

Flexible Distance Learning with Adaptive Learning Management System (LMS) in Education: Engagement, Adoption and Barriers - Systematic Literature Review

Ayorinde Oduroye¹, Akanbi Joshua Olawale¹, Akoma Chizurumoke², Otemuyiwa Divine-Favour², Ihekwoaba Blessing Nwosu², Orah Chijioke² & Theophilus Bamise Ajala^{1*}

¹Department of Computer Science, College of Computing and Information Sciences, Caleb University, KM 15, Ikorodu-Itoikin Road, Imota, P.M.B. 21238, Lagos State, Nigeria. ²Department of Cybersecurity, College of Pure and Applied Sciences, Caleb University, KM 15, Ikorodu-Itoikin Road, Imota, P.M.B. 21238, Lagos State, Nigeria. Corresponding Author (Theophilus Bamise Ajala) Email: ajalabamise@gmail.com*

DOI: <https://doi.org/10.38177/ajast.2026.10312>



Copyright © 2026 Ayorinde Oduroye et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Article Received: 15 July 2026

Article Accepted: 21 September 2026

Article Published: 23 September 2026

ABSTRACT

Education is a very strong tool that can promote the development of humans and societies through preparing people for meaningful jobs and improving productivity in general. In order to adapt to the challenges of modern logistics and increasing demands for flexibility, education has evolved from the old formats into distance learning with ODL helping to eliminate all sorts of barriers, such as age, money, work, and disability issues. There was a 2026 UTME in Nigeria which examined around 2.2 million candidates at 966 Computer-Based Test centers. In spite of such developments, there are still certain problems with the existing educational approaches and conventional LMS systems, one of which is the lack of personalization. Thus, it is absolutely crucial to develop adaptive LMS technology that would be able to adjust learning materials and activities to the needs and preferences of particular students. The objective of this study was to evaluate the degree of user engagement and adoption of the adaptive LMS and also to identify the challenges involved in the implementation of the LMS. In this study, the researcher used the theories of self-determination and transactional distance for distant learning. From this research, it is evident that the integration of artificial intelligence in adaptive learning technologies is useful for enhancing student performance in higher education in Nigeria. The implementation framework was suggested by this study for the adoption of the adaptive LMS. Based on the findings, recommendation was proffered.

Keywords: Distance Learning; Learning Management System (LMS); Adaptive LMS; User Engagement; Adoption; Personalized Learning; Artificial Intelligence; Open and Distance Learning (ODL); Self-Determination Theory; Transactional Distance Theory; Computer Based Test.

1.0. Introduction

Education is one of the most potent instruments that can foster development both of human beings and society as a whole. In the age of technological revolution, education plays the key role in preparing people for effective participation in life through acquisition of knowledge, skills, and critical thinking skills needed in the dynamic world (Niazi, 2025). Education helps each individual grow up and learn throughout life as the basic prerequisites for attaining self-realization and financial security. At the same time, educated citizens play a crucial part in social advancement as they help to decrease the rate of poverty, promote equality between sexes and democratize the government (Niazi, 2025). The goals of education include the preparation of people for job opportunities and productivity growth in the society (Alikor & Okachiku-Agbaraeke, 2025). (Alikor & Okachiku-Agbaraeke, 2025) defined education as the process including all spheres of life of the community from its physical features to the mental and psychological condition of the individuals with the aim of fostering knowledge and understanding. (Kuwar, 2021) argues that education definitely provides the necessary technical skills for operating with new technologies. Therefore, without education, it would be impossible to use the new devices.

The change from traditional learning methods to distant learning has not only been due to logistic problems, but it has also been a solution to the trends in the world which made it necessary for there to be flexible systems of education (Ashraf & Ali, 2025). The field of higher education system in Nigeria has changed by revolution owing to virtual education programs. This form of education has proved to be the most effective in meeting the needs of higher education taking into consideration the fact that the resources and infrastructure were limited. Because of the

new technology, traditional education centers were unable to deal with the rising number of students because it led to crowded and full classes as well as a lack of competent staff. Due to the problem, distant education became an alternative for those students who were in the position of being incapable of attending classes traditionally because of geography, financial or personal reasons (Ashraf & Ali, 2025). Distance learning is becoming increasingly popular in HE, where the number of distance learners was 11 million in 2017, 35 million in 2025 and is expected to be 50 million by 2029 (Trautwein et al., 2026). Distance education can be defined as a form of educational endeavor whereby the majority of or all of the instruction takes place in the hands of someone who is physically or temporally distant from the learner, to the extent that the vast majority of or all communication between instructors and students is made through an artificial channel, which could be either electronic or printed. By definition, distance education involves the utilization of technology as the principle mode of communication (Adamu, 2022). There have been massive transformations in both the conception and practices over the years leading to the change of terminology, which now includes in its definition, two subsets namely, open learning and distance learning: Open and Distance Learning (ODL) refers to the provision of distance education in ways that aim at eliminating or mitigating barriers to access, such as financial, learning, age, socio-economic, work or family responsibilities, disability, incarceration or any other barrier. “Open” in this case means a commitment to eliminate any unnecessary barriers to learning (Adamu, 2022).

(Keleş & Özel, 2016) Distance education, which is today known as distance learning or e-learning, has been around for centuries. Educational establishments have found solutions to meet their increasing demands by developing distance education. This method of education enables the creation of paths for education by the educators and learners with physical distance between them through the help of technology (such as audio, video, data, and written words). It can also be defined as an educational approach in which students, teachers, and teaching resources from different geographical locations are brought together by means of communication technology (Keleş & Özel, 2016). Overcoming the problems related to space and time is the primary objective of distance education. There could be learners who live in isolated, sparse and rural settings where there is no provision of education for them. There could also be learners who have easy access to schools or colleges but the college may not offer the desired course for the particular learner. Distance education enables the learner to get the benefit of education despite the inability to take part in the classes physically in a university. One of the most critical objectives of distance education is that it offers education to individuals, who are not physically present in a class (Keleş & Özel, 2016).

LMS is a critical tool that offers the platform and helps in achieving the objective of flexible distance learning. In this regard, according to (Al-Dhief et al., 2024), LMS can be seen as a web-based online software that is able to change information and session between students and also give them a place for their online learning (Al-Dhief et al., 2024). Indeed, as Ruga et al. (2024) emphasized, learner fit LMS adds to the basic interactions in the classroom environment by ensuring supportive learning and teaching engagement. LMS is essential in determining the level of success of learners’ academic achievements.

Some of the shortcomings of the conventional approach to teaching and learning are teacher-centered, static, linear, classroom-based, rigid learning timeframes and dependence on paper-based educational content. In order to

overcome these weaknesses, e-learning systems have been developed and implemented using the help of LMS like Moodle, Blackboard into traditional approaches to teaching. E-learning also introduced its own set of challenges, among which resource deficiency (Dube et al., 2026), and provision of static learning material are included. As mentioned by (Dube et al., 2026), even though current e-learning systems have their strengths, there are also certain weaknesses in their operation; for instance, traditional methods of learning and conventional e-learning system both have shortcomings in customization.

With the rate at which information technology is advancing, it becomes imperative for many educators to revisit the outdated and static classroom teaching approach and the role of students' learning styles in designing courses. A number of the existing LMS do not consider the learning styles of their learners; thus, this will affect their academic development. There are no standardized procedures on how to develop educational content that fits a certain student's preferred style of learning and can then be incorporated into an LMS (Lim et al., 2026). In recent times, there has been a growing trend in the application of Artificial Intelligence (AI) in order to provide personalized instruction to enhance the learning process of the learners. These adaptive LMS systems integrate AI into LMS in order to monitor students' performance and engagement (Lim et al., 2026). Taxonomy in teaching is the classification of thought process through the use of a multi-level strategy in accordance with the six levels of complexity of the thought process. The objective of taxonomy in teaching is the classification of students based on the style of learning and providing them with the most appropriate learning resources. Personalization is the linking of appropriate learning resources to the style of learning of the learner. One of the present problems with the customized LMS system is the lack of consideration of the concept of teaching taxonomy since the system has a few features compared to other regular LMS systems.

During the recent years, e-learning has developed into a highly effective method of teaching characterized by flexibility, scalability, and personalized learning opportunities. Adaptive learning in e-learning can be defined as the intelligent and dynamic customization of learning materials, learning objects, and learning activities to accommodate the specific interests and requirements of individual students. Through the analysis and interpretation of learner information, adaptive learning systems are able to make the right decisions about providing personalized learning experiences (Gligorea et al., 2023).

Adaptive learning is one of the education methods that involves the use of technology to personalize the learning process for every individual learner depending on his/her needs, preferences, and performance (Gligorea et al., 2023). This is possible by analyzing the data of the learner constantly including assessment outcomes, interactions, and progress. Adaptive learning systems have been getting more common because they can transmit the educational content and adapt according to the needs of certain learners (Gligorea et al., 2023). As per (Alwusfar, 2025), Adaptive learning systems (ALS) when integrated with LMS provide functionality that enhances personalized learning experiences immensely.

In this way, the key aim of this research is to improve on the advantages of the current LMS and to propose an approach that will lead to making an adaptive LMS by improving the style of the learners in learning. For this reason, this research aims at reviewing the literature on flexible distance learning using Adaptive LMS, especially

concerning engagement, adoption, and barriers. The research aims at synthesizing the existing knowledge on how adaptive LMS technologies are used in flexible distance learning and their impact on the engagement and adoption of learners.

1.1. Statement of the Problem

As stated in (Ramon-Yusuf) Nigeria, the most populous country in Africa has about 160 million people. Higher Education participation rate is quite low, where just a meagre 8.5 percent of the 18-30 years old eligible cohort is able to join in higher education; the universities face a lot of pressure hence the lack of access to university education, a major challenge that is almost impossible to solve, as explained above (Akinselure, 2026). In 2026, the Unified Tertiary Matriculation Examination, carried out by the Joint Admissions and Matriculation Board, from Thursday, April 16 to Saturday, April 25, 2026 had 2.2 million candidates at 966 accredited Computer-Based Test centres. (Samuel & Ogu, 2025) There are certain policies that have been put in place by the government of Nigeria through the National Universities Commission (NUC) to guide the implementation of ODL in Nigeria. These policies include: The National Policy on Education recognizes ODL as an important tool for ensuring educational access. The Open and Distance Learning Policy, which seeks to standardize ODL and provide quality assurance. In Nigeria, the majority of higher institutions adopt the conventional LMS, such as the Nigerian Open University (NOUN) having a large number of learners pursuing distance learning at their university, and the MIVA university which is still new, having a small number of learners enrolling for their online programs. The conventional universities offer dual mode program where they have been approved by the Nigeria Universities Commission (NUC) to run ODL centers such as LAUTECH, Caleb University Lagos (CUL), Covenant University (CU), and UI among others. Nevertheless, the traditional LMS often provides the same learning materials, activities, and learning paths to many learners, despite the differences existing between learners regarding previous knowledge, learning speed, preferences, motivation, computer skills, and educational needs. The problems faced with the traditional LMS have created an interest in the development of adaptive LMS. The adoption of adaptive LMS at Nigerian institutions is low.

1.2. Objectives of the Study

The specific objectives are to:

- 1) Analyze the existing body of literature about flexible distance learning and the adoption of LMS with a special focus on the aspects that determine users' involvement and adoption.
- 2) Determine the main obstacles standing behind the adoption and successful implementation of LMSs in flexible distance learning context in terms of infrastructure, digital literacy, usability, accessibility, and institutional support.
- 3) Create the framework for adaptive learning integration into LMS through dynamic content sequencing, adaptive assessment, recommendation of learning resources, adaptive feedback, and learning preference matching.
- 4) Analyze the effect of adaptive learning functions on user engagement and personalization of the learning process based on the learner's performance, progress, preferences, and needs.

- 5) Suggest recommendations for promoting the adoption, implementation, usability, accessibility, and effective usage of adaptive LMS in flexible distance learning.

2.0. Literature Review

There had been LMS technology for some years, but it gained popularity during the recent past because of the COVID-19 outbreak in the year 2020. The organizations and education institutions adopted LMS in the process of teaching and learning because of the inability to interact face to face. Currently, there are numerous universities, colleges, and schools that have migrated into virtual teaching and learning (Al-khresheh, 2022). This section contains some insights drawn from previous works, and hence the literature review may be synthesized thematically as follows under user engagement and adoption.

User Engagement

The issue of user engagement becomes the key topic discussed in the LMS and adaptive learning literature. Specifically, a number of empirical studies demonstrate that the efficiency of the LMS is not solely defined by the presence of such systems but rather depends on how active learners interact with the material, participate in certain activities, and feel motivated during the entire period of learning. According to Herniawati et al. (2025) who conducted the systematic review of LMS literature in relation to higher education, LMS platforms help in enhancing the student engagement and motivation to learn, especially in the context of online and blended learning. Moreover, according to Sidi et al. (2026), there is a positive correlation between the usage of e-learning platforms and cognitive and affective engagement of students.

One of the key elements in this theme is the application of adaptive learning in order to personalize engagement. Gligorea et al. (2023) have demonstrated that artificial intelligence and machine learning algorithms help to personalize the learning process through adaptation of educational material for each learner. Another contribution to the idea of personalization is made by Alwusfar (2025) in her research where she proved that adaptive learning helps to improve user satisfaction and engagement due to the individual approach to content. Also, Ahmed et al. (2025) have shown that students who used the adaptive learning technology performed better in terms of engagement and academic results compared to traditional classes.

Supporting this notion, evidence from Hossain & Islam (2026) further supports the association between adaptive functionality and engagement. According to their findings, engagement levels were higher for the students who used AI adaptive LMS than for those who used traditional LMS, depending on the level of interaction with the platform, the number of quizzes taken, and self-reports of engagement. However, Baswardono et al. (2026) have pointed out one limitation in gamifying traditional LMS; namely, engagement methods must be adaptive rather than content-based.

The Nigerian literature offers a more context-oriented view of engagement. According to Adayilo et al. (2025), AI-based adaptive learning systems could be helpful in terms of enhancing learning achievements and engagement in the secondary schools of Nigeria; however, it is critical to mention the significance of appropriate infrastructure, preparation of educators, and system design. Similar results were reported by Biliaminu et al. (2026), who stated

that although the use of LMS has led to increasing education opportunities in Nigeria, engagement was still a challenge due to insufficient levels of digital literacy and lack of training of teachers.

The work by Umar et al. (2026) is especially valuable concerning the use of an adaptive LMS engagement model in a constrained Nigerian context. The authors managed to get their adaptive e-learning platform an 80.5 score on the System Usability Scale, a 79.5% rate of completed modules, and favorable perceptions from teachers about the platform's usefulness and behavioral intention. Moreover, learners with disabilities were able to acquire comparable educational results, showing that an adaptive and inclusive LMS can be effective and equitable without expensive hardware.

LMS Adoption

The second theme that comes up is the adoption and use of LMS systems among the students, lecturers, and other education institutions. Lintao et al. (2025) highlighted technology acceptance models, user engagement, and pedagogic innovations as the key themes in the adoption studies of LMS systems. They also conducted the bibliometric study that showed the significant growth in the studies on LMS systems from 2019 to 2025.

Technology Acceptance Model (TAM) has been widely used to explain LMS adoption. Mella-Norambuena et al. (2024) indicated that 69% of the theoretical models used in literature concerning the intention and LMS use by university professors were TAM. However, the review highlights a significant difference between intention to use and LMS use. More than 50% of the reviewed literature focused on the former, only 15% of the studies focused on the latter, while 31% considered both factors. This means that a positive attitude towards LMS adoption does not always lead to actual use of such technology. The implementation and training of institutional staff have also played a role in the adoption of technology. For instance, Adewumi et al. (2025) implemented Moodle technology in a Nigerian University through a process of planning, implementation, training, deployment, and evaluation.

Digital infrastructure and access form another vital aspect for adoption. Inadequate digital infrastructure, lack of access to digital tools, and poor internet connection have been cited by Ndibalema (2025) as major challenges for LMS adoption in the country's tertiary institutions. Unstable internet connections and high costs were some of the technical challenges for the adoption of e-learning reported by Abdulrasheed (2025). The case from Nigeria reveals that although basic LMS adoption is on the rise in the country, adoption of advanced and adaptive LMS systems is still low. According to Abuodha et al. (2024), LMS platforms were increasingly being used in Kenyan universities, but they were yet to adopt adaptive capabilities in their LMS systems. The authors suggested the use of machine-learning methods to help LMS platforms interpret data and automatically modify the learning process. Recently, Abduldayan et al. (2026) reported increasing awareness of AI technology among lecturers and students.

Adoption is also highly related to system quality, usability, trust, and satisfaction. Alwusfar (2025) stated that system quality is highly correlated with user satisfaction; reliability and usability were considered as key factors. User satisfaction can also be increased by data security and system reliability. It is evident from these results that the adoption and continued usage of the LMS by users will not be possible if it lacks reliability and usability.

Benefits of LMS

A LMS is quite effective in organizing and delivering the digital content. When making up your mind about implementing an LMS in your district, do not forget about some other benefits that LMS can offer (Chigozie-Okwum et al., 2018):

Communication: LMS facilitates communication with your students and parents outside the class through such instruments as: Discussion forums, Real-time messaging, Videoconferencing, E-mails, Announcement postings and many others.

Accessibility: Internet-based LMS is available to all students irrespective of their geographical location. This way, colleges and universities can cover a wide range of students.

Flexibility: Different people learn differently and LMS helps to provide necessary flexibility for everyone. Students are able to revise the information if needed and research further any topic of their interest.

Variety: The LMS accommodates diverse learning styles. The learner can access the content in audio, visual, pictures, articles, and simulation formats.

Collaboration: LMS tools aid students in collaborating on their group projects. Tools that allow group blogs and wikis are included in the platform to serve as a means of collaboration.

Community: An LMS tool facilitates a community of learners who work together towards the creation of knowledge. Discussion forums, linking and file sharing, and instant messaging facilities encourage student communities to form and share knowledge.

Types of E-Learning Platforms

E-learning systems may be classified into different categories according to their use in teaching and learning (Sifawa & Horo, 2026):

Learning Management System (LMS): LMS systems include Moodle, Blackboard, and Canvas, among others, which provide the means for managing, delivering, grading, and monitoring the courses.

Content Management System (CMS): CMS systems provide an opportunity to create, store and distribute content.

MOOCs: Massive Open Online Courses (MOOCs) are defined as platforms like Coursera, edX, and Udemy, which offer free large-scale classes online provided by well-known institutions.

Synchronous and Asynchronous Learning Platforms: This is where we have Zoom, Microsoft Teams, Google Meet, etc. They provide live classrooms (synchronous) or pre-recorded classes (asynchronous).

Collaborative Learning Platforms: This category includes platforms such as Edmodo and Google Classroom that focus on social learning.

Types of LMS

LMS is the software which has been customized in order to handle knowledge management, courses, and training in an efficient manner. It includes all the required training tools needed by the teachers, instructors, and trainees in order to design, deliver, and assess the training and development initiatives. It assists in making sure that all

students and other personnel in the educational institution are engaged within the framework of the institutional setting (Mufti et al., 2025). This section presents different types of LMS

Moodle: Moodle is a system used to develop online learning systems and other website forms. It is an international improvement project which aims at aiding a social constructivist in constructing a school. Initially, Moodle is an acronym for modular object-oriented dynamic learning environment and it is beneficial to both programmers and policymakers in the education sector.

Schoology: Schoology is a cloud-based LMS which facilitates course management, access to curriculum and supplementary material, and collaboration in a social network setting (Krouska et al., 2017).

Atutor: ATutor is an open-source LMS that is used in the development and delivery of online courses. Administrators have a very easy task in installing or updating ATutor, customization of themes and addition of new functionalities through feature modules. Educators can easily conduct online courses as well as manage the web based instructional contents. Students acquire knowledge in a learning environment that is adaptive and social in nature (Krouska et al., 2017).

Blackboard System: Blackboard is a LMS that is used not only as a repository of information but also as a means of communication through emails, announcements, discussion forums, and podcasts. The effective usage of Blackboard is completely dependent on the competence of the users. Users need to effectively use this educational technology in order to facilitate learning. Otherwise, it will be one step forward for technology and two steps backward for pedagogy (Elmabrok et al., 2026). According to (Akinselure, 2026), the National Universities Commission hosted a strategic engagement meeting with the Anthology Blackboard team in order to discuss the usage of Blackboard LMS in the country's universities.

Canvas Platform: This is a LMS which allows personalization of the interface according to what an institution or users desire, characterized not only by its pedagogical flexibility of its natural unity of applications, but also by its small possibility of errors and quickness in the execution of its functions. The Canvas platform includes several courses, fast updates, access to different educational applications that serve both teachers and students and above all, it gives the opportunity to manage five types of users: student, teacher, designer, observer and administrator. (Cieza-Mostacero, 2025).

Google Classroom: This is a cloud-based LMS that gives teachers the opportunity to make assignments, announcements and even formative questions for students to answer. Teachers can monitor how students perform and give them feedback in real-time as long as they are online. (Chahal, 2021).

Feature of LMS

Based on Ali et al. (2022), LMS must possess the following characteristics: 1. Robustness, availability at anytime and anywhere; 2. Scalability to accommodate future growth; 3. Interoperability to allow various resources that could be integrated into the existing systems; 4. Students-Centered with enhancement techniques; 5. Communication tools available for both: Instructor-Student and Students-Students' tools through discussion

boards, messages, and e-mails; 6. Ability to use multimedia material; 7. Stability and security, i.e., only authorized users can use the system.



Figure 1. Different Canvas tools (Chahal, 2021).

Benefits of Adaptive LMS

Today's e-learning systems are capable of developing and sharing educational content and collective intelligence. Students may search for the educational content on the Internet and determine whether the educational content is appropriate for the fulfillment of their learning goals. However, searching and organizing the appropriate content easily distracts learners from their learning process (Huang and Shiu, 2012). In order to deliver the appropriate educational content to the largest number of students of higher education institutions, open and flexible approaches and the development of adaptive systems should be used. The interest of higher education institutions in using the adaptive learning as an innovative approach based on data to the educational process is becoming more and more apparent. Nevertheless, the implementation of adaptive learning by higher education institutions does not proceed at a rapid pace in spite of promising results of recent researches concerning the effectiveness of this approach (Morze et al., 2021). To enhance the advantages of adaptive LMS, Angeioplastis et al. (2026) incorporate AI into Moodle LMS called PREPARE (Personalized Education Framework for AI-Enabled Adaptive and AR-Enhanced Learning); Adaptive learning in PREPARE is achieved by using continuous learner profiling and personalization features. When the course starts, learners take the Index of Learning Styles (ILS) quiz based on the Felder-Silverman Learning Style Model (FSLSM) that covers the following four dimensions: Active-Reflective,

Sensing-Intuitive, Visual-Verbal, and Sequential-Global. The learner profile thus obtained offers a static picture of the learner's preferences and helps personalize the learning process at an early stage. In support of the above, in the research conducted by (Katsaris et al., 2026), the researchers proposed a hybrid Recommendation Approach for Adaptive Worksheet; the worksheet engine is the core orchestration service and connects with the other services including the user profiling, learning styles, learning methods, learning subjects and learning objects through lightweight RESTful interfaces. The other services provide inputs required for creating personalized worksheets.

Stages of Implementing Adaptive LMS

According to (Morze et al., 2021) this section presents the stages involved in implementing adaptive LMS:

Stage 1: Learner's log into the e-learning system and choose a course to study. Every learner is registered in all the courses of his/her educational program, each course being associated with certain semesters.

Stage 2. Learners are offered a pre-test and/or survey to assess their level of knowledge, learning styles, desired learning outcomes. Test results will be used as the basis for generating a learning path. Gaps in knowledge are also detected at this stage.

Learning path generation stage. At this stage learners should be offered individual learning paths based on the test results at Stage 2. There are no automated tools available in Moodle LMS to offer this stage. Therefore, other tools have to be used to implement this stage and generate individual learning trajectories for learners.

Learning stage: This stage involves identification of recommended material and a student is dealing with the content of a course. To ensure flexibility of the content microlearning is utilized. Content divided into small logically complete units can be easily accessed in any activity or resource that takes place at this stage of learning. Deferred Feedback or Immediate Feedback mode with Certainty-based marking (CBM) are the modes when the student does not only answer the question but also states the degree of their confidence in the answer.

Post-test stage: As soon as the learner has completed the whole learning path, it becomes necessary to assess the efficiency of learning and make certain changes, if needed. Summative assessment can be done through tests, projects (either individual or group one) or speech, etc. Therefore, such activities as Quiz, Workshop and Assignment prevail at this stage. It becomes necessary to analyze the results of summative assessment to identify strong and weak points of the e-learning course and make plans for the further improvement of it.

Barriers to Adoption of Adaptive LMS

Skills and Training of Users: Digital illiteracy and low levels of self-efficacy among some teachers and learners can be named as an important barrier. Particularly in case of less technologically advanced faculty members, poor ICT skills become a barrier to adopting complex LMS functions. The fear or anxiety about adopting new methods becomes an additional barrier (Haibao, 2025).

Technological Barriers: The next group of barriers is purely technological and relates to issues of unreliable infrastructure and access. Poor internet connectivity and bandwidth problems influence the functioning of LMS. This problem is mentioned as the most significant one in developing and rural countries (Haibao, 2025).

Usability and design challenges. If the LMS interface is difficult to navigate, not designed for mobile devices, or slow in performance, then users may see it as too much hassle. Particularly, students tend to quickly compare the LMS to other modern user-friendly applications. When the LMS seems outdated, or when the course material is poorly organized in online mode, then the users' involvement decreases (Haibao, 2025). Resistance to Change and Low Acceptance Adoption of LMS tools is usually restricted by cultural resistance, especially from staff who are used to conventional face-to-face approach. Students are faced with several barriers as well, such as low digital literacy, lack of motivation, and difficulties with navigating the LMS interface (Mbewe, 2025).

Limited budget: The limitations imposed by the budget do not only restrict the possibilities of financing the technological needs of the institution but also restrict the possibilities of training the educators and the learners (Muraina et al., 2025).

Long Term Effect of Adaptive LMS on Student Engagement

(Mufti et al., 2025) in the modern world, the application of AI to the field of education makes it possible to create innovative environments of teaching and learning. The implementation of personalized learning demonstrates that the process of education can be enhanced infinitely and make it possible to select the best materials and teaching approaches considering the unique characteristics of each individual learner.

Intelligent tutoring systems and other artificial intelligence solutions use machine learning techniques to evaluate the knowledge of the learners and to provide them with appropriate instruction and feedback which is useful for bridging the gap in the knowledge of each particular learner and for their progress at an optimal speed (Kehind-Awoyele et al., 2024). Student engagement is a very important factor in the process of academic success which involves several dimensions such as behavior, emotions, and cognition (Fredricks et al., 2004).

Recent research has demonstrated that the application of AI-based instructional strategies may influence positively the learning outcomes of the students, in particular, the results in such areas as knowledge retention and development of problem-solving and critical thinking skills. By using customized instruction and allowing the students to learn at their own speed, it is possible to maximize their learning potential (Kehind-Awoyele et al., 2024).

Theories in Distance Learning

As defined by (Usta et al., 2026), Transactional Distance Theory (TD) theory is the one that explains the psychological and communicative distance that develops between learners and the instructor, course content, and learning environment. The psychological distance develops where there is not enough dialogue, course structure fails to meet the learner's needs, or learners face problems managing their learning processes. It is believed that such a psychological distance has a vital role in the participation of the learners in the learning process. In case of failing to notice the development of this distance, the learners become disengaged in the learning process. Moore says that in all kinds of distance learning, the physical distance between the instructor and the learner is secondary to the TD and success in distance education can only be gained by reducing the psychological distance and not the physical one.

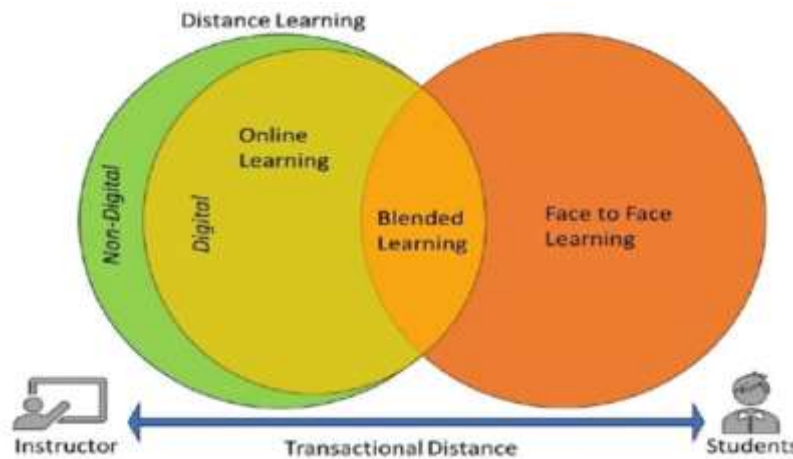


Figure 2. Diagrammatic representation of Transactional distance (Achuthan et al., 2024).

(Sanal et al., 2025) Self-Determination Theory (SDT) provides a theoretical framework and practice for more effective and highly motivated university students in distance education. The SDT is known as a universal macro theory which stresses that high success in the learning process relates to high motivation. The SDT is an approach which encourages and facilitates personal development and well-being, motivation, competence and sustainability of well-being in different contexts. Self-Determination Theory of E-Learning or learning independence is one of the skills that must be developed by students who adopt the distance learning method or e-learning learners.

Table 1. Summary of Reviewed Literature.

Author & Year	Methodology	Results	Limitation
Adewumi et al. (2025)	Pragmatic mixed-methods approach involving LMS implementation	Moodle implementation increased awareness	Focused mainly on LMS implementation, training and lecturer acceptance
Lintao et al. (2025)	Bibliometric analysis	LMS research increased substantially from 2019–2025	Did not directly evaluate the effectiveness of LMS adoption
Gligorea et al. (2023)	Literature review	AI/ML algorithms support personalized learning experiences	Did not focus on a specific adaptive learning application
Herniawati et al. (2025)	Follow PRISMA procedure	LMS use was associated with increased motivation, student engagement	Less focus on adaptive LMS
Alwusfar (2025)	Quantitative survey research using Structural Equation Modeling (SEM)	adaptive learning improved satisfaction and engagement	the study focused primarily on satisfaction
Ndibalema (2025)	Qualitative case study	Inadequate infrastructure were barriers to LMS use	Conducted in only two universities
Mella-Norambuena et al. (2024)	Employed PRISMA approach	Technology Acceptance Model was the dominant framework (69%)	Heavy reliance on TAM may not adequately explain engagement, or adoption of adaptive LMS features

Baswardono et al. (2026)	Literature synthesis examining AI, Felder-Silverman Learning Style Model in LMS	Adaptive gamification provides opportunities for more personalized engagement	Focuses mainly on adaptive gamification
Abuodha et al. (2024)	Employed ML IN LMS	Universities use LMS	The study is proposal oriented
Ahmed et al. (2025)	Employed quantitative experimental study	AI-integrated adaptive learning leads to higher academic performance	Conducted among undergraduate students in public universities, limiting generalization to distance-learning contexts
Hossain & Islam (2026)	Quantitative quasi-experimental design using a simulated dataset of 2,120 undergraduate students	Students using AI-adaptive LMS achieved higher post-test scores	Original LMS data was not used
Biliaminu et al. (2026)	Literature review	Consider SDG-4, LMS expanded access and flexibility but also exposed digital divides	Less focus on adaptive LMS adoption
Adegbiyi et al. (2026)	Quantitative research	During pandemic, students demonstrate positive attitudes toward digital technologies	Less focus on long-term adoption of adaptive LMS technologies
Sa'ad & Isa (2025)	Review-based research	LMS serves as a mechanism to expand accessibility	limited empirical evidence for user engagement and adoption
Abdulrasheed (2025)	Mixed-methods study	Accessibility, usability, and content quality predicted academic experience	Focus on only one institution (NOUN)
Sidi et al. (2026)	Mixed-methods design	Higher frequency of e-learning platform use	Less focus on specific adaptive features
Adayilo et al. (2025)	Empirical investigation	Given adequate infrastructure, AI adaptive learning boosts student outcomes, engagement, and satisfaction	Focused on secondary education, which may limit applicability to higher education
Umar et al. (2026)	Mixed-methods using SUS, TAM, platform analytics, and interviews	The adaptive platform achieved SUS of 80.5, module completion of 79.5%	Cannot generalize because it focused on a specific Physics department
Abduldayan et al. (2026)	Empirical investigation	AI awareness is increasing, but adoption of AI-enabled LMS remains low	Limited evidence exists on the long-term impact of AI-LMS on student engagement

Proposed framework for Adaptive LMS for Student Engagement and Adoption

The framework involves integrating an adaptive learning engine in the traditional LMS. The framework gathers details about the learner and monitors the learners' interactions with the system at all times. This information is analyzed and used to develop the learner's profile, which is used to modify the learning process.

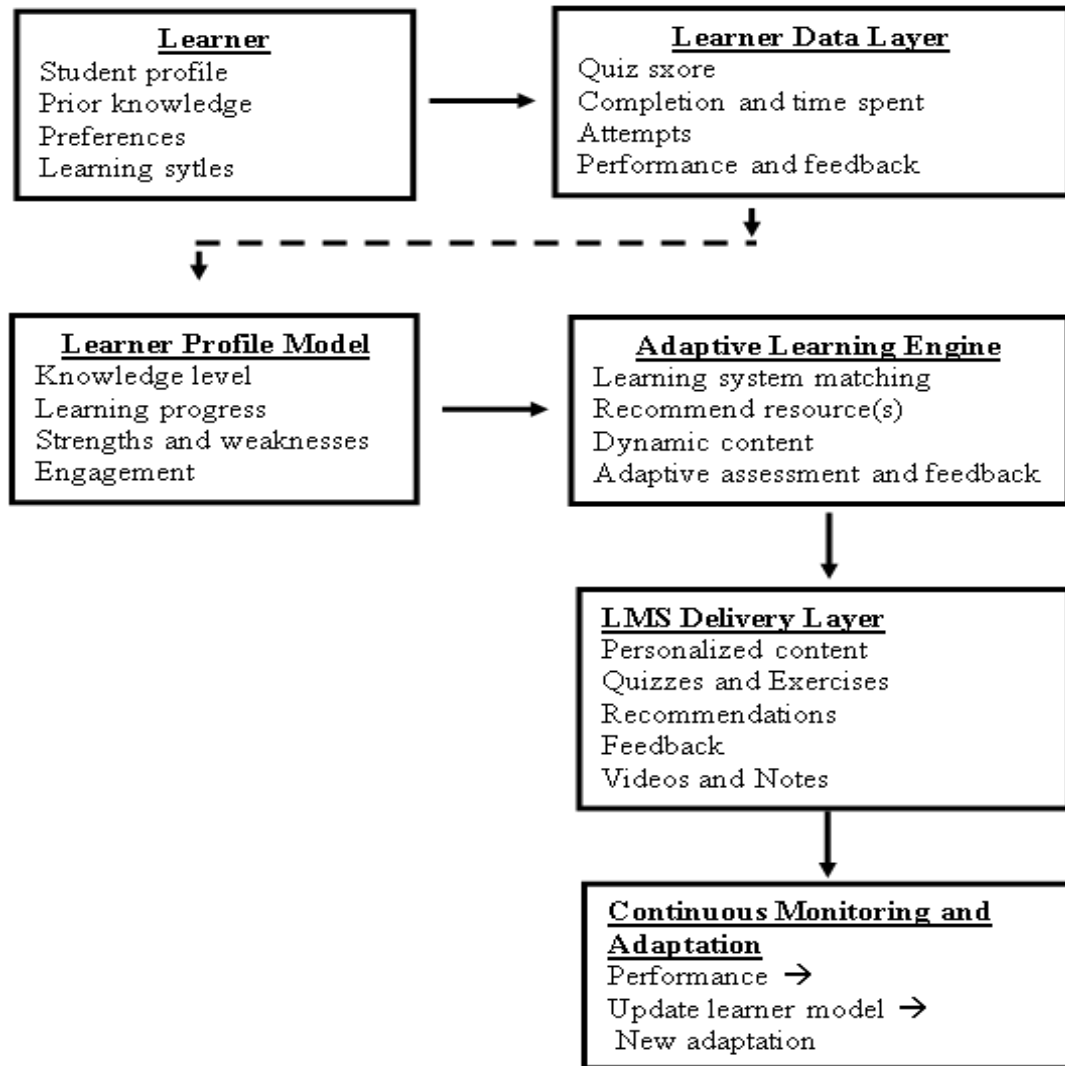


Figure 3. Proposed Diagram of the Adaptive LMS.

The proposed architecture is made up of different components that have been put together with the aim of incorporating the capacity for adaptive learning into an LMS. The Learner Profile Manager acts as the basis of the architecture in that it keeps all relevant data related to the learner, which includes past learning experience, performance, preferences, and progress.

This is supported by the Adaptive Assessment Engine, which modifies the level of assessment questions depending on past learner performance. If learners are doing well, they will be given harder questions to answer; if they are having trouble, they will be given easier questions.

Recommendation Engine recommends learning resources tailored to each learner according to his/her performance, learning needs, preferences and past interaction with the LMS. The recommended resources may range from videos, notes, interactive materials, practice materials, examples and other supporting material. Adaptive Feedback Engine gives personalized and immediate response to any activity by learners rather than just informing if something is right or wrong. The engine is able to detect the areas of difficulty and suggest corrective action as well as learning material. The strategy will ensure that feedback is used as a tool for the continuous improvement of the performance of the learners.

Learning-Preference Matching Module uses the information on how the learner prefers to interact with the learning materials in order to determine the appropriate form of the content. For instance, learners who prefer visual material will get more illustrations and videos while text-based learners will get more notes and readings.

3.0. Methodology of the Study

The current study is based on a compilation of literature and publicly available information with respect to the use of adaptive LMS for flexible distance learning in education. The study uses articles in various academic databases including Google Scholar, Research Gate, Citeseerx, ScienceDirect, Scopus using search strings like (“adaptive LMS” OR “flexible learning” OR “distance learning”) AND (“user engagement” OR “adoption” OR “acceptance” OR “barriers”) AND (“Self-determination theory in distance learning” OR “transactional distance theory in distance learning”)

Database Search

A research strategy was developed and implemented to find different databases that would have recent and pertinent research articles related to this topic: Flexible Distance Learning with Adaptive LMS: Engagement, Adoption and Barriers - Systematic Literature Review. The timeline of this research is from 2016 to date.

Review Strategy

In the current study, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach was adopted to ensure transparency, reproducibility, and rigidity in selecting the relevant literature. Language: English; Publication type: Peer-reviewed journal papers and conference papers; Area: Education; Availability: Full-text. The Figure presented below represents an analysis of the comments on the PRISMA approach.

Search Stage

Search Stage 1 (Extraction)

An extensive search was done from five (5) electronic databases. This resulted in a total of 254 articles which had to go through a meticulous process of screening.

Search Stage 2 (Screening)

After getting rid of duplicate articles and irrelevant articles, there was a certain number of articles left for analysis.

Search Stage 3 (Eligibility)

A total of 91 articles were considered relevant for the research while doing relevant literature. After this, some articles were eliminated because of the lack of methodology and only depending on the abstracts due to the payroll limitation.

Search Stage 4 (Inclusion)

Out of 254, 55 articles were chosen as relevant to the research.

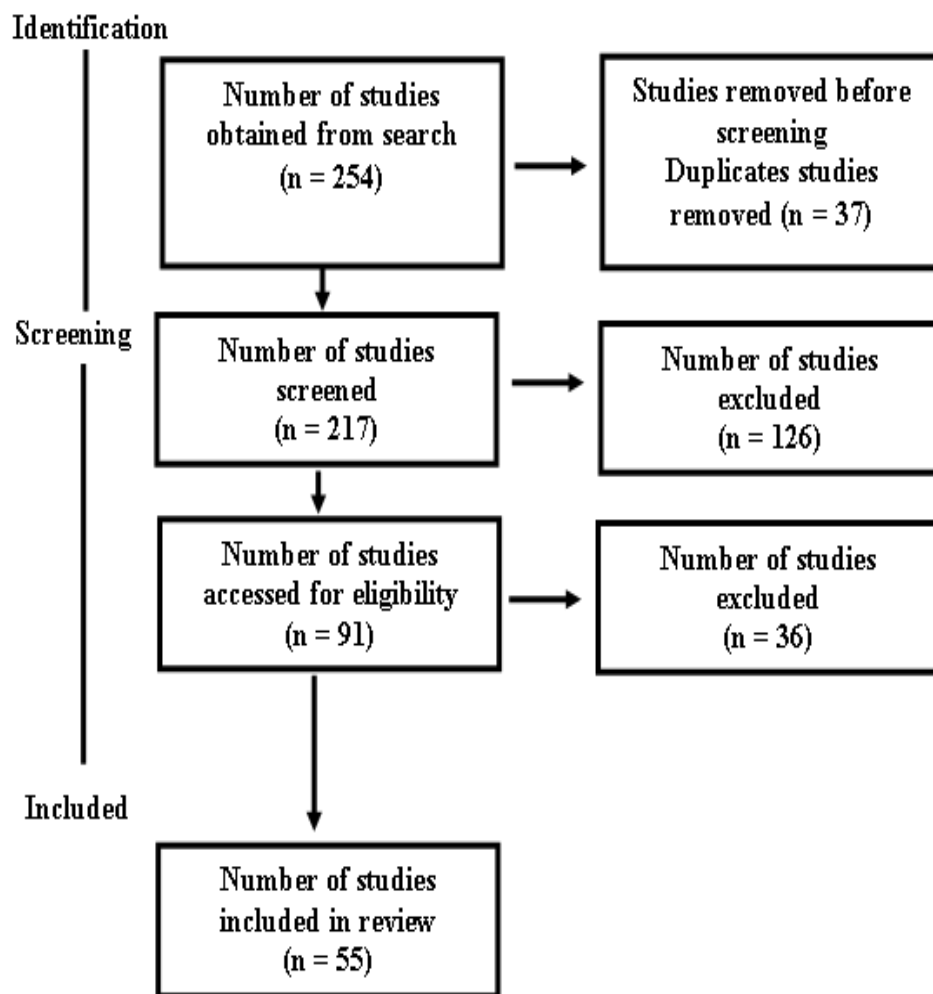


Figure 4. Feedback of the PRISMA Analysis.

4.0. Discussion

From the results obtained from the reviewed literature, it is clear that LMSs have been proven to be one of the essential elements of flexible distance education, but the success of these systems largely depends on how they are designed and implemented in the learning process of both the users and educators. The common themes identified from the reviewed literature were user engagement and adoption of LMSs. The use of artificial intelligence (AI) and adaptive learning was another emerging trend.

User Engagement

Research evidence suggests that the use of LMSs can have a positive impact on student engagement in cases where the learners are offered accessible, interactive, and personalized learning opportunities. According to Herniawati et al. (2025), LMS systems help develop learning motivation and increase student engagement. In the same way, Sidi et al. (2026) identified the significant positive connection between e-learning platform usage frequency and students' cognitive and affective engagement. Personalization appears to be another important approach to increase engagement based on the reviewed literature. Gligorea et al. (2023) note that AI and machine-learning techniques can enable personalized learning experience, while Hossain and Islam (2026) and Ahmed et al. (2025) indicate the increased student engagement and achievement among the users of adaptive learning enabled by AI.

LMS Adoption

There is evidence from the literature that indicates that LMS adoption is determined by technology, individual, and organizational factors. According to Mella-Norambuena et al. (2024), the Technology Acceptance Model (TAM) was the most popular model utilized in 69% of research reviewed by the researchers. The same conclusion was drawn by Adewumi et al. (2025), who highlighted the significance of implementation, training, deployment, and evaluation in the context of adopting Moodle in a Nigerian university. The quality of the system is also an important aspect that influences LMS adoption. Specifically, Alwusfar (2025) identified a significant influence of system quality on user satisfaction, including its reliability and usability.

Barriers to Adoption and Engagement

Although the implementation of LMSs offers numerous advantages, various limitations have been noted in the literature that may limit their adoption and use. The factors that limit adoption include lack of digital infrastructure, lack of access to digital devices, lack of internet connectivity, lack of capacity building, and lack of institutional support, as noted by Ndibalema (2025). Issues of this kind are also noted in Nigeria by Biliaminu et al. (2026), who indicated that although LMS adoption increased educational flexibility, it also increased the digital gap among poor and rural students. This finding is important to the proposed theoretical framework, in that it shows that adaptive feature should be combined with usability, accessibility, and proper content delivery in the proposed model. If the advanced LMS system lacks accessibility, it will fail to address issues of flexible distant learning.

Adoption of AI-Enabled Adaptive LMS

A crucial point from the above synthesis is the difference between traditional LMS and adaptive LMS adoption. Abuodha et al. (2024) found out that universities have greatly adopted LMS platforms but not adaptive LMS. This is even more apparent in Abduldayan et al. (2026) where they discovered that there is increasing awareness of AI technologies by both lecturers and students, yet adoption of such technology in LMS is still low to moderate. The Nigeria case also shows that adaptive learning is possible if there is proper implementation. In a study conducted by Adayilo et al. (2025), it was found out that AI-based adaptive learning systems can enhance learning and engagement in Nigeria when there is proper infrastructure, preparation of educators, and design considerations. This is further supported by Umar et al. (2026) where there is an illustration of adaptive e-learning being practical in Nigeria as shown by scores of 80.5 System Usability Scale, 79.5% completion of modules, as well as positive perception of usefulness and behavioral intentions by teachers.

Implications for the Proposed Framework

Overall, the results support the Adaptive Learning Integration Framework for Flexible Distance Learning (ALIF-FDL). In the literature review, it was found that the traditional LMS approach where the students are subjected to a rather uniform set of learning content and assessments does not take into account the diversity in terms of abilities, pace, preferences and level of engagement of the learners. For this reason, the suggested ALIF-FDL proposes a concept of adaptive learning engine that employs the learner's data and interactions to customize the learning process. In conclusion, the literature supports the concept of an LMS architecture (that is used in order to develop ALIF-FDL) where the learner's data are constantly analyzed.

5.0. Conclusion

LMSs have proven to be an integral part of flexible distance learning due to the fact that they offer the chance to interact with educational materials outside the traditional classroom environment. Nevertheless, it has been revealed from the literature that the potential of LMS systems in enhancing flexible learning is limited by the fact that most LMS platforms offer standard learning experiences. While more institutions are adopting the LMS system, especially at the university level, some of its advanced features such as adaptive learning, predictive analytics, automation of assessment, and personalized learning have not yet been utilized. Another conclusion made by this study is that learner engagement is closely linked to personalization and the learner's interaction with the LMS. Therefore, an ideal flexible distance-learning LMS will not only make available learning materials but will constantly adapt the learning experience based on the needs of the learners. Unreliable internet connection, poor access to devices, high cost, lack of training and digital divide are some of the challenges that may hinder the learner from reaping the maximum benefits from the LMS platforms. This challenge is quite applicable in developing countries and even Nigeria in particular. Using the thematic synthesis, the research concludes that the integration of adaptive learning capabilities in an LMS can be done using the Adaptive Learning Integration Framework for Flexible Distance Learning (ALIF-FDL). Therefore, it can be concluded that the change from traditional LMS to adaptive LMS is an important avenue for flexible distance learning. However, for successful implementation, there must be balance between technology intelligence and human intelligence.

6.0. Recommendations

Based on the findings of the study, the following suggestions are proffered in order to enjoy the benefits of implementing flexible distance learning with adaptive LMS in education:

1. Institutions should incorporate adaptive learning abilities into the current LMS platforms to go beyond traditional one-size-fits-all approach to learning. This should be done through dynamic content sequencing, adaptive assessment, resource recommendation, adaptive feedback and learning preferences matching.
2. Institutions should invest in enhancing their digital infrastructure and accessibility by improving internet connectivity, making available enough digital devices and lowering cost associated with technology, especially among learners from remote areas and those living in poverty.
3. Training and capacity building initiatives should be regularly conducted for lecturers and students to enhance their digital skills, thus enabling them to effectively use LMS and AI enabled adaptive learning functions.
4. Developers and institutions of LMS should consider usability, reliability, security and user trust when incorporating adaptive learning systems. Adaptive learning capabilities should be developed with learners in mind and at the same time be reliable, secure and easily usable.
5. Future researches should focus on empirical evaluation of adaptive LMS using actual data collected from learners and indicators such as engagement, adoption, academic performance, usability and user satisfaction. More emphasis should also be made on the adoption of advanced AI functions in future, considering the literature indicates that most institutions use LMS only for instructional purposes.

Declarations

Source of Funding

This study did not receive grant from any funding agencies in the public, commercial, or not-for-profit sectors.

Competing Interests Statement

The authors declare no competing professional, personal or financial interests.

Consent for Publication

The authors declare that they consented to the publication of this article.

Contributions of Authors

All the authors made an equal contribution from conceptual design, data collection, drafting the article to revision of the article. All the authors have read and approved the final copy of the manuscript.

References

- Abduldayan, H.A., Jibril, F.N., & Tizhe, M. (2026). Implementing AI-enabled learning management system for colleges of education in Kwara State: Insights from a systematic review. 28(1).
- Abdulrasheed, A. (2025). Impact of e-learning platforms on academic experience at National Open University of Nigeria. *Journal of Education Research and Library Practice*. <https://doi.org/10.70382/ajerlp.v10i8.071>.
- Abuodha, L.A., Busi, M.K., & Masese, N. (2024). Using machine learning techniques to enhance adaptive learning management system in the case of Kenyan universities. Pages 385–391. <https://doi.org/10.47772/ijriss.2024.807032>.
- Achuthan, K., Muthupalani, S., Kolil, V.K., & Raman, R. (2024). Transactional distance theory in distance learning: Past, current, and future research trends. *Contemporary Educational Technology*, 16(1). <https://doi.org/10.30935/cedtech/14131>.
- Adamu, A.U. (2022). Status of open and distance learning in Nigeria. *Commonwealth of Learning*. <https://doi.org/10.56059/11599/4070>.
- Adayilo, D.M., Oyefolahan, I.O., Anekwe, N., & Ndunagu, J.N. (2025). Developing adaptive learning systems leveraging artificial intelligence for personalised education in Nigeria. In 1st International Hybrid Conference of Faculty of Science, Gusau, Nigeria. <https://doi.org/10.57233/ihcfs.014>.
- Adegbiyi, A.T., Adeleke, I.A., & Abdulrauff, M.F. (2026). Digital classroom technology strategy adoption as academic innovativeness and technological development in less digitalized nations during pandemic lockdown. *Journal of Advanced Science and Optimization Research*, 12. <https://doi.org/10.70382/sjasor.v12i9.062>.
- Adewumi, S.E., Ogbuju, E., & Ihinkalu, O. (2025). Institutionalizing learning management system: An open distance learning approach. *Kasu Journal of Computer Science*, 2(1): 70–85. <https://doi.org/10.47514/kjcs/2025.2.1.007>.

- Akinselure, W. (2026). 2026 UTME sparks kudos, knocks [Online]. Punch.
- Akinselure, W. (2026). NUC, Blackboard LMS push for data-driven digital learning in universities [Online]. Punch.
- Ahmed, S., Rehman, H.U., Zaheer, M.Z., & Pervez, N. (2025). The impact of AI-powered adaptive learning systems on student performance in higher education. *Social Science Review Archives*, 3(4): 133–145. <https://doi.org/10.70670/sra.v3i4.1103>.
- Al-Dhief, F.T., Al-Nasser, A., Tharikh, S.M., & Al-Nasser, H. (2024). Review of learning management systems: History, types, advantages, and challenges. *Indonesian Journal of Electrical Engineering and Computer Science*, 33(1): 350–360. <https://doi.org/10.11591/ijeecs.v33.i1>.
- Ali, S.S., Moawad, I.F., & Helmy, Y.K. (2022). Challenges of learning management systems and current trends. *International Journal of Advanced Engineering Management and Science*, 8(9): 15–24. <https://doi.org/10.22161/ijaems.89.3>.
- Alikor, O., & Okachiku-Agbaraeke, S. (2025). Education for a productive society in 21st century Nigeria: The relevance of social justice. *International Journal of Research and Innovation in Social Science*, Pages 1796–1803. <https://doi.org/10.47772/ijriss.2025.903sedu0137>.
- Al-Khresheh, M. (2022). Revisiting the effectiveness of Blackboard learning management system in teaching English in the era of COVID-19. *World Journal of English Language*, 12(1). <https://doi.org/10.5430/wjel.v12n1p1>.
- Alwusfar, L.A. (2025). Improving learning management system performance: A comprehensive approach to engagement, trust, and adaptive learning. *IEEE Access*, 13: 46408–46425. <https://doi.org/10.1109/access.2025.3550288>.
- Angeioplastis, A., Konstantakis, M., Aliprantis, J., Ordoumpozanis, K., Varsamis, D., & Tsimpiris, A. (2026). AI for all: Adaptive, accessible, and inclusive learning experiences in the age of intelligent LMSs. *Information*, 17(2): 216. <https://doi.org/10.3390/info17020216>.
- Ashraf, N., & Ali, A. (2025). Flexibility and freedom: A comprehensive study of distance education in 21st century at higher education in Pakistan. *Journal of Social Sciences Review*, 5(1): 390. <https://doi.org/10.62843/jssr.v5i1.504>.
- Baswardono, W., Kurniawan, B., Hasibuan, Z.A., Supatmi, S., & Osma, A.N. (2026). Adaptive gamification in learning management systems: A systematic literature review. 1(2). <https://doi.org/10.66472/dimuvi.v1i2.408>.
- Bilaminu, B.M., Olaniyan, M.F., Odegbemi, C.D., & Odegbemi, O.B. (2026). The impact of learning management systems stimulated by the COVID-19 pandemic on SDG 4 in Nigeria: Quality education. *Discover Education*. <https://doi.org/10.1007/s44217-025-00781-3>.
- Chahal, K.S. (2021). Features of learning management systems (LMS) for improving teaching and learning. *Journal of Interdisciplinary Cycle Research*, 13(11): 192–206.

Chigozie-Okwum, C.C., Ezeanyej, P.C., & Odii, J.N. (2018). Adoption of learning management systems in Nigerian tertiary institutions: Issues and challenges. *International Journal of Computer Applications*, 181(30). <https://doi.org/10.5120/ijca2018918173>.

Cieza-Mostacero, S.E. (2025). Canvas LMS and the learning process: An explanatory study. *TEM Journal*. <https://doi.org/10.18421/tem144-77>.

Darwin, D., & Chaeruman, U.A. (2022). The implementation of self-determination theory in e-learning to improve listening skills. *Journal of Education Research and Evaluation*, 6(2): 264–272. <https://doi.org/10.23887/jere.v6i2.35693>.

Dube, S., Madzore, A., Dube, S.P., & Mpande, B. (2026). Enhancing personalized e-learning systems in higher education through artificial intelligence: A rapid systematic literature review. *International Journal of Research and Innovation in Social Science*, 10(2). <https://doi.org/10.47772/ijriss>.

Elmabrok, A.S., Mohamm, S.A., Nassib, H.F., & Sulieman, R.F.M. (2026). Learning management system in higher education case study (Blackboard system).

Gligorea, I., Cioca, M., Oancea, R., Gorski, A.T., Gorski, H., & Tudorache, P. (2023). Adaptive learning using artificial intelligence in e-learning: A literature review. *Education Sciences*, 13(12): 1216. <https://doi.org/10.3390/educsci13121216>.

Haibao, C. (2025). Barriers to learning management system usage in higher education: A mixed-methods study in Malaysia. *International Journal of Research and Innovation in Social Science*, 9(10). <https://doi.org/10.47772/ijriss>.

Hameed, S.Q., & Hasan, H.S. (2021). Learning management system developments and challenges: A literature review. *Mesopotamian Journal of Computer Science*, 2021: 35–43. <https://doi.org/10.58496/mjcs/2021/005>.

Herniawati, A., Holifah, L., & Syakur, A. (2025). Effectiveness of learning management system (LMS) use in higher education. *International Journal Corner of Educational Research*, 4(1): 20–29. <https://doi.org/10.54012/ijcer.v4i1.625>.

Hossain, E., & Islam, M.S. (2026). AI-based adaptive learning systems and student academic performance. *International Journal of Research and Innovation in Social Science*, 10(5): 5–17. <https://doi.org/10.47772/ijriss.2026.100500002>.

Katsaris, I., Sfakiotakis, S., Logothetis, I., & Vidakis, N. (2026). A hybrid recommendation approach for adaptive worksheet generation using pedagogically structured learning objects. *Information*, 17(5): 437. <https://doi.org/10.3390/info17050437>.

Kehind-Awoyele, A.A., Adeowu, W.A., & Oladejo, B. (2024). Enhancing classroom learning: The impact of AI-based instructional strategies on student engagement and outcomes. *International Journal of Research and Innovation in Social Science*, Pages 5732–5742. <https://doi.org/10.47772/ijriss.2024.803429s>.

- Keleş, M.K., & Özel, S.A. (2016). A review of distance learning and learning management systems. In *Virtual Learning*. <https://doi.org/10.10.5772/65222>.
- Krouska, A., Troussas, C., & Virvou, M. (2017). Comparing LMS and CMS platforms supporting social e-learning in higher education. In *2017 8th International Conference on Information, Intelligence, Systems & Applications*. <https://doi.org/10.1109/iisa.2017.8316408>.
- Kuwar, P.R. (2025). Impact of education on economy. *Triyuga Academic Journal*, 2. <https://doi.org/10.3126/taj.v2i1.45620>.
- Lim, E.H., Muniandy, M., Cheang, K.W., Chai, T.Y., Yoing, T.F., & Kok, H.M. (2026). Intelligent learning pathways: A customizable LMS framework for modern education. *International Journal of Information and Education Technology*, 16(2). <https://doi.org/10.18178/ijiet.2026.16.2.2516>.
- Lintao, G., Budasi, G., Atmadja, A.T., & Mahayanti, N.W.S. (2025). Learning management system adoption in adults' continuing learning: A bibliometric analysis. *Journal of Cultural Analysis and Social Change*. <https://doi.org/10.64753/jcasc.v10i2.2067>.
- Mbewe, S.L. (2025). Challenges and barriers to learning management systems adoption in higher education: A thematic literature review.
- Mella-Norambuena, J., Chiappe, A., & Badilla-Quintana, M.G. (2024). Theoretical and empirical models underlying the teaching use of LMS platforms in higher education: A systematic review. *Journal of Computing in Higher Education*, 12: 997–1023. <https://doi.org/10.1007/s40692-024-00336-9>.
- Morze, N., Varchenko-Trotsenko, L., & Terletska, T. (2021). Stages of adaptive learning implementation by means of Moodle LMS. In *Myroslav I. Zhaldak Symposium on Advances in Educational Technology*. <https://doi.org/10.5220/0012065500003431>.
- Mufti, S., Arshad, M., & Akbar, A. (2025). The long-term impact of artificial intelligence-enhanced learning management system on student engagement and retention. *Research Journal for Social Affairs*, 3(6): 1175–1183. <https://doi.org/10.71317/rjsa.003.06.0587>.
- Muraina, I.S., Agoi, M.A., Abam, S.O., & Ayinde, B. (2025). Barriers and enablers of e-learning technology adoption and diffusion among Nigerian undergraduate students: An evaluative analysis. *E-Learning Innovations Journal*, 3(2): 55–72. <https://doi.org/10.57125/elij.2025.09.25.03>.
- Ndibalema, P. (2025). Perspectives on the use of learning management systems in higher learning institutions in Tanzania: The gaps and opportunities. *Social Sciences & Humanities Open*, 11: 101463. <https://doi.org/10.1016/j.ssaho.2025.101463>.
- Niazi, A. (2025). Education is the foundation of individual growth and social progress. *Integrated Journal for Research in Arts and Humanities*, 5(4): 80–83. <https://doi.org/10.55544/ijrah.5.4.11>.
- Ramon-Yusuf, S. (n.d.). Trends in open and distance learning in the Nigerian university system [Online]. Academia.edu.

Ruga, S.N.M., Gikonya, N.W., & Kyalo, D.N. (2024). Impact of learning management systems on distance learners' academic progress in Kenya's public universities: A descriptive survey. *International Journal of Research and Innovation in Social Science*. <https://doi.org/10.47772/ijriss.2024.803147s>.

Sa'ad, M., & Isa, A. (2025). Learning management systems: A potent tool for transforming the Nigerian education system beyond the classroom. *International Journal of Innovative Information Systems & Technology Research*, 13(3): 132–140.

Samuel, E.U., & Ogu, O.G. (2025). The future of open and distance learning in Nigeria: Opportunities and challenges in higher education. *Naveen International Journal of Multidisciplinary Sciences*, 1(4): 66–79. <https://doi.org/10.71126/nijms.v1i4.39>.

Sanal, S.O., Torun, F., & Guler, T.D. (2025). Examining self-determination theory in the context of higher education and distance education. *International Journal of Technology in Education*, 8(4): 1079–1100. <https://doi.org/10.46328/ijte.1245>.

Sidi, A., Muhammad, M.A., & Muhammad, D. (2026). Assessing the influence of e-learning platforms on student engagement and academic achievement in multidisciplinary courses at Umaru Ali Shinkafi Polytechnic, Sokoto. *International Journal of Innovative Social & Science Education Research*, 14(2): 189–197.

Sifawa, A.S., & Horo, H.A. (2026). Challenges faced by students in using e-learning platforms for teaching and learning at Shehu Shagari College of Education, Sokoto. *Journal of Contemporary Education Research*. <https://doi.org/10.70382/hujcer.v11i8.043>.

Trautwein, C., Bettinger, R., Rebien, J., Pampel, A.M., & Hast, M. (2026). Distance learning as the higher education format of the future? The importance of the study entrance phase. *Beiträge zur Hochschulforschung*, 48(1): 84–105. <https://doi.org/10.25656/01:35007>.

Umar, A.Y., Saidu, R., & Rdadi, S. (2026). Design, development, and evaluation of an adaptive e-learning platform for physics education: An implementation study from a Nigerian college of education, Katsina. *International Journal of Research and Scientific Innovation*, 13(6). <https://doi.org/10.51244/ijrsi>.

Usta, I., Ugurhan, Y.Z.C., & Ozen, E. (2026). Development and validation of a multidimensional perceived distance scale in open and distance learning: A transactional distance theory-based approach. *European Journal of Educational Research*, 15(4): 1025–1046. <https://doi.org/10.12973/eu-jer.15.4.1025>.