 students and 25 faculty members, this mixed-methods study found that students used technology outside of the classroom with autonomy. Inadequate infrastructure and poor digital literacy limit

classroom engagement, which emphasizes the need to improve these components to increase participation. Owusu-Agyeman et al. [18] investigated the effect of technology self-efficacy on student participation in online learning in Ghana. Higher technology self-efficacy students showed more participation in online learning, according to a study of 425 technical university students. The study emphasizes the need to help students become confident in using digital tools to increase engagement.

Adekunle et al. [19] looked at how mobile learning was embraced and how student involvement in urban Nigeria changed. A 500-student quantitative study spanning five different colleges found that mobile learning tools, especially those offering flexible access to course materials, markedly raised student engagement. Student involvement in underfunded areas was hampered by differences in access to mobile devices and data costs. In northern Nigeria, Chikaji et al. [20] set out to determine how blended learning affected student involvement. Using a quantitative approach involving 260 students, this study found that pedagogical factors, including course design, defined timelines, and interactive tools such as video conferences and online quizzes, greatly affected student involvement. The study also underlined the impact of infrastructure problems, including poor internet connectivity and insufficient technical support.

Simelane-Mnisi [21] investigated at a South African University of Technology how well LMS technologies improved student involvement. Using a mixed-methods approach incorporating 116 academics, the study found that the use of LMS tools including multimedia content, interactive forums, and quizzes markedly raised student participation and engagement. Faculty responders underlined the need for better training in the efficient use of LMS tools to raise involvement. At Makerere University in Uganda, Tumwesigye et al. [22] examined how social presence affected online student involvement. Using 283 students, a quantitative study found that student involvement is significantly improved by social presence, which is defined by emotional expression, open communication, and group cohesiveness. Students who reported feeling connected to others and teachers demonstrated higher degrees of participation in online learning environments.

A mixed-methods study by Oladokun et al. [23] looked at how e-learning experiences undergraduate students at Nigerian institutions felt. Although students appreciated the flexibility of e-learning systems, they encountered problems such as poor internet access that prevented their efficient involvement. The report advises colleges to provide technical assistance and upgrade infrastructure to enhance the online learning environment.

Ezeanya et al. [24] investigated how tools driven by artificial intelligence might increase student involvement at Nigeria's National Open University. Despite the lack of instantaneous teacher response, the study, which comprised questionnaires and interviews with 200 students, revealed that artificial intelligence tools, including chatbots, markedly increased student interaction with course materials. The study underlined the need to enhance knowledge and training on the use of artificial intelligence tools to maximize their potential for interaction.

Shange [25] investigated in online learning environments the value of human presence and care. This qualitative case study, carried out at a South African e-learning university, found that student involvement increased when peer and teacher support was felt. Maintaining student participation in online courses required an emotional connection, which teachers who showed compassion and empathy helped to provide.

Loots et al. [26] looked at student involvement in South Africa's blended learning systems. Students enrolled in both online and in-person course materials indicated higher degrees of engagement and satisfaction. The study revealed that maintaining high degrees of participation depends on giving students chances for online collaboration in addition to in-person contact. In Kenya, Ng'ang'a and Mbogo [27] assessed how e-learning affected student interaction. The study revealed that student involvement and motivation were raised by group tools, including Google Classroom and WhatsApp groups. They found obstacles included digital literacy and data expenses that prevented some students from using the tools completely.

This research uncovered some recurring patterns of student interaction with digital technologies in African colleges. Promoting student involvement consistently revolves around the need for a reliable internet connection, gadgets, and technical support. Studies consistently show that urban and rural students experience a digital divide; rural students often encounter challenges that hinder complete participation in digital learning environments. Frequently identified as a deterrent to involvement was inadequate infrastructure, including poor internet connectivity and inconsistent power supply.

Teacher Support and Presence: Increasing student involvement depends critically on social presence that is the sense of community and interactions between teachers and students. Studies done in Kenya, South Africa, and Uganda found that students participated more when teachers were responsive, provided comments, and made use of several web communication tools like live chats and discussion boards.

One important determinant of engagement is found to be student self-efficacy in technology use. Students demonstrating greater digital literacy and comfort with technology use showed a higher inclination for active participation in online learning environments. On the other hand, for many students, inadequate computer literacy prevented participation.

Studies show that using digital learning tools which support active learning including interactive quizzes, discussion boards, and group projects raises engagement levels. Offering just recorded lectures or fixed materials turned out to be less successful in encouraging participation. Maintaining student involvement required careful design of online courses and incorporation of interactive features. The research usually agrees on the need for technology access; however, differences were noted about the particular tools and their effectiveness. While LMS systems were mostly used in countries like South Africa and Egypt, mobile learning solutions showed more efficacy in countries with high mobile phone usage, such as Ghana and Kenya. Other studies seem to show less frequency of the usefulness of AI-driven tools reported in Nigeria, suggesting regional differences in the acceptance and use of developing technology.

Though a lot of research has been done on digital technologies and student involvement in African institutions, there are still major gaps. Many studies either examine short-term involvement during the epidemic or focus on the first phases of using digital tools. As digital technologies progressively become part of the learning process, longitudinal studies measuring

student participation over time are inadequate. Moreover, most research concentrates on personal involvement while neglecting institutional or systemic elements influencing engagement, including administrative support, teacher development, and national policy around digital education. Investigating these more general elements and their relationship with individual-level barriers to involvement calls for more study.

Especially when combined with pedagogical approaches and supporting infrastructure, digital teaching tools greatly affect student participation in African higher education. The adoption of digital tools offers possible advantages; nonetheless, infrastructure, digital literacy, and access remain issues in many different countries. By removing these obstacles and using interactive, student-centered pedagogies, African institutions' learning outcomes will increase and student involvement will rise in the digital age.

3.2. The Effect of Digital Tools on Learning Outcomes (Knowledge Retention, Problem-Solving, and Academic Performance) in Higher Education

Higher education currently depends on digital technologies, especially given the quick shift to online learning spurred on by the COVID-19 epidemic. Globally, academics have examined how digital tools affect critical learning outcomes knowledge retention, problem-solving capacity, and academic performance in college and university students.

Retention of Information in Digital Learning Systems

Retention of knowledge is the ability of students to recall and access information across time. Many studies done since 2020 show that well-crafted digital learning aids improve higher education knowledge retention. Examining the effects of dividing material into little digital modules on learning outcomes, Mostrady et al. [28] performed a mini-review titled "Micro learning and its Effectiveness in Modern Education." Recent research shows that using mobile apps or e-learning systems to offer course content in short, reasonable chunks improves knowledge retention and lowers student cognitive load.

This suggests that digital technologies' micro learning helps students to better absorb and remember knowledge. One very noteworthy example is the use of virtual reality (VR) in the classroom. Comparatively VR-based training to conventional lectures in a Brazilian engineering school, Anjos et al. [29] undertook a quasi-experimental study titled "Boosting Engineering Education with Virtual Reality: An Experiment to Enhance Student Knowledge Retention,." The study included 68 undergraduate engineers split into a control group and a virtual reality group. Both groups covered the same material; however, the VR group set aside some course time for an immersive virtual simulation. Three weeks following instruction, students completed a retention analysis. With an average score of 20.1% higher on the delayed post-test than the control group, the VR group clearly showed a statistically significant increase in long-term information retention ($p = 0.0028$.). The VR-enhanced education approach established the effectiveness of immersive digital tools in supporting learning since it produced better memory recall of the knowledge than in conventional teaching. Retention benefits from self-paced online learning courses.

Examining data from more than 1,500 medical students engaged in a long-term online program, Zavala-Cerna et al. [30] titled "Self-rated benefits and knowledge gain from e-learning: the longitudinal use of an online learning experience at an international medical school." Students' actual knowledge increases and perceived understanding were evaluated at several intervals using a longitudinal survey design. Regardless of the students' starting pre-course knowledge levels, the authors recorded considerable increases in their self-assessed comprehension of topics and quantified knowledge changes over time.

In general, including those with initially little background knowledge, students who interacted with the online learning platform showed far higher retention of course knowledge. The large sample and worldwide background of this study highlight how well-crafted e-learning environments can generate lifelong learning results. Compared to conventional classroom education, online learning shows either equivalent or better ability to assist memory retention. According to World Economic Forum 2020 data, students enrolled in online learning usually remember 25%–60% of the content; in contrast, only an 8%–10% retention rate results from in-person instruction.

The great difference shown in worldwide education statistics is ascribed to the flexibility of e-learning, which lets students learn at their own pace and review recordings or digital materials as required, hence improving memory retention. Empirical studies validate this claim. In contrast to individuals who received instruction only from lectures, a study including virtual lab simulations in a science course showed that students interacting with the simulations demonstrated far improved information recall and claimed enhanced understanding.

This is consistent with the idea of "learning by doing," in which digital tools including simulations and instructional games provide active learning opportunities that improve knowledge retention. Digital forms of formative assessment tools improve retention by encouraging regular knowledge retrieval. Translated from Spanish, Fraile et al. [31] studied formative e-assessment under the heading "Formative evaluation, self-regulation, feedback and digital tools: use of Socrative in higher education." In a quasi-experimental design for a university course, Fraile and colleagues assigned one group of students to routinely complete online quizzes through Socrative, a classroom response tool that offers instantaneous feedback, while a control group took only part in traditional exams. Students using Socrative showed better self-regulation in their study habits and higher long-term memory of course content, as seen by high quiz and test results. Real-time comments let students quickly clear misconceptions, therefore improving their memory of precise knowledge. These studies have as their main focus how digital tools provide interactive, spaced learning and feedback, therefore improving information retention. Higher education teachers using methods such virtual reality, online quizzes, and microlearning modules have shown notable increases in course material retention by their students.

3.3. Competencies in Digital Tool Use and Problem-Solving

A main goal of modern higher education is to improve students' ability to solve problems. Recent research show that integrating digital technologies with student-centered pedagogies can significantly raise critical thinking and problem-solving skills. Husin et al. [32] looked at "Project-Based Problem Learning: Improving

In the framework of Indonesian engineering education, the problem-solving abilities of higher education engineering students using digital tools allow students to participate in real-world projects. They applied a Project-Based Problem Learning (PBPL) method and evaluated how this affected their problem-solving ability. Using a sequential mixed-methods approach, the study included qualitative interviews following a quantitative pre-test/post-test assessment of skill increases. Engineer undergraduates from Universitas Negeri Padang made up the sample. After the PBPL intervention, Husin et al. [32] noted a considerable improvement in problem-solving ability. While interviews demonstrated that PBPL, enabled by digital project tools, improved students' capacity to examine problems methodically and engage in critical thinking, post-test results of students on a problem-solving assessment indicated progress.

The results show that teamwork abilities have improved, implying that the digital project-based approach improved both individual problem-solving and cooperation, which is necessary to handle difficult problems. Published in Thinking Skills and Creativity, Lu and Xie [33] "A Systematic Review of the Application of Educational Technology to Develop Problem-Solving Skills," conducted a methodical review. To improve problem-solving abilities, the writers looked at many studies spanning 2015 to 2023 using technologies including simulations, serious games, and intelligent tutoring systems. Lu and Xie [33] synthesized results from higher education environments and found that students' problem-solving capacity is improved when digital technologies are purposefully included in well-designed active learning activities. Particularly when these tools supported problem-based learning approaches, the research revealed that many studies using game-based or simulation-based learning showed improvements in students' capacity to apply concepts and solve difficult problems. This is consistent with meta-analytic results: a recent meta-analysis by Alshammary and Alhalafawy [34], which investigated learning outcomes generally, also found positive effects on cognitive outcomes including critical thinking and problem-solving, when digital platforms were used in education.

Generally speaking, the opinion is that, given its implementation in an interactive and learner-centered manner, technology can operate as a catalyst for the acquisition of higher-order thinking skills. Many empirical research studies show how well specific digital interventions improve problem-solving abilities. Tremblay et al. [35] looked at how game-based learning fits Canadian higher education. According to a 2023 evaluation of game-based learning research, a college course included instructional games whose results were compared to a conventional teaching segment. Among students using the game-based learning technique, the results showed considerable improvements in cognitive skills, including attention, reasoning, and decision-making, compared to their peers in conventional lecture-based classrooms.

The better reasoning processes shown by students in the game-based group when faced with problems indicate that the cognitive skills are somewhat correlated with problem-solving. Secondary school pupils participating in a digital game-infused curriculum showed improved critical thinking and problem-solving ability, according to a 2022 German Demange et al. study. Compared to a control group guided by conventional techniques, notable increases in originality, adaptability, and logical thinking were found. Conducted at the secondary level, this German study reflects trends in higher education: interactive digital environments, such as serious games or simulations, efficiently engage learners in complex activities, thereby improving their problem-solving skills. In African higher education, there is a trend towards the incorporation of digital tools to develop problem-solving and other necessary abilities for the twenty-first century. Cole [36] reports "Empowering Education: The Transformative Role of Technology in Africa, for UNESCO IICVA, emphasizes how digital innovation in African universities is seen as a means to improve and augment traditional education, thereby fostering students' critical thinking and problem-solving capacity.

Cole notes several projects using mobile tools and e-learning systems to support inquiry-based learning, which calls for students to solve problems and practice creativity. Although there is great promise, studies point up certain difficulties. Investigating "online collaborative problem-solving as an outcome of digital skills in technical and vocational higher education," Luengo-Aravena et al. [37] undertook a noteworthy study in Chile (Computers & Education, vol. 218). Students of a technical university engaged in an online cooperative problem-solving project were surveyed by the researchers. Students' digital ability levels high, medium, low were first assessed, then their happiness and self-assessment were measured after an online CPS exercise. Students with lower digital competence evaluated their group's problem-solving efficacy as poor and indicated significantly lower satisfaction with the group process.

On the other hand, students with better degrees of skill showed a more positive view of online teamwork. Particularly in many African situations where students may have varying prior experience with technology, digital literacy gaps might hinder the growth of problem-solving skills in online spaces. Through active learning opportunities, the literature indicates that digital tools such as project-based learning platforms, simulations, and games improve problem-solving abilities in higher education students. Students need help using the tools if they are to gain these advantages. Scaffolding activities and ensuring students have the necessary digital skills will help them participate successfully in challenging online problem-solving.

3.4. Digital Learning Tools and Academic Performance

Usually measured by course grades, exam results, or GPA, academic achievement is a critical indicator of how well digital tools work. Since 2020, many research have looked at how digital learning tools and platforms affect higher education student performance. Most research show either neutral to positive effects on academic achievement, especially when digital technologies increase student involvement; certain studies draw attention to possible difficulties that could lower grades. Results from an African point of view have been encouraging. Published in the African Journal of Education and Practice,

Mwangi [38] undertook a desk review titled The Impact of Digital Learning Tools on Student Performance in Kenya, synthesizing results from several past studies and publications pertinent to the Kenyan setting. According to Mwangi's study, student performance in Kenyan higher education has improved, thanks in part to digital resources such as virtual libraries, online courseware, and learning management systems.

The research examined found elements causing this improvement: more student involvement, more easily available learning resources, and customized pacing. Mwangi did, however, find difficulties in Kenya, such as uneven internet connections and varying degrees of digital competence among teachers, which would lessen these benefits. Concrete data from an actual research by Cheruiyot and Tumuti [39] at a Kenyan institution enhances the review. Using a sample of Kenyatta University City Campus students, the study "Effect of E-Learning Tools on Student Academic Performance" used a survey and regression design. The study examined how students' academic achievement correlated with the use of e-learning tools like electronic libraries and the university LMS. Test scores and GPA show that using e-learning tools greatly improved students' academic performance, according the study. Regression study found that the degree of use of electronic learning tools might explain a notable amount of the variance in student grades. Strong agreement among students indicated that the shift to online learning platforms throughout the epidemic improved their learning efficiency and results.

According to Kenyan studies, infrastructure helps digital learning tools to provide flexibility and accessibility in learning so improving academic achievements in African higher education. International studies offer a complex view while reflecting these positive outcomes. Published in Discover Education, volume 2024, Akpen et al. [40] conducted a methodical review titled "Impact of Online Learning on Student Performance and Engagement". Three: The researchers examined eighteen peer-reviewed studies done over several nations between 2019 and 2024. The study found variable but generally positive effects on academic achievement of online learning.

According to several research included in the review, students' ability to learn at their own speed made possible by online learning's flexibility and autonomy helped to produce better results. Exam averages and pass rates reportedly improved during the COVID-19 shift to online learning, according to some research, which explained this by students' access to recorded lectures and more control over their study plans. Akpen et al. [40] underlined that student involvement is a major determinant; in some cases, completely online learning produced lower engagement and interaction, thereby perhaps negatively affecting performance if not addressed.

Mediators of academic outcomes in online contexts were found to be factors like the quality of the digital platform, the dependability of internet connectivity, and students' motivation levels: Empirical data support this: a well-designed and interactive online platform combined with student motivation usually results in stable or better performance; conversely, feelings of isolation or technological obstacles can negatively affect grades. Quantitative meta-analyses provide more data. Combing results from 30 studies carried out between 2015 and 2021, Alshammary and Alhalafawy [34] performed a meta-analysis titled "Digital Platforms and the Improvement of Learning Outcomes: Evidence Extracted from Meta-Analysis," so synthesizing findings from digital and conventional learning environments. Many studies examined academic achievement using criteria including course grades and exam results. Alshammary and Alhalafawy [34] found a positive impact size (Hedges' $g = 0.28$) favoring digital learning, meaning that students using digital platforms somewhat outperformed their peers in conventional classrooms on average. Though small, the effect that was noted attained statistical significance ($p<0.001$). The meta-analysis revealed no publication bias, suggesting a real effect. Generally speaking, integrating digital platforms either does not negatively impact academic performance outcomes in higher education or leads to a small improvement in them. Particular case studies have recorded notable performance enhancements.

Online and offline tests in Greece were compared by Fyllos et al. [41] who found that students' exam results following a period of online learning were notably higher than those of a comparable cohort engaging in offline learning. The online cohort, according to the authors, benefited from digital resources that increased learning and raised exam performance including recorded lectures and online practice tests. Furthermore, digital tools helping with ongoing evaluation and feedback usually produce better course performance. In Latin America, Morán et al. [42] investigated the use of a gamified online assessment platform inside a university physics course including 200 Ecuadorian students.

Using a controlled design, the study "Uso de plataformas digitales gamificadas para la evaluación formativa en educación científica" had one group of students participate regularly with formative quizzes and feedback via the digital platform, while the control group was only exposed to a traditional final exam. The results were notable: the cohort undergoing formative e-assessments scored final marks over 30% above the control group. Frequent recall of material and feedback improved students' knowledge and, hence, their exam performance. In a study on technical education, Torres and Sanchez [43] discovered that students using a continuous digital assessment model which included regular online quizzes and exercises had a 20% increase in academic performance relative to those assessed just by end-of-term exams. In fields like mathematics and engineering, where iterative practice with digital tools strengthens students' problem-solving strategies, the improvements are especially clear. Both studies show that by encouraging ongoing formative learning rather than depending solely on one-time examinations, digital tools improve academic performance. Because they can track their development and immediately address areas of weakness, students engaged in these programs often report lower anxiety and higher involvement. One should realize that not all the evidence points in one direction. Many research studies highlight the need for implementation quality for teachers since they show circumstances when digital learning could be insufficient. Examining student performance in Los Angeles during remote learning amid the epidemic, a Chicago Booth Review (2022) article looked at the results. The virtual format helped about 10% of students improve their grades; most showed poorer performance than in-person learning.

This is in accordance with earlier American (pre-2020) studies by Xu and Jaggars showing that, particularly among students with less strong academic backgrounds, fully online college courses are linked with somewhat lower completion

rates and grades. According to the Booth Review article, several student subgroups performed particularly well in online learning, possibly in response to fewer interruptions or more flexibility. However, it also emphasizes how many others struggled, suggesting that in the absence of sufficient support, online learning could worsen performance differences.

Unless teachers encourage contact and involvement, research by education economists [44] cautioned that online courses may produce worse student grades. The results illustrate variability rather than contradicting the positive research; student performance with digital tools may depend on personal ability and the learning environment. Examining the association between digital capabilities and academic achievement among 200 Middle Eastern nursing undergraduates, researchers from Fatima College of Health Sciences, UAE (2023) have found that studies show that pupils who have advanced digital skills and high degrees of self-efficacy in technology use often have far better GPAs than those of their classmates with low technical competencies. According to a study the writers cite, excellent digital skills and active learning practices are prerequisites for success in e-learning environments among Korean university students. The results show that tech-savvy and well-prepared pupils may efficiently use digital tools to improve performance. On the other hand, a lack of digital literacy or self-control could make the use of such technologies useless and possibly negative for performance. Research published going forward shows that digital tools have mostly improved learning outcomes in higher education. Flexible, on-demand access to resources and interactive materials that strengthen memory reinforcement usually helps to improve knowledge retention.

Using digital tools in active learning designs improves critical thinking and problem-solving abilities. Project-based learning, simulations, and games meant to actively involve students in the application of ideas help to demonstrate this. Many times, the use of digital technologies that increase engagement, provide immediate feedback, or enable tailored pacing has maintained or increased academic performance that is measured by grades.

Studies from Africa mirror world trends and show that, using e-learning, appropriate infrastructure and training can improve university student performance. Researchers underline that best results come from both teachers and students being sufficiently ready for digital learning. This calls for an emphasis on training, inspiration, and assistance to avoid problems including low involvement and unequal results.

When combined with a balanced and well-supported educational framework, digital technologies clearly increase retention, boost problem-solving skills, and help to ensure academic success in higher education.

3.5. Obstacles and Limitations in the Implementation of Digital Teaching Tools in African Universities

More specifically, after 2020, African colleges have gradually included digital teaching tools, including learning management systems (LMS), video conferencing platforms, mobile learning apps, and online evaluation systems into their curriculum. The quick shift to online and blended learning during the COVID-19 pandemic exposed several difficulties preventing the efficient use of these learning resources. Recent studies carried out since 2020 throughout the continent have found infrastructure constraints, digital literacy gaps, and contextual obstacles influencing both professors and students. With an eye towards particular kinds of technologies, including Learning Management Systems (LMS) like Moodle, video conferencing platforms like Zoom, mobile learning, and digital assessments, this literature review synthesizes results from at least modern studies.

3.5.1. Moodle and Several E-Learning Systems are Among Learning Management Systems

Many studies point up challenges to the acceptance of Learning Management Systems in African universities. In order to assess the difficulties of online learning using a Learning Management System (LMS) during the COVID-19 epidemic, Moonasamy and Naidoo [45] performed a quantitative survey comprising 125 South African undergraduates. Students complained most about inadequate digital tools (devices), poor internet connection, power outages, and expensive data charges as the main challenges with online learning. Using a survey (n=141) and factor analysis, Aboagye et al. [46] investigated "COVID-19 and E-Learning: The Challenges of Students in Tertiary Institutions," classifying the issues raised by students about e-learning. The main barrier was found to be accessibility problems, including poor internet and device access; social concerns and lecturer-related issues, such as insufficient online teacher support, came second. The authors' regression analysis revealed that lecturer-related elements had the most significant impact on students' online learning capacity; students were generally unprepared for thorough online study. The results underline how much LMS-based learning in different African settings is hampered by shortcomings in fundamental infrastructure and resources, including energy, internet connection, and devices.

Enwereji and Van Rooyen [47] conducted a qualitative systematic review of 20 e-learning articles to identify common barriers in online education, particularly in South Africa, as detailed in their work titled “Exploring the barriers to online student learning support services: A review.” The barriers were categorized into themes: personal constraints (e.g., low digital skills or technophobia), enabling conditions (infrastructure and resources), deficits in social interaction, pedagogical challenges, limitations of technology, and motivational issues. The writers come to the conclusion that good LMS integration calls for addressing several aspects, including teaching users to improve their comfort and motivation in online environments and providing dependable technology. This is in accordance with empirical research showing that many African colleges lacked the required plans to assist staff members and students during the sudden shift to online learning, therefore failing their e-learning readiness.

Teachers' opinions on LMS tools point to still more difficulties. To find the elements impacting the acceptance and use of Moodle LMS for emergency remote learning from a UTAUT perspective, Korsah [48] polled teacher educators at Colleges of Education in Ghana. The study used a descriptive cross-sectional design utilizing a questionnaire grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT). Results revealed that the main determinant of teachers' desire to

make use of Moodle was social influence, including institutional and peer support. On the other hand, performance expectation and effort expectation which relate to perceived value and simplicity of use had little influence. When supported by colleagues and communities, Ghanaian teachers showed a greater likelihood of using Moodle than the platform's simplicity or apparent efficacy. This suggests that the adoption of learning management systems depends significantly on institutional culture and collegial support. To increase actual utilization, the paper emphasizes the need to improve service quality in LMS systems through consistent system updates, user-friendly interfaces, and technical assistance.

LMS systems could have natural restrictions on use. 51 lecturers from 11 West African universities, including Nigeria, participated in Olugbade, et al. [49] multi-country study "Challenges and Limitations of Moodle LMS in Handling Large-Scale Projects: West African Universities Lecturers' Perspective, which examined Moodle's efficacy. Using an online questionnaire in addition to descriptive statistics and ANOVA, this quantitative analysis indicated generally good impressions: professors appreciated Moodle's easy-to-use interface and its support of student involvement and teamwork. Features like communication tools, assignment submission, and the LMS gradebook clearly made participants very happy. Teachers noted resource shortages; more specifically, scalability problems highlighted by servers and bandwidth often struggling with large courses or projects. Gender-based disparities were noted; male academics expressed a somewhat higher positive opinion of Moodle than female lecturers. Universities did not show any notable variations, though, suggesting a rather consistent experience among them. This study shows that although faculty members generally approve of Moodle, large-scale and efficient use depends on improvements to the underlying infrastructure more specifically, on speed, uptime, and capacity. These speakers' general ease on the platform suggests that they have access to training and support a contrast with many less-funded environments.

3.5.2. Platforms For Video Conferences: Synchronous Tools and Zoom

For live lectures, the epidemic age saw notable reliance on video conference tools as Google Meet, Zoom, and Microsoft Teams. Research show that using these platforms presented significant challenges for African teachers and pupils. Mpungose [50] conducted an interpretive qualitative case study titled "Students' Reflections on the Use of Zoom Video Conferencing for Online Learning at a South African University." This study included interviews and reflections from first-year students to investigate their experiences with Zoom. A noteworthy contextual discovery shows that most South African students come from remote or underdeveloped areas with limited access, complicating synchronous video learning. Many students reported poor Wi-Fi connectivity at home and struggled with data costs, which led to differences in involvement. Examining 678 tweets from university students across South Africa, Azıonya and Nhedzı [51] netnography "The Digital Divide and Higher Education Challenge with Emergency Online Learning: Analysis of Tweets in the Wake of the COVID-19 Lockdown," reflects the digital divide. By means of qualitative content analysis of social media, Azıonya and Nhedzı [51] found a notable volume of student concerns about online learning. Students from historically underprivileged colleges said that online learning highlighted already existing disparities rather than improving their educational access during lockdowns. Students' capacity to attend live Zoom lectures or participate in real-time was hampered by network coverage problems, insufficient devices, timing restrictions (such as the need to study late at night when networks were less crowded), socio-economic challenges, and limited digital skills. According to the study, video conferencing can widen the digital gap without interventions. To meet the requirements of low-income and rural students, it advised using more inclusive and flexible teaching approaches, including asynchronous options and mobile-friendly materials.

With video platforms, faculty faced similar difficulties. Using tools like Zoom, Okoro et al. [52] "An assessment of tutoring performance, challenges and support during COVID-19: A qualitative study in a South African University," looked at the management of online teaching by lecturers and student tutors. Analyzed thematically, interviews taken inside a single faculty at a South African institution exposed many difficulties in the online teaching environment. Unreliable internet access and insufficient data for video sessions presented difficulties for tutors. Attributed to the lack of explicit rules or preparation for moving tutorials online, tutors and lecturers displayed inadequate understanding and training on the use of internet platforms. This resulted in a degradation of the human connection usually necessary for successful tutoring; tutors felt disconnected from their students, which clearly reduced student participation and interest in the online environment. The study underlined the need for universities to improve support for online teachers, including professional development in online pedagogy, standardization of e-tutoring systems, and the building of communities of practice among tutors for peer assistance. In the absence of sufficient assistance, the simple introduction of Zoom or similar technologies was useless. Anticipating individual adaption, Mpungose [53] notes that many universities used video conferences and other e-learning tools without enough training for staff or students. Often, the lack of enough preparation resulted in teachers turning to improvisation, which infuriated the students.

For people with connectivity, video conferences helped to ensure that instruction could continue despite obstacles. Fianu et al. [54] investigated the ongoing Zoom use in Ghana and found that students are more likely to keep using these technologies outside of emergency situations when they see obvious advantages and institutional support. Still, the study highlighted similar access problems and argued for the combination of synchronous and asynchronous techniques. Infrastructure issues, including bandwidth and electrical concerns, inadequate training, and the socioeconomic digital divide, greatly limit the efficacy of Zoom and related platforms in African institutions. These tools are most successful when combined with offline support and when institutions actively assist users in overcoming technical challenges.

3.5.3. Mobile Learning Devices and Access

Given the great proliferation of mobile phones in Africa, mobile learning the use of smartphones or tablets for educational purposes is seen as a bright prospect throughout the continent. Many students access live classrooms or learning management

systems via mobile devices. To find continuing issues and success elements, Mogaka and Odoyo [55] systematically reviewed 50 research on mobile learning in Kenyan colleges. According to the review, contextual restrictions and usability issues often beset mobile learning projects. The writers came to the conclusion that Kenyan institutions must improve the usability of mobile learning tools and the effectiveness of mobile content distribution. Mobile technology presents challenges for both teachers and students, especially when programs like mobile LMS interfaces or educational apps lack user-friendliness or when material is not optimized for small screens and limited bandwidth. The study revealed that students' self-efficacy in using mobile devices for learning needs development; thus, teaching them to maximize gadget use could help to produce better results. Having a smartphone by itself does not guarantee good mobile learning; suitable support systems are absolutely necessary.

Empirical studies validate these claims. At a university in Ghana, Adzifome and Agyei [56] polled 222 students both distance and vacation learners about their use of mobile devices for learning needs. According to studies using quantitative surveys, mobile learning was only sporadically included in students' learning environments. Most students have cellphones and said they would be useful for educational purposes. The college offered certain assisting tools, including mobile device access to a learning management system (LMS). The results revealed that mobile learning was mostly underused; although students accessed some course materials through their phones, official learning activities were not often carried out using the university LMS on mobile devices. Often, instead of the official mobile LMS software, students used unofficial tools including WhatsApp groups or viewing PDFs on their phones. This action exposes a disparity between the availability of resources and their real consumption. To increase student involvement, Adzifome and Agyei contend that policies and instructional design have to change; institutions should use mobile-friendly teaching practices and maximize their LMS and content for mobile access.

Given the patterns of device use revealed during the epidemic, mobile access is absolutely essential. To investigate the online learning experiences of nursing and radiography undergraduate students during COVID-19, Ogolodom et al. [57] carried out a cross-sectional survey including 540 students from 11 Nigerian universities. Remarkably, 65% of students used cellphones as their primary tool for online learning much more than the number of those using computers. About 60% had a personal device, meaning that a noteworthy 40% lacked access to such technology, which limited their capacity to engage completely or mandated them to discover other solutions. Furthermore, 52.4% of students evaluated the quality of their internet connection as "poor." The research identified key challenges faced by Nigerian students: financial constraints (inadequate funds for data or devices), unreliable internet access (slow or unstable connections), and, in many cases, lack of computer access (resulting in reliance on mobile devices). Students reported feeling isolated, and they connected this to poor online peer and instructor communication. This comprehensive study carried out in Nigeria shows that, despite the great availability of mobile phones enabling online learning for many students, problems with data affordability and network quality greatly reduced the effectiveness of mobile learning. Given poor infrastructure, the significant reliance on mobile phones often resulted in a less than ideal educational experience.

Notwithstanding these obstacles, mobile learning is a necessary component of digital education in Africa since, for the majority of the population, mobile phones are the most easily available tools. Some research highlights possible benefits; for example, mobile learning gives students flexibility and immediacy so they may quickly access knowledge or participate in learning from any place. Eliminating the technical, financial, and organizational obstacles impeding the success of mobile learning is the assigned goal. Though these particular solutions are often only momentarily addressed in the literature, strategies including optimizing learning platforms for mobile use, negotiating cost-effective data plans for educational purposes, and using the offline functionalities of applications warrant investigation in practice. Mobile learning has promise in African institutions; nevertheless, comparable infrastructure and capacity issues influencing LMS and video conference deployment impede it.

3.5.4. Digital Tools and Virtual Exams

In higher education, the shift to digital teaching tools includes assessment strategies, using Moodle, Google Forms, or dedicated e-assessment systems to run online quizzes, assignments, and tests. Research done starting in 2020 shows that online assessments in African institutions ran across problems with academic integrity as well as technical ones. Focusing on academic honesty, Verhoef and Coetser [58] qualitatively examined the attitudes and actions of South African university students during remote online exams in 2020. The authors looked at student comments gathered from an institutional academic dishonesty forum in line with worldwide examples. Research revealed a notable rise in academic dishonesty including plagiarism and cheating during online tests, mostly related to inadequate supervision and the pressures associated with the epidemic. Students admitted that without an invigilator, referencing notes or talking with peers seemed easy and attractive. Inadequate time management in a less-structured home environment exacerbated some people's reported dishonesty, which resulted from feelings of overwhelm, tension, or uncertainty about the material. Technical problems were mostly responsible; several students had trouble using the online testing systems or suffered from connectivity issues throughout the test, which caused anxiety and the use of shortcuts. According to the research, online assessments should be reevaluated in order to reduce academic dishonesty that is, by restructuring tests (e.g., using open-book formats and practical assessments) and improving honor codes or monitoring systems in low-bandwidth settings. Due mostly to its sudden character, Verhoef and Coetser [58] observe that universities were not sufficiently ready to uphold academic integrity throughout the shift to online exams.

Notable were also technical obstacles in digital assessment. The Nigerian study by Ogolodom et al. [57] revealed that poor internet access caused students to struggle with online examinations and assignments, leading to late or incomplete entries brought on by network outages. Some students lacked laptops, which made it challenging for them to type long

responses on mobile devices, which led to frustration or task abandonment. Maboe and Tomas [59] conducted a study in Southern Africa that found that poor technical knowledge, including both platform use and basic ICT skills, markedly hampered the completion of online tests, therefore compromising student success. Many students needed lessons on negotiating the testing system during their higher education, therefore revealing pre-existing digital literacy deficits that institutions had not previously addressed before the epidemic.

Online assessment systems present problems for teachers. Due to inadequate training, many teachers find it difficult to monitor student progress and configure online quizzes or tests with the necessary settings, including timers and randomization. Examining students in Uganda, a 2024 study by Olaniyan et al. [60] titled "Distance Learning and Challenges of Technologies by Students in Uganda" draws attention to underlying institutional shortcomings in evaluation as well. To qualitatively investigate their difficulties with remote learning, this study used a snowball sample technique including thirty university students in Kampala, Uganda, at several academic levels. Along with inadequate internet access, the study found technical challenges with the learning platform as one of the most often mentioned issues. Students pointed out the instability of many e-assessment systems under low bandwidth situations by reporting problems with platforms stopping during tests or inaccurately recording responses. According to the experiences of Ugandan students, issues with dependability and user experience could affect the presence of online examinations, thereby reducing their overall efficacy. The study's authors urge more preparation and assistance to sufficiently equip teachers and students for successful online learning and instruction, thereby implicitly including assessments within this framework.

Apart from problems of connectivity and cheating, one is quite concerned about the lack of feedback and control in digital tests. Based on an Indonesian study, researchers, including Saputra [61], underlined in a worldwide setting the difficulties of tracking student development in online contexts. Without in-person contact, African professors said they found it difficult to evaluate which students were falling behind and to confirm each student's originality of work. Belay and Tesfaye [62] found limited participation and cheating in online continuous evaluation; these results were validated during the epidemic across many nations. To evaluate their students, several professors used oral vivas or additional homework, therefore adding to their burden. According to Olaniyan et al. [60], several studies show that online assessment provides more flexibility; for instance, students may take tests from many locations and maybe at different times, so benefiting working or remote learners. While students often suffer anxiety related to new formats and technical problems, the literature from 2020 to 2023 mostly emphasizes problems rather than benefits: academic staff in Africa express concerns regarding the maintenance of standards and fairness in online assessments.

3.6. Overview of Results and Identified Research Deficiencies

According to the literature analysis, African institutions face many linked issues that hinder the efficient application of digital instructional resources. Most studies find several consistent obstacles, including inadequate infrastructure characterized by poor internet connectivity, unreliable electricity, and limited access to devices alongside deficits in digital literacy among students and faculty and a lack of sufficient institutional support. While teachers struggle to change their curricula and tests for digital platforms, students regularly find it difficult to access synchronous lectures because of data costs or network unreliability. Lack of training and readiness compounds the problems since many organizations embrace digital tools without adequately equipping people for successful interaction.

Notwithstanding these parallels, there are notable distinctions. While some research underlined behavioral issues including academic dishonesty in online exams and declining student involvement, others highlighted technological and infrastructure limitations. Urban institutions showed better LMS adoption and mobile learning preparedness than rural ones, but rural locations faced major accessibility issues. Students stressed access and emotional pressure, while faculty members focused on growing workloads and educational obstacles; there were differences between their experiences.

This summary highlights a clear research vacuum: few studies have evaluated scaled long-term treatments meant to remove these obstacles. Instead of looking at accepted solutions or frameworks for the sustainable integration of digital technologies, much of the research highlights the documenting of acute difficulties faced at the beginning of the epidemic. Comparative multi-country research is lacking, which would help to distinguish universal problems from those local to particular settings and encourage cross-institutional learning. Investigating strategic interventions including mobile-optimized platforms, inclusive policy reforms, and targeted digital training that can improve fairness and efficacy in digital teaching inside African universities would help future studies to close this gap. These results help to respond to the particular goals:

3.7. Digital Teaching Tools Are Currently Being Implemented In African Higher Education Institution

According to the study, African colleges use several digital tools to support online and hybrid learning. Moodle and Blackboard, among Learning Management Systems (LMS), help to offer course content, assignments, and student tracking. Synchronous lectures and conversations depend heavily on video conference tools such as Google Meet, Zoom, and Microsoft Teams. The accessibility and communication efficiency of mobile learning apps and platforms like WhatsApp and Telegram make them quite common. Furthermore, digital evaluation platforms such as Google Forms, Socrative, and Kahoot are particularly used for tests and feedback collection. Especially in the sciences, technology, engineering, and mathematics (STEM), advanced technologies such as virtual labs, augmented reality (AR), virtual reality (VR), and gamified platforms are progressively being integrated. These tools meet many pedagogical needs content distribution, engagement, assessment, and collaboration but their use depends on institutional capability and faculty digital expertise.

According to the analysis, African institutions routinely make use of several digital tools: Moodle, a Learning Management System (LMS); Zoom and Microsoft Teams, video conferences; mobile learning apps; and digital assessment

tools. Strong infrastructure-equipped institutions have embraced cutting-edge technologies such virtual reality simulations, gamified learning platforms, and virtual labs. Among the several teaching purposes these tools serve are material distribution and real-time evaluation.

3.7.1. Effects of Digital Tools on Student Engagement

The literature emphasizes how greatly digital technologies influence student involvement. Features like interactive polls, real-time quizzes, virtual breakout rooms, and gamified content, when used effectively, improve active engagement and peer cooperation. Asynchronous learning tools and mobile-friendly systems give students more freedom, hence improving their ongoing involvement. Consistent involvement is hampered by differences in digital access, especially in impoverished or rural organizations. Engagement levels drastically drop in cases when students encounter inconsistent internet access, power outages, or inadequate personal tools. Lack of organized digital pedagogy and poor digital facilitation skills among professors can lead to passive learning environments, thereby reducing the efficacy of these tools on student motivation and interaction.

Digital tools have affected African university student involvement in several different ways. Studies show that well-integrated digital tools improve student enthusiasm, involvement, and teamwork. Interactive learning is facilitated by real-time tests, discussion boards, and gamification components. Still, limited device ownership in some locations and poor internet connections have caused disengagement and absenteeism especially in rural and underfunded institutions.

Impact of Digital Tools on Learning Outcomes (Knowledge Retention, Problem-Solving, Academic Performance)

The study showed how well digital technologies combined with good pedagogical strategies improve learning results. Promoting spaced learning and retrieval practice helps multimedia content, microlearning, recorded lectures, and online quizzes greatly improve knowledge retention. By encouraging practical and project-based learning which lets students confront real-world challenges tools such as simulations, instructional games, and collaborative platforms improve problem-solving skills. Studies show that by allowing interactive and inquiry-driven environments, using digital tools helps kids develop higher-order thinking. Analytics tools in learning management systems and adaptive learning systems help to improve academic performance by means of consistent usage of formative assessments and feedback systems. Students' digital literacy and teachers' ability to design successful digital learning environments determine these advances. In settings marked by poor capacity, the impact on learning results is usually either negligible or possibly negative.

The study showed that when material is delivered through microlearning modules, recorded lectures, or interactive simulations digital tools improve knowledge retention. Using tools for collaboration, games, and simulations in project-based learning improves students' capacity for solving problems. The integration of digital technologies with formative evaluations and active learning methodologies shows modest to considerable improvement in academic achievement. Digital preparedness and students' digital skills greatly influence learning outcomes.

3.7.2. Challenges and Barriers in Digital Teaching Tools

Many structural and contextual issues still exist that prevent the efficient application of digital learning resources in Africa. The main problems are infrastructure-related ones, including poor broadband coverage, high data charges, uneven power supply, and insufficient institutional technological infrastructure funding. Furthermore, a difficulty exacerbated by limited access to training and professional development opportunities is the often poor digital capabilities demonstrated by staff and students. One major challenge is institutional preparation since many colleges lack clearly defined policies or implementation strategies for digital learning. Adoption is much hampered by cultural attitudes and aversion to change, particularly among professors experienced with conventional instruction. Even with tools at hand, their overall usefulness is often underused due to poor strategic planning and inadequate support structures. The current obstacles lead to a different environment for digital integration whereby metropolitan, well-funded institutions progress more than their rural or resource-limited counterparts.

Different obstacles prevent the efficient application of digital tools throughout Africa. Among the elements causing the problem include inadequate infrastructure (including internet access and electricity), high data costs, poor digital literacy among teachers and students, and institutional support or policy direction missing. Further challenges include limited device access, especially for low-income students, and technical issues with digital platforms. The above listed elements have led to different acceptance and effectiveness all throughout the continent.

3.8. Suggestions for Enhancement of Digital Tools Usage in Learning and Teaching

The study supports a comprehensive strategy to improve the digital learning environment in African higher education. Recommendations emphasize the need to enhance ICT infrastructure in every institution, especially in underprivileged areas, and to support reasonably priced internet access through public-private cooperation. Improving the pedagogical use of technology depends primarily on the necessity of focused digital literacy programs for students and ongoing professional development for teachers. Institutions must create clear, inclusive digital education policies that support mixed learning approaches tailored to specific local environments. It is essential to invest in digital content with local relevance and mobile-friendliness. Furthermore, institutionalizing monitoring and evaluation methods helps assess how digital tools affect engagement and learning outcomes, thereby enabling evidence-based scaling of successful interventions and continuous improvement.

The study supports focused expenditures in faculty development and digital infrastructure. Institutions must implement inclusive digital education policies, improve staff and student training, and ensure reasonably priced device and data access. Blended learning strategies that combine online and offline approaches help to increase equity. Achieving scalable and sustainable digital education in Africa depends on cooperation among governments, institutions, and technology companies.

4. Conclusion

Digital teaching tools are gradually changing the structure of African higher education systems. These instruments have great potential to increase participation and learning outcomes; nevertheless, their usefulness varies depending on infrastructure constraints and skill level differences. Through concerted institutional and policy initiatives, addressing these obstacles will help African universities efficiently use digital technology for the transformation of teaching and learning.

4.1. Recommendations of the Study

1. Improve ICT infrastructure and ensure consistent internet connectivity for every kind of institution.
2. Establish thorough digital literacy initiatives for academics and students at both national and institutional levels.
3. Provide access to digital tools and platforms under subsidized or institutional support.
4. Create institutional and national policies supporting flexible and mixed learning approaches.
5. To guarantee their scalability and efficacy, routinely track and assess digital learning projects.

4.2. The Study Contributions

For Practice:

For university officials and teachers trying to improve digital teaching strategies, this paper provides useful information. While addressing implementation issues, the book stresses efficient tools and approaches.

To Theory:

By proving the function of digital tools in influencing student interaction, motivation, and cognitive results within the African context, this review improves constructivist and engagement-based learning theories.

Future research should focus on:

The study emphasizes the need for long-term and comparative research among several African regions. The evaluation of long-term learning outcomes, the scalability of digital tools, and the impact of institutional policies on enabling digital transformation should thus take first priority in future studies.

4.3. The Limitations of this Study

Although the suggested study seeks to shed important light, numerous difficulties could surface:

Digital Divide: For certain pupils, particularly in remote regions, access to the required technology e.g., internet connectivity, cell phones, and computers may be restricted.

The study will span several African nations, each with a unique cultural and linguistic setting; therefore, it will influence the generalizability of the results.

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