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The journey and the impact of Artificial Intelligence on LMS in a Mozambican Higher Education Context

O percurso e o impacto da Inteligência Artificial em LMS no Contexto do Ensino Superior Moçambicano

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Abstract. In the evolving landscape of global education, Artificial Intelligence's (AI) integration into Learning Management Systems (LMS) promises a transformative shift. This paper presents Mozambique's journey in this domain, comparing it with global advancements. While the Mozambican higher education sector stands at the cusp of a digital revolution, its engagement with AI in LMS remains foundational. This is juxtaposed against the global trend where AI tools, such as ChatGPT, are rapidly becoming standard in many educational platforms, enhancing personalization, efficiency, and data-driven insights. The benefits of AI integration, such as tailored learning experiences and administrative automation, are counterbalanced by challenges, including data privacy concerns and over-reliance on technology. Drawing from real-world case studies, the paper highlights pioneering endeavours that showcase AI's potential in reshaping educational paradigms. As Mozambique navigates its unique challenges, insights from global best practices offer a roadmap for harnessing the transformative potential of AI in LMS, aiming to elevate its higher education sector to new heights.

Keywords: Artificial Intelligence, Learning Management Systems, Mozambique, Higher Education, LMS

Resumo. Na evolução da educação global, a integração da Inteligência Artificial (IA) nos Sistemas de Gestão de Aprendizagem (*LMS*) promete uma transformação significativa. Este artigo investiga a jornada de Moçambique neste domínio, comparando-a com os avanços globais. Enquanto o setor de ensino superior moçambicano está à beira de uma revolução digital, seu envolvimento com a IA em *LMS* ainda está em uma fase inicial. Isso é contrastado com a tendência global, onde ferramentas de IA, como o ChatGPT, estão rapidamente se a se tornar padrão em muitas plataformas educativas, aprimorando a personalização, eficiência e insights baseados em dados. Os benefícios da integração da IA, como experiências de aprendizagem adaptadas e automação

administrativa, são equilibrados por desafios, incluindo preocupações com a privacidade dos dados e excesso de dependência da tecnologia. Através de estudos de caso do mundo real, o artigo destaca esforços pioneiros que mostram o potencial da IA em remodelar os paradigmas educacionais. Enquanto Moçambique navega pelos seus desafios únicos, os insights das melhores práticas globais oferecem um roteiro para aproveitar o potencial transformador da IA em SGA, com o objetivo de elevar seu setor de ensino superior a novos patamares.

Palavras-chave: Inteligência Artificial, Sistemas de Gestão de Aprendizagem, Moçambique, Ensino Superior, LMS

1 Introduction

In the modern digital transformation era, Learning Management Systems (LMS) have emerged as pivotal tools in higher education. LMSs are digital platforms designed to manage and deliver educational courses that have revolutionized how institutions approach teaching and learning (Ally, 2008). They offer a centralized and integrated approach, enabling educators to streamline course administration, track student progress, and enhance the learning experience.

According to Coates, James, & Baldwin (2005) LMS provide a flexible and interactive platform, allowing students to access resources, submit assignments, and engage in discussions from anywhere in the world. As higher education institutions grapple with the challenges of expanding enrollments, diverse student needs, and the rapid pace of technological change, LMS have become indispensable.

According to Aldahwan & Alsaeed (2020) and Manhiça, Santos, & Cravino (2022) the integration of Artificial Intelligence (AI) into LMS is a natural progression in the evolution of educational technology. With its ability to analyze vast amounts of data, make predictions, and automate tasks, AI holds immense promise for enhancing its capabilities.

AI-powered analytics can provide educators with insights into student performance, helping them identify at-risk students and tailor interventions accordingly. Furthermore, powered by AI, adaptive learning can personalize learning pathways based on individual student needs, ensuring that each student receives instruction at their own pace and level (Adams Becker, et al., 2017). Chatbots, another AI application, can assist students with queries in real-time, enhancing student support and engagement.

Mozambique, a nation with a rich cultural heritage and diverse educational challenges, presents a unique context for exploring AI in LMS. The University of Eduardo Mondlane (UEM), is Mozambique's oldest and most prestigious higher education institution, stands at the forefront of these technological advancements. However, like many institutions in developing nations, UEM faces challenges such as limited resources, infrastructural constraints, and the need to cater to a diverse student population with varying levels of digital literacy (Bonde & Matavel, 2022). In this context, the potential of AI to optimize LMS and provide scalable, personalized learning solutions is particularly compelling.

Given the transformative potential of AI in LMS, the unique challenges and opportunities presented by the Mozambican higher education landscape, this study seeks to bridge the gap in the literature. While there is a growing body of research on AI in LMS globally, there is a paucity of studies focusing on its application in the specific context of Mozambique.

This study, therefore, aims to present the current state, potential benefits, challenges, and future directions of AI integration in LMS within Mozambican higher education. The insights from this research could serve as input for other institutions in similar contexts. The paper is structured as follows:

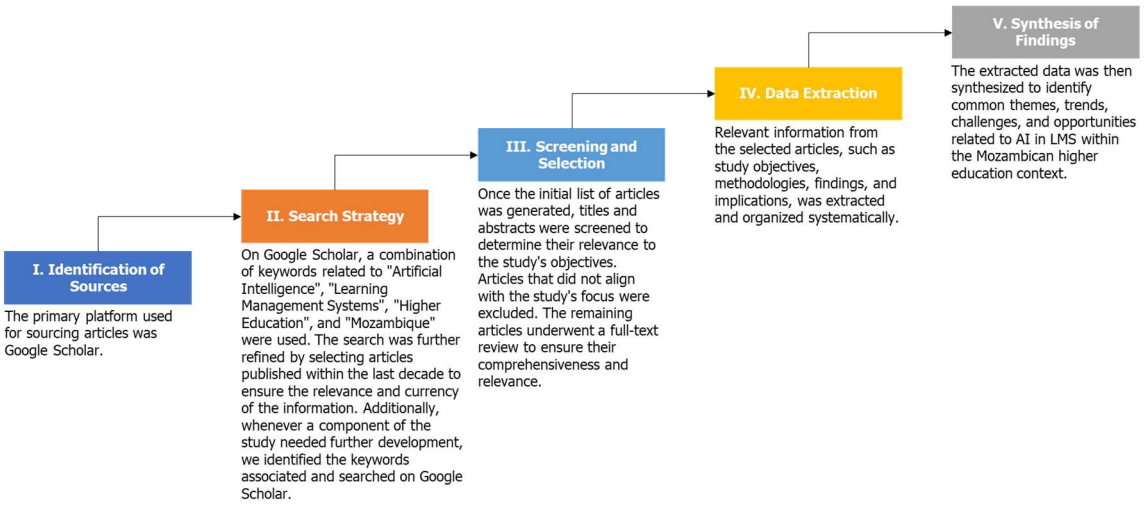
- **Introduction**: The opening section sets the stage by presenting the overarching objective of the paper. The section outlines the research goals and the key contents which will be explored in the subsequent sections.
- **Literature Review Process**: This section presents the methodology used to achieve the results presented in the paper. It explains the systematic approach taken to gather and analyze the relevant literature.
- **AI and LMS: Definitions and Historical View**: This section provides the foundational understanding of the key terms discussed in this paper. The historical perspective offers insight into the evolution of these technologies, especially considering the Mozambican context.
- **Impact of AI in LMS: Globally and Mozambican Context**: This section forms the core of the paper, investigating the global integration of AI in LMS. It explores benefits and challenges worldwide, followed by an in-depth exploration of the Mozambican context, considering the country unique challenges and opportunities.
- **Conclusions**: The final section summarizes the key findings and insights resulting from the study. The section reiterates the implications and significance of the study in the broader educational landscape.
- **References**: This section provides a list of sources and references cited throughout the paper, to present the foundational literature supporting the research.

2 Literature Review Process

This section presents the systematic approach that was adopted in this study, focusing on the literature review process concerning the integration of AI in LMS within Mozambican higher education. By detailing the steps, tools, and criteria employed, this methodology aims to provide transparency, replicability, and a clear understanding of how the study's findings were achieved.

Using the academic search engine Google Scholar as a primary source, the methodology ensures that the review is comprehensive and current. The subsequent sections will go deeper into the specific processes, from source identification to data synthesis, ensuring a holistic understanding of the research approach. The process involved several stages, from the initial identification of relevant sources to the final synthesis of findings, as presented on the Figure 1.

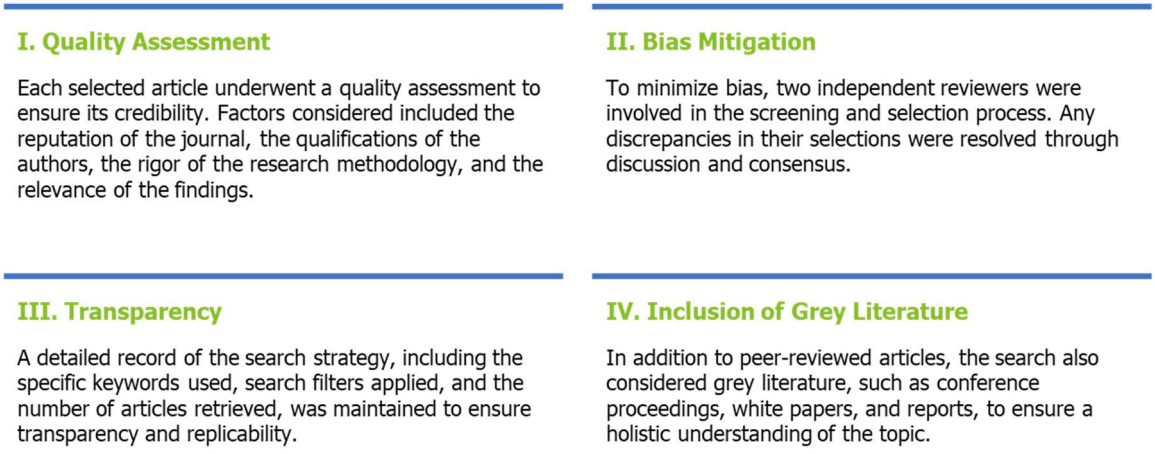
Figure 1
Stages for identification of relevant sources to include in the study.



The systematic approach ensures the review is comprehensive, unbiased, and replicable.

Using Google Scholar, the study leverages technology to access a wide range of articles, ensuring the review is grounded in the most recent and relevant literature. Other relevant aspects to validate the study as presented on the Figure 2:

Figure 2
Relevant Aspects to validate the study.



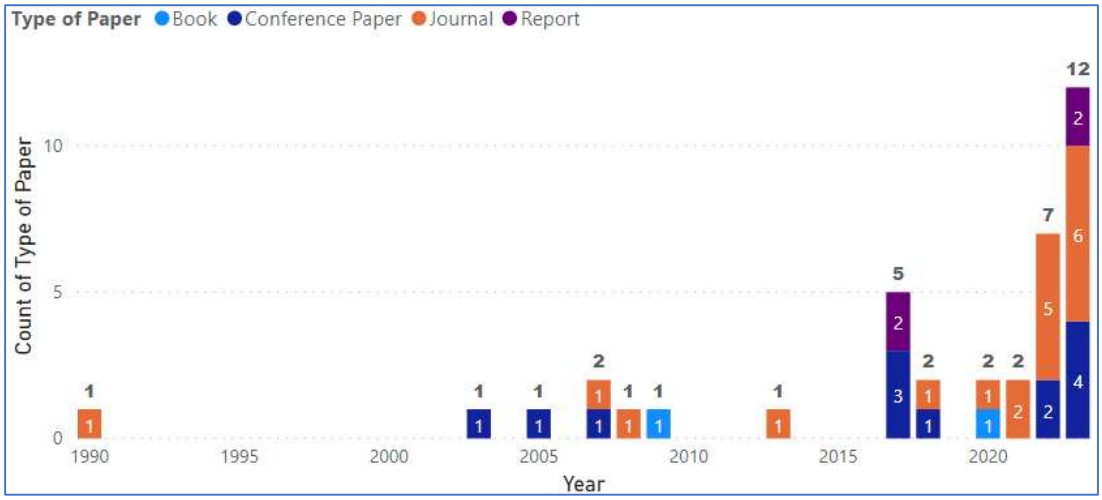
Regarding the methodology followed, it is important to clarify that the study is structured as a "State of the Art" paper rather than a traditional "Systematic Literature Review". At the same time, it used a systematic approach to gather relevant information from a single, highly pertinent source (Google Scholar). The authors aim to offer valuable and insightful perspectives while transparently explaining our chosen methodology. The authors conducted a Systematic Literature review, which is father detailed in (Manhiça,

Santos, & Cravino, The use of artificial intelligence in learning management systems in the context of higher education : Systematic literature review, 2022).

Through the review process, 38 articles were identified for inclusion in the study. Most of these are articles from journals published between 2017 and 2023, ensuring the latest insights. However, the authors intentionally included some older papers, dating back to 1990 and spanning from 2003 to 2014, to provide historical context and trace the field's evolution. To summarize the list of the sources, the Figure 3 presents a graphical representation that captures key trends and insights from the selected articles.

Figure 3

Overview of the papers reviewed



3 AI and LMS: Definitions and Historical View

In computer science, the term Artificial Intelligence (AI) is used to describe computational technologies that allow machines (i.e., computers) to act and make decisions that mimic human behavior and intelligence (McCarthy, 2007).

Machine Learning (ML) is a subfield of Artificial Intelligence. Statistical methods and computational algorithms teach machines to perform specific tasks through examples and data experimentation(Michalski, Carbonell, & Mitchell, 2013). For Russell & Norvig (2009), AI focuses on building intelligent agents that receive perceptions of the environment and perform actions that affect that environment. These further define a rational agent as one who, for each possible sequence of perceptions, must select an action expected to maximize its performance measure, given the evidence provided by the sequence of perceptions and by any internal knowledge of the agent.

The genesis of Learning Management Systems (LMS) can be traced back to the late 20th century, with the advent of computer-assisted learning. As technology began to permeate educational institutions, there was a growing need for a centralized system to manage and deliver digital content. The 1990s introduced the first LMS platforms primarily used in corporate training programs. However, according to Watson & Watson (2007) their potential in academic areas was soon recognized.

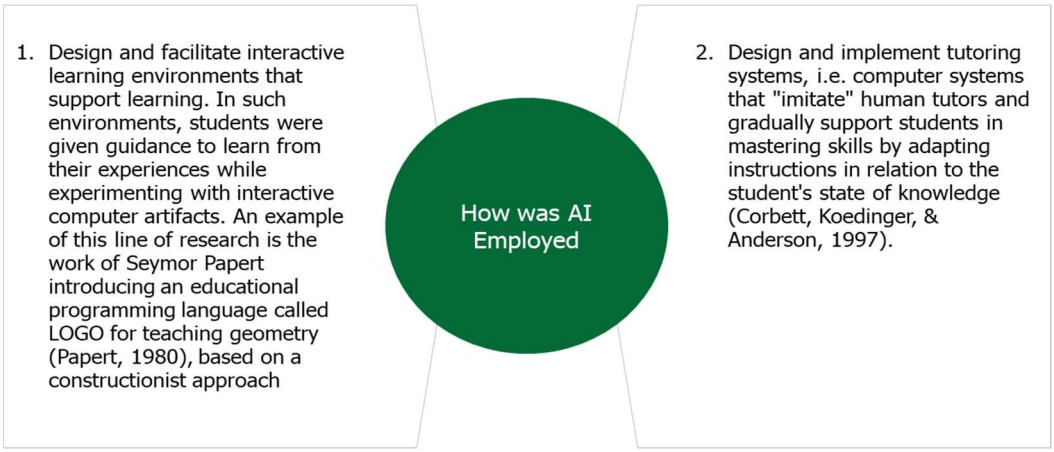
Systems like Blackboard, launched in 1997, began to gain traction in universities and colleges, offering a platform to manage course content, assessments, and student data. The early 2000s marked the emergence of open-source LMS platforms like Moodle.

These cost-effective and customizable platforms became popular choices for many educational institutions, fostering a culture of collaboration and shared resources (Dougiamas & Taylor, 2003). With the proliferation of smartphones and tablets in the 2010s, LMS providers started optimizing their platforms for mobile learning.

The shift to cloud based LMS solutions also began, offering scalability, flexibility, and real-time collaboration (Attaran, Attaran, & Celik, 2017). Currently, LMSs are integral to higher education institutions worldwide. They have evolved from content management systems to sophisticated platforms supporting learning, analytics, gamification, and social learning (Turnbull, Chugh, & Luck, 2020).

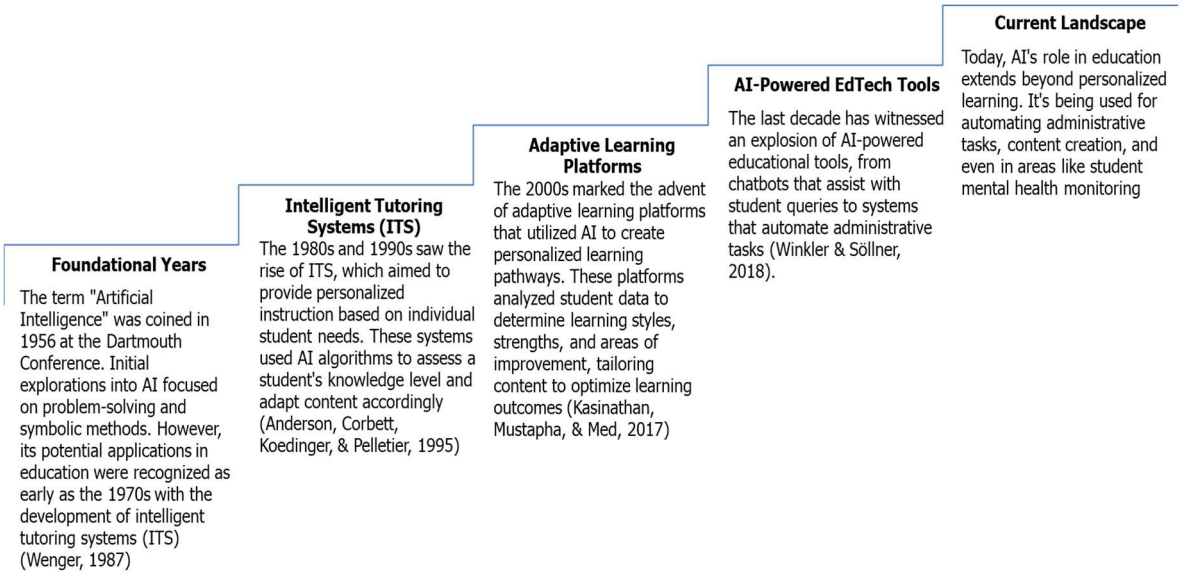
Research on the use of AI and ML in education has been ongoing since the late 70s and 80s when the first computer-assisted instruction (CAI) and intelligent tutoring systems (ITS) were developed (Nwana, 1990). In the early days, AI methods were employed in two ways, as per Figure 4:

Figure 4
How was AI initially Employed in Education?



Though rooted in ancient history, the concept of AI began to take a more defined shape in the mid-20th century. Its application in education, however, is a relatively recent phenomenon. Figure 5 shows the evolution of the use of AI in the educational landscape.

Figure 5
Evolution of AI in Education



4 Impact of AI in LMS: Globally and Mozambican Context

This section explores the impact of Artificial Intelligence (AI) in Learning Management Systems (LMS) from both a global and Mozambican perspective. It comprises three subsections:

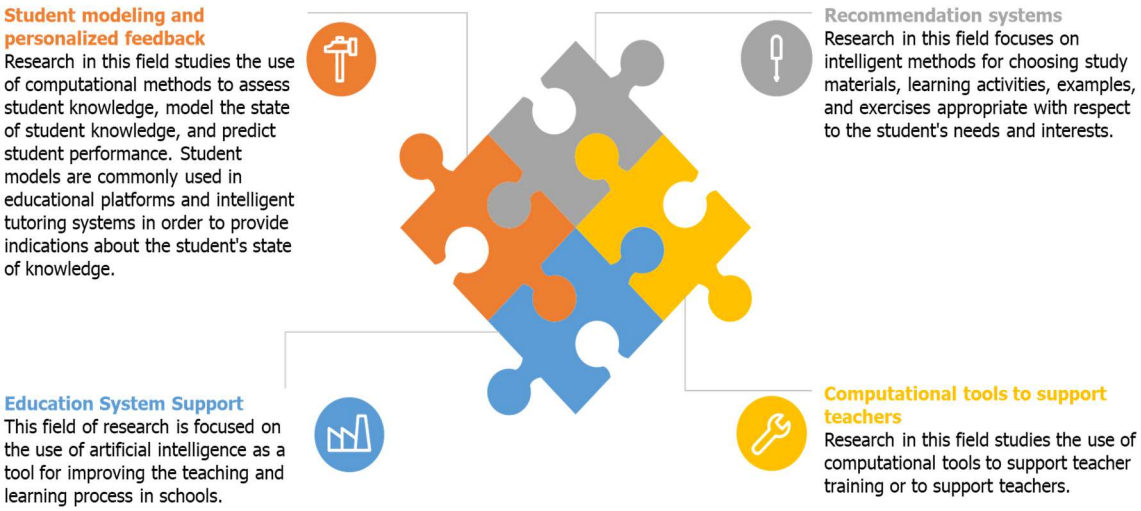
- **Current State of AI in LMS - Globally**: An overview of AI integration into LMS worldwide, highlighting benefits and challenges with real-world case studies.
- **Benefits and Challenges**: An examination of the advantages and hurdles presented by AI in LMS.
- **Impact of AI in LMS - Mozambican Context**: A focus on Mozambique, assessing the current state of AI in LMS, specific challenges, and unique opportunities in this evolving educational landscape.

4.1 Current State of AI in LMS - Globally

According to Castañeda & Selwyn (2018), AI is rapidly becoming prevalent across various sectors, including education. Hemachandran et al. (2022) state that AI in education offers a tailored learning experience catering to individual needs and pacing. AI can provide a more supportive and consistent educational environment by reducing human biases and emotional inconsistencies, protecting students from potential emotional setbacks.

Four main lines of research explore the use of AI methods in the context of LMS (Manhiça, Santos, & Cravino, 2022) as shown on Figure 6.:

Figure 6
Main lines of research that explore the use of AI methods in the context of LMS



The integration of Artificial Intelligence (AI) into Learning Management Systems (LMS) has transformed the landscape of global education. As institutions worldwide strive to provide more personalized, efficient, and data-driven learning experiences, AI has emerged as a pivotal tool in achieving these goals.

The global education sector is witnessing a transformative shift by integrating Artificial Intelligence (AI) into Learning Management Systems (LMS). This integration reshapes how education is delivered, consumed, and assessed. AI-powered tools, such as ChatGPT and other generative models, are rapidly becoming integral components of many LMS platforms. These tools are being employed for a multitude of purposes, such as:

I. **Tutoring and Assistance**: AI-driven chatbots and assistants provide real-time support to students, answer queries, and guide them through complex topics (Halaweh, 2023).
II. **Content Creation and Curation**: AI aids educators in generating content, formulating quizzes, and offering suggestions for course improvements (Verleger & Pembridge, 2018).
III. **Adaptive Learning**: AI algorithms assess students' strengths and weaknesses, tailoring content to provide a personalized learning experience (Adiguzel, Kaya, & Cansu, 2023).
IV. **Predictive Analytics**: These tools can predict students' performance, enabling educators to offer proactive support (Bozkurt, Xiao, Lambert, Pazurek, & Crompton, 2023).
V. **Language Translation and Support**: For LMS platforms catering to diverse linguistic user bases, AI assists in real-time translation and linguistic support (Bahrami, Bahrami, Behboodi, & Pourrafie, 2023).

4.2 Benefits and Challenges

Using AI in education systems can change the way we teach and learn in many good ways. However, like all new things, it also comes with its own set of problems. These systems can include AI's benefits and main challenges to higher education and the issues to watch out for:

Main benefits

- **Personalized Learning**: AI allows content to be tailored to individual learners, enhancing engagement and retention (Halaweh, 2023).
- **Efficiency**: Automating administrative tasks saves resources and allows educators to focus more on pedagogy (Halaweh, 2023).
- **Data-Driven Insights**: AI provides actionable insights based on student data, enabling timely interventions (Alshahrani, 2023).
- **Scalability**: AI-driven LMS can cater to many students, ensuring consistent quality (Adiguzel, Kaya, & Cansu, 2023).

Main challenges

- **Data Privacy Concerns**: The extensive use of student data raises concerns about privacy and data protection (Bozkurt, Xiao, Lambert, Pazurek, & Crompton, 2023).
- **Dependency**: Over-reliance on AI tools may reduce human interactions in the learning process (Halaweh, 2023).
- **Technical Glitches**: As with any technology, AI-driven LMS can face technical issues, impacting the learning experience (Raman, et al., 2023).
- **Training and Adaptation**: Educators need training to effectively utilize and integrate AI tools into their teaching (Fırat, 2023).

4.3 Impact of AI in LMS - Mozambican Context

Mozambique, a nation with a rich cultural heritage and a growing emphasis on education, has progressively integrated technology into its higher education sector. Adopting Learning Management Systems (LMS) in Mozambican universities and colleges is a testament to this commitment. This section goes into the status of LMS in Mozambican higher education, explores any existing AI integrations, and highlights the unique challenges and opportunities that the nation faces in this domain.

Mozambican higher education stands at the cusp of a digital revolution, with a budding interest in adopting LMS. While a discernible drive exists to integrate these digital platforms, concrete adoption remains limited. Despite the evident potential of educational technologies, their actual application in Mozambican teaching practices is still embryonic, highlighting the gap between awareness and practical implementation (Nuvunga & Pempe, 2017). The desire to integrate modern technologies into pedagogical

strategies is palpable, yet significant strides are needed to make this a widespread reality.

When it comes to AI in LMS, Mozambican higher education appears to be at a nascent stage. The literature reviewed did not offer explicit instances of AI's current integration in Mozambican LMS. This absence can be interpreted as AI's integration being an unexplored domain in the nation's higher education.

However, the broader context suggests a cautious approach to new technologies, given the challenges with basic digital tool integration in teaching practices (Uacane & Pego, 2021). AI's potential in enhancing LMS—from offering personalized learning trajectories to furnishing data-driven insights—remains a promising research area to explore in Mozambique.

Below are the key challenges identified as relevant to the Mozambican Higher Education Context:

I. **Infrastructure Limitations**: According to Pessuro (2022), Mozambique grapples with infrastructural challenges, especially in its rural locales. The adoption of digital platforms, including LMS, is often hampered by these limitations. The challenges of implementing e-learning in the nation are often underscored by infrastructural impediments and a lack of resources.
II. **Training and Development**: Beyond infrastructure, the training of educators emerges as a pivotal concern. Integrating digital tools necessitates substantial professional development endeavors to equip teaching staff with the nuances of these platforms (Borges, Tavares, & Tumbo, 2021).
III. **Digital Literacy**: The terrain of digital literacy in Mozambique is uneven. While some educators and students might be conversant with digital tools, a significant portion still requires foundational training, posing challenges in LMS adoption (Salimo & Gouveia, 2017).
IV. **Technological Resources**: Comprehensive adoption of LMS demands an array of technological resources. The institutions must be equipped with the necessary hardware and software, often significant investments (Moore & Piety, 2022).

Below are the key opportunities identified as relevant to the Mozambican Higher Education Context:

I. **E-learning Potential**: The domain of e-learning in Mozambique brims with untapped potential. With the right tools and strategies, digital platforms can serve as a catalyst, offering flexible learning paradigms and bridging educational divides (FLORES, RIBEIRO, & ECHEVERRIA, 2017).
II. **Growing Awareness**: A silver lining in the educational landscape of Mozambique is the burgeoning awareness of the potency of educational technologies. This momentum can be leveraged to galvanize more focused efforts toward digital transformation (Nuvunga & Pempe, 2017).
III. **AI's Untapped Potential**: The untouched expanse of AI in LMS presents a significant opportunity for Mozambique's higher education system. Early adopters

can enhance their pedagogical strategies and position themselves at the forefront of educational innovation (Gamede, Ajani, & Afolabi, 2022).

Even though Mozambique's higher institutions face problems, there are many chances for growth. With the right planning, investment in infrastructure, and training, the country can use AI in education systems to greatly improve its higher education.

Mozambique's integration of AI within LMS is at an embryonic stage. The reviewed literature does not offer explicit instances of advanced AI tools like ChatGPT being utilized in Mozambican LMS. The primary focus remains on the foundational adoption of LMS platforms and addressing infrastructural and literacy challenges (Nuvunga & Pempe, 2017) (Uacane & Pego, 2021).

Around the world, AI tools like ChatGPT are quickly becoming important parts of many education systems. They are being used in many different ways:

a) **Adaptive Learning**: LMS platforms worldwide have started using AI to assess students' strengths and weaknesses and tailor content accordingly, ensuring a more personalized learning experience (Burmistrov, 2023).
b) **Chatbots**: Many LMS platforms now incorporate chatbots to answer student queries in real-time, facilitating instant support (Merelo, et al., 2023).
c) **Predictive Analytics**: AI-driven analytics can predict at-risk students, allowing educators to intervene proactively (Ouyang, Wu, Zheng, Zhang, & Jiao, 2023).
d) **Automated Administrative Tasks**: AI helps automate tasks like scheduling, student attendance, and grading, making administrative processes more efficient (George & Ontario , 2023).
e) **Language Translation**: For LMS platforms with a diverse user base, ChatGPT can assist in real-time translation, breaking down language barriers (Rasul, et al., 2023).
f) **Feedback Mechanism**: Students can interact with ChatGPT to provide course feedback, which can then be analyzed to offer insights to educators (Rasul, et al., 2023).

Mozambique is just starting to use AI in education systems, while other countries already use advanced AI tools. Mozambique is still trying to use basic education systems because of problems with facilities, lack of digital skills, and lack of access to high-tech tools. Looking at what other countries are doing, here are some ideas that Mozambique's Universities could consider:

I. **Pilot Programs**: Before adoption, pilot programs can be initiated in select institutions to test the integration of AI tools in LMS. This approach will allow for real-time feedback and iterative improvements.
II. **Focus on Core Features**: Initially, Mozambique higher education institutions can focus on integrating core AI features that address immediate needs, such as chatbots for student support or predictive analytics to identify students needing assistance.

III. **Explore ChatGPT's Potential**: While Mozambique higher education institutions work on the foundational adoption of LMS, parallel exploration of tools like ChatGPT can be initiated. Even if full integration takes time, pilot programs can be launched in select institutions.

While Mozambique's higher education institutions are still in the early stages of AI integration in LMS, tools like ChatGPT offer a glimpse into the future of education. By drawing insights from global best practices and integrating advanced AI tools, Mozambican institutions can significantly enhance their educational landscape.

5 Conclusions

Integrating Artificial Intelligence (AI) into Learning Management Systems (LMS) represents a transformative shift in the landscape of higher education globally and within the context of Mozambique's higher education landscape.

Worldwide, the adoption of AI in LMS is rapidly advancing. From personalized learning paths to predictive analytics, AI is reshaping how educators deliver content and how students engage with it. The benefits, such as enhanced personalization and efficiency, are evident. However, challenges like data privacy concerns and implementation costs underscore the need for a balanced and thoughtful approach to integration.

Mozambique's journey in integrating AI into LMS is both promising and challenging. While there is a clear momentum in LMS adoption, especially in leading institutions like Universidade Eduardo Mondlane, the integration of AI is still in its early stages. Collaborative efforts can pave the way for a more AI-centric educational approach in the country.

Mozambique's unique socio-cultural and economic context presents challenges, including infrastructure limitations and the need for enhanced digital literacy. AI has the potential to bridge educational gaps, making quality education accessible to students even in remote regions.

In the context of LMS, the exploration of generative AI models, like ChatGPT, indicates a future where students can have more interactive and human-like digital learning experiences. These models can revolutionize LMS platforms' support systems, content creation, and language translation.

As AI continues to evolve, its role in LMS is bound to expand. For Mozambique's higher education system, this signifies an opportunity to be at the forefront of an educational revolution. However, it is imperative for stakeholders, from policymakers to educators, to approach this integration with a focus on ethical considerations, especially concerning data privacy and the potential over-reliance on technology.

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