

The impact of Artificial Intelligence on a learning management system in a higher education context: A Position Paper

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Abstract.

This position paper provides an overview of the most important practices in the field of Artificial Intelligence (AI) used in educational contexts, with a focus on the main platforms used for teaching (LMS) to support the development of a research work at Eduardo Mondlane University (UEM) in Mozambique. To that end, definitions and descriptions of relevant terms, a brief historical overview of Artificial Intelligence (AI) in education and an overview of the common goals and practices of using computational methods in educational contexts are provided. The state of the art regarding the adaptation and use of Artificial Intelligence is presented and we discuss the potential benefits and the open challenges. The paper also presents the methodology and key steps which will be developed at UEM to achieve the research goals.

Keywords: Artificial Intelligence (AI); Higher Education; Learning Management System (LMS); Position Paper

1 Introduction

The advance and adoption of technology, along with the data science revolution brought to education, has provided countless opportunities for educators, students, curriculum developers and pedagogical directors, content creators and researchers [1]. Technology is having and will continue to have a major impact on the education system all over the world, and advances in artificial intelligence (AI) brought new possibilities and challenges to teaching and learning, with the potential to change management structures and architecture of higher education institutions.

According to Kavitha & Lohani [2] AI arouses enthusiasm for the future of how the education system works, and AI is part of some e-learning platforms, by providing support to the teaching and learning processes. According to Vicari [3], artificial intelligence promises to introduce improvements in education for all levels, with promises of unprecedented qualitative improvement, focusing on providing students and other actors in education systems with a precise customization of their needs according to their requirements, and being able to integrate the different forms of human-machine

interaction. In educational platforms such as Learning Management Systems (LMS), according to Morrison [4], Artificial Intelligence offers numerous possibilities related to inclusive education where solutions focus on products and services to support people with disabilities in their interaction with the environment.

In this way, this position paper discusses the impact that Artificial Intelligence can have on the higher education system using the Eduardo Mondlane University in Mozambique as a case study for the development of a research work. The paper presents a proposal to investigate the educational implications of Artificial Intelligence in the way students learn and how the institution teaches and evolves its management processes with the support of artificial intelligence.

2 Literature review

2.1 Artificial Intelligence and Education

In computer science, the term AI is used to describe computing technologies that allow machines to make decisions that mimic human behavior and intelligence [5]. Beyond the computer science and engineering, according to the dictionary Lexico [6] AI can be defined as: “*the theory and development of computer systems that can perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision making and translation and interpretation*”. For Russel & Norvig [7] Artificial Intelligence focuses on the construction of intelligent agents that receive perceptions of the environment and execute actions that affect that environment. Machine Learning (ML) is a subfield of AI, in which statistical methods and computational algorithms are used to teach machines through examples and data experimentation on how to perform specific tasks [8].

Both AI and ML thrive on data. AI needs data to build its intelligence given that big data allows AI to reach its full potential, so it would be fair to say that there is no data-driven AI without big data [9]. From the necessity of analyzing data, two interesting areas of investigation into the use of AI for Education are educational data mining (EDM) and learning analytics (LA). In computer science, data mining is the process of discovering interesting and useful patterns and relationships in large volumes of data. Educational Data Mining (EDM) develops methods and applies statistical, machine learning and data mining techniques to analyze data collected during teaching and learning. According to UNESCO [9] EDM tests theories of learning and informs about educational practice. Learning Analytics (LA) is an emerging discipline that seeks to improve teaching and learning by critically evaluating raw data and generating patterns to characterize student habits, predict student responses, and provide timely feedback. LA supports decision making, adapts readable content, simplifies realistic assessments, and provides personal oversight of student progress [9].

2.2 Brief context of AI in Education

Reviewing the paper written by Nwana [10] it is understood that research on the use of AI and ML in education has been ongoing since the late 1970s, when the first computer-assisted instruction (CAI) and information systems were developed. According to Chounta [1], in the beginning, AI methods were employed in two ways:

a) Design and facilitate interactive learning environments that support learning. In such environments, students would receive guidance to learn from their experiences while experimenting with interactive computer artifacts. An example of this line of research is the work of Seymour Papert introducing an educational programming language called LOGO for teaching geometry [11], based on a constructionist approach. Seymour Papert's constructionist approach has been criticized for demanding radical changes to the status quo of education;

and b) Design and implement tutoring systems, that are computer systems that “imitate” human tutors and gradually support students in the mastery of skills, adapting instructions in relation to the student's state of knowledge.

Thus, it can be stated that Artificial Intelligence was initially used as a learning tool for students to learn by experimenting with computational algorithms or as a technology to support the personalization of learning environments and the adaptation of instructions to the student's personal needs and goals.

The success of intelligent tutoring system (ITS) was largely due to the fact that these systems were able to track student performance and choose appropriate content to practice skills and promote knowledge tailored to the needs of each student using student models that are implemented using Artificial Intelligence methods, a good example of this can be found in apps like Duolingo [12].

However, despite the positive results demonstrated using ITS, its practice has been criticized for not considering the social aspects of the learning process, for the lack of social interaction and for not promoting the acquisition of social skills.

2.3 Artificial intelligence in LMS

AI has been part of many e-learning platforms for quite some time, helping students learn more efficiently using various multimedia resources [2]. According to Aldahwan and Alsaed [13], there are several AI approaches, such as Fuzzy Logic (FL), Decision Tree, Bayesian systems, Neural Networks, Genetic Algorithms, and Hidden Markov Systems, used in adaptive education systems. According to Chen and Lin [14] Artificial Intelligence research in education, impacts 4 areas namely: Education Administration, Teaching, Learning and student and teacher performance evaluation.

- a) Education administration focuses on enabling instructors or teachers to perform their administrative functions, such as grading and providing feedback to students more effectively.
- b) In teaching AI serves instructional purposes or as a pedagogical tool that is used to facilitate interactions between teachers and students in a teaching environment.

- c) In learning AI enables tracking of learning progression, including knowledge, understanding, and uses the data to enhance system features and customize content according to students' needs and abilities, which motivates students.
- d) In assessing student and teacher performance AI solutions can better analyze study data, helping instructors create personalized learning plans for each student and reduce human bias which is also an emerging issue for AI in education.

3 Proposed work and methodology

Eduardo Mondlane University (UEM) is a Mozambican public institution, founded in 1962 and the first and oldest institution of higher education in Mozambique [15]. It currently has around 40,000 students distributed among the Bachelor, Master, and PhD degrees [16]. At UEM, in general, the use of virtual environments for teaching and learning processes has gone through several developments over the last years, from which several initiatives for training teachers and students stand out. In 2002, UEM implemented distance learning (DL), having created in 2004 the Distance Learning Center (CEND) and started its operationalization in 2009, becoming the first higher education institution in Mozambique to offer remote and online courses, [17]. The interest in the use of these platforms quickly surpassed the exclusive view of distance education and began to attract the attention of face-to-face teaching, where several actors within the institution agreed to use them to support and reinforce face-to-face teaching and this was a crucial aspect in ensuring of continuity of the teaching and learning process during the COVID-19 pandemic [18].

Currently, despite not being centralized, all faculties have support systems, and the new challenges demand a change from UEM and the Mozambican education system so that they can address new educational needs [19].

We propose a work with the objective of evaluating the impact of Artificial Intelligence in a learning management system (LMS) in the context of higher education at UEM. To achieve this objective, the following activities will be developed:

- i. Identification of the main roles that AI can play in the context of the Mozambican higher education system using UEM as a case study
- ii. Evaluate the main AI techniques and algorithms, applicable in the context of the existing education management systems at UEM and how they can support the process of evaluating the main stakeholders
- iii. Test Artificial Intelligence and machine learning solutions and assess the impact they can have on students, teaching staff, and academic management.
- iv. Assess the main ethical and data privacy challenges associated with the use of Artificial Intelligence in the context of Mozambican higher education and what approaches can be implemented to overcome these challenges.

The introduction of Artificial Intelligence in Education, along with new opportunities and promising potentials, as described in the section above, has also introduced

challenges that could potentially impede its growth and impact. This work at UEM will focus on the following challenges:

a) Pedagogical challenges

Computational approaches should, on the one hand, focus on personalization and adaptation to meet student needs, but, on the other hand, one should consider communication and promote collaboration and the acquisition of social skills that will enable learning in a global social arena. Teaching staff must learn new digital skills to use AI in pedagogical and meaningful ways, and AI developers must learn how teachers work and create sustainable solutions in real-life environments.

b) Ensuring inclusion and accessibility

Least developed countries such as Mozambique are at risk of experiencing new technological, economic, and social divisions with the development of AI. Some key obstacles, such as basic technological infrastructure, must be faced to establish the basic conditions for the implementation of new strategies that take advantage of AI to improve learning [9]. According to Abou-Zahra et al. [20], artificial intelligence has the potential to be a watershed in digital accessibility, through AI implementations based on pattern recognition.

c) Privacy and data protection challenges

AI methods in educational contexts rely heavily on keeping detailed records of personal data (demographic and historical data) and student activities and using this data to provide adaptive and personalized support tailored to individual student needs. However, the unsolicited and non-transparent collection and use of private data has often been criticized and raises ethical and legal considerations, especially since several countries in the world have established laws for data protection. According to Slade and Prinsloo [21], ethical and privacy issues in the analysis of teaching and learning include conditions for data collection, informed consent, non-identification of data, transparency, data security, data interpretation, as well as classification and management of the data.

For the development of works of this nature, there are many methods aimed at the design and construction of artifacts, but one has emerged as a differential methodological proposal to face the challenges that involve the use of technology in education: Design Science Research (DSR). According with Dresch et al. [22], this methodology, used more commonly in studies in information systems, administration, engineering, and computing, has gained ground as an alternative to studies in education that involve the development of artifacts and require a more interdisciplinary and collaborative approach. The proposed work will have the following key steps:

1. The work will start with a systematic review of the literature to collect information about Artificial Intelligence in Education and the context of Higher Education in Mozambique and UEM using the methodology proposed by [23].
2. Based on activity 1, further research will be carried out to determine what is the status of AI in Education before trying to obtain results in the project. This initial phase is traditionally called the "state of the art". In the state of the art we will study the research works that have been developed in the area of Artificial Intelligence in Education. We will assess emerging trends as well as challenges associated with the research subject.

3. Technological Analysis of AI Solutions in Education and UEM will focus on understanding the types of technology around the research project, as well as those existing in the case study environment, to recognize their advantages and disadvantages. Therefore, this segmented analysis, but at the same time integrated, will lead to a decision-making process in which the goals, requirements and limits of the project are established. At this stage, interviews and surveys will be carried out with various actors of the education system at UEM to obtain their perceptions about their teaching challenges and their perceptions about Artificial Intelligence.
4. Design and implementation of experimentation artifacts in the UEM environment will consist in the development of Artificial Intelligence solutions that are compatible with the LMS systems in use at UEM as identified in the previous step. The idea behind this phase will be to be able to build artifacts that allow understanding the impact of Artificial Intelligence in the context of UEM LMS systems.
5. Analysis of results and Revisit to artefacts. Final reflection where the analysis of the research results will be made, and comparisons will be made to the existing theoretical models and empirical studies. Based on this analysis, the artifacts will be revisited so that they are better aligned with the needs of the case study domain, and, in this way, a final reflection will be made in relation to the research carried out.

4 Conclusions

In this position paper, we provide an overview of the most important AI and ML practices used in educational contexts, with a focus on LMS portals aimed at supporting education. To that end, we provide definitions and descriptions of the terms that have been referenced in this article, a brief historical overview of AI and ML in education, and an overview of the common goals and practices of using computational methods (AI and ML) in educational contexts. The aim of this paper was to present an overview of a proposed research project at UEM to assess the impact of AI on an LMS using the DSR methodology. In this sense, the research challenges associated with UEM were presented, to find the concepts that relate these areas and explore the possibilities in the research project. There are several research opportunities available that need to be addressed to broaden our theoretical and empirical knowledge in this field.

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