Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v15i30.2242

Scientific articles

Revolucionando la Educación: Integración de Inteligencia Artificial en Sistemas de Gestión del Aprendizaje

Innovating the education: Integration of artificial intelligence in Learning Management Systems

Revolucionando a educação: integrando inteligência artificial em sistemas de gerenciamento de aprendizagem

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Resumen

El estudio se realizó para explorar la combinación de inteligencia artificial (IA) y aprendizaje adaptativo que personaliza la educación ajustando contenidos y actividades según el desempeño y necesidades de cada estudiante en sistemas de gestión de aprendizaje (Learning Management Systems, LMS). Se llevó a cabo en la Universidad Autónoma de Querétaro, en la Facultad de Informática, e identificó cómo estas tecnologías pueden personalizar y mejorar la experiencia de aprendizaje. El estudio planteó las siguientes preguntas clave: ¿Cómo puede la inteligencia artificial personalizar el aprendizaje para satisfacer las necesidades de cada estudiante? y ¿Cómo afecta la inteligencia artificial al rendimiento y la motivación de los estudiantes. El estudio utilizó un enfoque de métodos mixtos, combinando análisis cuantitativos de datos de desempeño de los estudiantes con entrevistas cualitativas para explorar las percepciones de los mismos. Los resultados mostraron mejoras significativas en el aprendizaje personalizado y el rendimiento de los estudiantes. Según los estudiantes, la inteligencia artificial contribuyó, a hacer el aprendizaje más adaptativo y motivador. La integración de la IA en un LMS no solo puede transformar drásticamente la educación, sino que además plantea retos éticos que deberán abordarse para garantizar que todos los estudiantes puedan beneficiarse de manera equitativa.

Palabras clave: Aprendizaje Adaptativo, Inteligencia Artificial (IA), Personalización del Aprendizaje, Sistemas de Gestión de Aprendizaje (LMS), Tecnología Educativa.

Abstract

The study was conducted to explore the combination of artificial intelligence (AI) and adaptive learning, which personalizes education by adjusting content and activities based on students' performance and needs in Learning Management Systems (LMS). It was carried out at the Universidad Autónoma de Querétaro, in the Faculty of Informatics, and identified how these technologies can personalize and enhance the learning experience. The study posed the following key questions: How can artificial intelligence personalize learning to meet each student's needs? How does artificial intelligence affect students' performance and motivation? The study used a mixed-methods approach, combining quantitative analysis of student performance data with qualitative interviews to explore students' perceptions. The results showed significant improvements in personalized learning and student performance. According to the students, artificial intelligence contributed to making learning more adaptive and motivating. The integration of AI into an LMS can not only drastically transform education but also raises ethical challenges that must be addressed to ensure equitable benefits for all students.

Keywords: Adaptive Learning, Artificial Intelligence (AI), Personalized Learning, Learning Management Systems (LMS), Educational Technology.

Resumo

O estudo foi conduzido para explorar a combinação de inteligência artificial (IA) e aprendizagem adaptativa que personaliza a educação ajustando o conteúdo e as atividades de acordo com o desempenho e as necessidades de cada aluno em Sistemas de Gestão de Aprendizagem (LMS). Foi realizado na Universidad Autónoma de Querétaro, na Faculdade de Ciência da Computação, e identificou como essas tecnologias podem personalizar e melhorar a experiência de aprendizagem. O estudo fez as seguintes perguntas-chave: Como a inteligência artificial pode personalizar o aprendizado para atender às necessidades de cada aluno? e como a inteligência artificial afeta o desempenho e a motivação dos alunos? O estudo utilizou uma abordagem de métodos mistos, combinando análise quantitativa de dados de desempenho dos alunos com entrevistas qualitativas para explorar as percepções dos alunos. Os resultados mostraram melhorias significativas na aprendizagem personalizada e no desempenho dos alunos. Segundo os alunos, a inteligência artificial contribuiu para tornar o aprendizado mais adaptativo e motivador. A integração da IA em um LMS não apenas pode transformar drasticamente

a educação, mas também traz desafios éticos que precisarão ser enfrentados para garantir que todos os alunos possam se beneficiar de forma equitativa.

Palavras-chave: Aprendizagem Adaptativa, Inteligência Artificial (IA), Personalização da Aprendizagem, Sistemas de Gestão de Aprendizagem (LMS), Tecnologia Educacional.

Reception Date: July 2024 **Acceptance Date:** January 2025

Introduction

In today's digital age, learning management systems (LMS) have evolved dramatically by integrating advanced technologies such as artificial intelligence (AI) and adaptive learning, transforming higher education. Initially emerging as platforms to manage content and facilitate communication between students and faculty, LMSs are now at the forefront of educational innovation. With varieties ranging from open-source systems to completely proprietary cloud-based solutions, flexibility and customization have become paramount.

Research on these emerging technologies at the x, particularly within the Faculty of Computer Science, is crucial as it has the potential to completely transform traditional teaching methods. The objective of the research is to analyze how the integration of artificial intelligence and adaptive learning in LMS can improve the quality of learning for both students and teachers at the Faculty of Computer Science, promoting their adaptation to new technologies.

This research seeks to answer the following questions: How can AI and adaptive learning personalize learning to better meet individual students' needs? What impact do these technologies have on student academic performance and motivation?

The hypothesis of this study is that the integration of artificial intelligence and LMS significantly improves academic performance and personalization of learning, addressing the individual needs of students, as it would allow for more personalized learning tailored to the individual needs of each student. This integration not only promises to improve learning efficiency but also increase knowledge and satisfaction of both students and teachers.

On the other hand, artificial intelligence is transforming learning management systems, as it allows for the addition of important functions, such as personalized learning. Here, algorithms adapt the content to the needs of the course and the learning pace of each student. This indicates that it would not only improve the learning efficiency of the student, but also that of the teachers by providing more detailed and useful

feedback. According to researchers such as Jones (2019) and Smith et al. (2020), AI can be autonomous, perform assessments and provide immediate feedback to the student, which represents a significant contribution for teachers.

Furthermore, the implementation of AI in LMSs is facilitating new forms of interaction, even on a large scale, which is crucial in large groups, where limited time and resources make it difficult to provide individualized feedback. However, there are major challenges in incorporating AI into educational platforms. Wilson and Lee (2019) point out concerns about data privacy and equity in access to these advanced technologies. According to Greenfield (2017), the digital divide could widen if AI innovations are not implemented in an inclusive manner. Therefore, it is essential to train teachers and students in the use of these advanced resources.

This change promises to improve the learning performance of students at the Faculty of Computer Science at the Universidad Autónoma de Querétaro. However, it also represents a major challenge, as aspects of access, privacy and personalization in education must be reconsidered. Furthermore, the impact of LMS will depend on how students and teachers take advantage of these emerging opportunities.

Learning Management Systems

Learning management systems began in 1924, with Pressey who first mentioned the term teaching machine, this was the basis for what we know today as a learning management system. At that time, the devices allowed students to answer questions and receive feedback immediately, this marked the beginning of automation in education Pressey, SL (1924). Later in 1929, Lazerte developed problem solving, tools that not only verified correct answers but also analyzed the student's thought process, this gave rise to formative assessment that is not only focused on final answers Knowly (2020).

, Learning Management Systems (LMS), were introduced for the Macintosh platform, marking the beginning of management systems for learning on mobile devices, the founder of *Moodle* in 2002 Dougiamas, was a key moment since it is open source and we continue to use it globally today, later in 2008 the platform was introduced to implement private clouds, this allowing LMS to be fully online without the need for local installation, this leads us to easy access and maintenance of these systems Knowly (2020). Contemporary authors and recent studies say that there are several recent studies and articles that detail the evolution and what the future trends of LMS are, such as the works that are available on academic blogs and specialized platforms Thrive Learning (2020).

Among the main features of LMS are course management, communication tools, assessment and monitoring for the integration of multimedia content. Chickering and

Ehrmann (1996) highlighted the importance of LMS integration in the classroom to promote continuous and deep interaction between students and course content, work on good educational practice is essential for the implementation of technology from the classroom.

Among the characteristics, the communication tools mentioned by Harrington, Staffo and Wright (2006) stand out. They say that LMS can extend student participation beyond the traditional classroom, since they use tools such as forums, blogs and wikis to encourage asynchronous communication and Navaporn Snodin in 2013 found that the use of LMS platforms facilitated collaborative learning and student independence through the formation of groups and participation in group activities Snodin, NS (2013).

Evaluation and monitoring also allows teachers to observe the progress of students through the reports provided by the platforms and online evaluations. This makes it easier for teachers to identify areas for improvement and where support is needed with students, since the reports show where the students are (Thinkific (2023).

Along with the integration of multimedia content, it is a great feature of these systems since, together with the integration as mentioned in the complete guide on Knovator LMS, it is said that these systems are capable of integrating different content formats, such as videos, presentations, texts, forms, among others. More interactive content is also being generated with the use of games for a more immersive learning experience for students Knovator Technologies (2023).

In the case of higher education, several authors highlight the benefits that an LMS can bring, such as: Accessibility and flexibility, Naveed et al. (2017) and Kayange (2019) highlight that LMSs provide access to education from anywhere and at any time, which is especially useful in environments with limited educational infrastructure; According to Samsudin and Mohamed (2019), the use of an LMS can reduce teaching and learning costs by 50-70% by eliminating the need for a physical location and reducing the costs associated with hiring instructors; Personalization and quality Alkharang (2014) points out that LMSs improve interaction between students and instructors, allow for course customization, and ensure quality through peer review of educational content; LMS organization and management allows you to organize and centralize all educational materials in one place, facilitate online collaboration, and effectively manage educational content (Seth, 2024).

LMSs also have issues; Integration and flexibility, one of the main challenges is the lack of integration with other systems and the rigidity of reporting, which can make it difficult to measure the impact of training (Seth, 2024); Technology infrastructure there are many countries including Mexico the main limitation is poor technological

infrastructure. Almaya and Alamri (2018) and Kayange (2019) highlight that the low availability of technologies such as telecommunications and computers limits the effective use of LMS; Resources and training a successful implementation of an LMS requires an effective team and adequate training of users. Ignoring these factors can lead to costly delays and underutilized systems, Hidden costs and maintenance. In addition to initial costs, there are additional costs for licensing, extended support, upgrades and maintenance that can exceed the expected budget (Seth, 2024).

Types of Learning Management Systems

Learning management systems (LMS) are platforms designed to manage, document, track, report on, and deliver educational and training programs. There are several types of LMS, such as open source LMS, cloud-based LMS, and locally installed LMS, and those designed specifically for the educational or corporate industry.

Open source LMS

Open source LMSs, such as *Moodle* and Open edX, allow users to tailor the software to their specific needs without incurring high licensing costs. These types of platforms are especially useful for organizations looking for flexibility and customization. However, they do require a skilled technical team for implementation and maintenance.

LMS owners

On the other hand, proprietary systems, such as *Blackboard*, provide comprehensive technical support in exchange for a licensing fee. These systems are often less customizable than open source ones, but are ideal for organizations that need quick, complete solutions without relying on specialized technical staff.

Cloud-based vs. on-premise LMS

On-premise LMSs are platforms hosted and managed on an organization's internal servers, in contrast to cloud-based LMSs managed by a third-party vendor, and offer benefits such as automatic updates, accessibility from anywhere, and lower upfront costs. Lambda Solutions (2019) highlights that these platforms are ideal for organizations seeking scalability and easy maintenance. In contrast, on-premise LMSs are hosted and managed on an organization's internal servers. While they offer greater control and customization, they can incur high infrastructure and maintenance costs.

Educational LMS vs. corporate

On the other hand, LMS designed for the educational sector focus on content delivery, interaction between students and teachers, and evaluation and monitoring of learning progress. Chickering and Ehrmann (1996) stressed the importance of these systems to promote good educational practices.

In corporate settings, LMSs often include compliance training and ongoing professional development. Carlisle (2022) highlights that corporate LMSs often include features such as gamification and detailed analytics to assess employee performance, as well as being more intuitive for managers without technical expertise.

LMSs offer multiple benefits, such as flexibility and scalability for education and training. According to Samsudin and Mohamed (2019), the use of LMSs can reduce teaching and training costs by 50–70%. However, they also face significant challenges, such as lack of integration with other systems, rigidity of reporting, and hidden costs associated with licensing, support, and maintenance. Almaya and Alamri (2018) note that in countries with limited technological infrastructure, such as Mexico, effective LMS adoption is hampered by a lack of technological resources.

Integrating Artificial Intelligence and Adaptive Learning into LMS

In the field of higher education, several authors have explored how artificial intelligence and adaptive learning are transforming personalized learning. These authors show in their research that incorporating artificial intelligence into adaptive learning not only provides a more personalized and effective learning experience. It also opens up new opportunities for research and for future practical applications in the university environment.

Zhu, Q., Wang, X., Wang, Q., and Xia, Q. have made significant contributions to research on adaptive learning and the integration of artificial intelligence in this field. Their work, published in MDPI, focuses on the use of innovative technologies to personalize learning based on students' abilities and needs. The study, published in the International Journal of Educational Technology in Higher Education, examines the use of artificial intelligence in higher education and highlights how these technologies are being used to improve learning outcomes through personalized and adaptive learning systems.

Research published in the Journal of Educational Technology indicates that artificial intelligence in higher education according to Crompton and Burke (2023) concluded that artificial intelligence offers more effective and engaging learning experiences.

Materials and methods

The research is based on the mixed method, inspired by authors John W. Creswell and Vicki L. Plano Clark , recognized for their contributions to the field, which combines quantitative and qualitative methods to address complex problems in educational research . This mixed methods approach not only allows to evaluate the effectiveness of artificial intelligence technology in a quantitative approach, but also to understand the context, perceptions and subjective experiences of participants, enriching the understanding of the phenomenon under study and promoting a more effective, personalized implementation adjusted to the real needs of students.

Figure 1. Mixed methodology

Source: Own elaboration based on Creswell, Plano (2011) and Teddlie and Tashakkori (2012)

Using a mixed-methods approach, a sample of 132 students from the Faculty of Computer Science at the Universidad Autónoma de Querétaro was selected, considering the size of the enrollment of said faculty. To collect quantitative data, an online survey was used through Google Forms, with 25 questions based on a Likert scale, addressing the following variables: student experience using educational platforms, feedback on activities uploaded to an educational platform, communication with teachers and students through the platforms used, artificial intelligence tools incorporated into educational platforms.

Qualitative interviews were conducted with a selected group about their experience using popular platforms such as *Moodle, Canvas, Google Classroom* and *Blackboard.* The objective was to identify the features and usability of these platforms, as well as to investigate how adaptive learning is incorporated through artificial intelligence in LMS (Learning Management Systems).

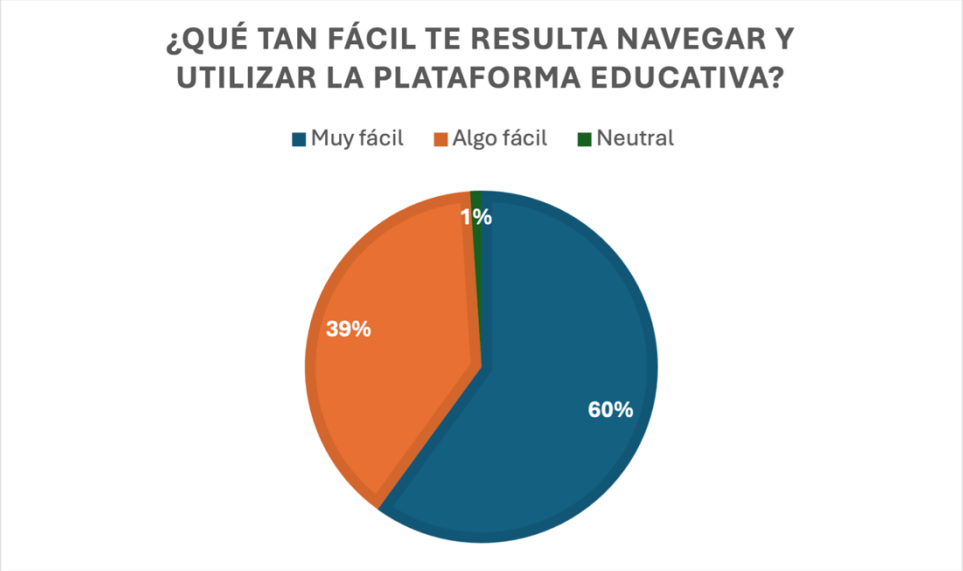
Surveys were administered to 132 students from the Faculty of Computer Science via a link, with four days to complete the survey. In parallel, in-depth interviews were conducted in person, which were recorded and transcribed for detailed analysis. Qualitative data were analyzed using content analysis techniques, which allowed the identification of themes and patterns in the participants' responses.

Qualitative data were analysed using content analysis techniques, while quantitative data were processed using descriptive statistical tools. The combination of quantitative and qualitative methods provided a comprehensive view of how technology, through learning management systems, can integrate artificial intelligence and adaptive learning in education. This mixed methodology ensures the validity and reliability of the findings.

Results

When analyzing the data obtained from the online survey applied to 132 students of the Faculty of Computer Science, significant findings were identified in various variables regarding the experience of students using educational platforms. It was observed that sixty percent of the students mention that using the educational platform is very easy, while thirty-nine percent say that it is somewhat easy to use the educational platform and only one percent mention that it is difficult to use. This suggests that the vast majority of students find it easy to use the educational platform (Figure 2).

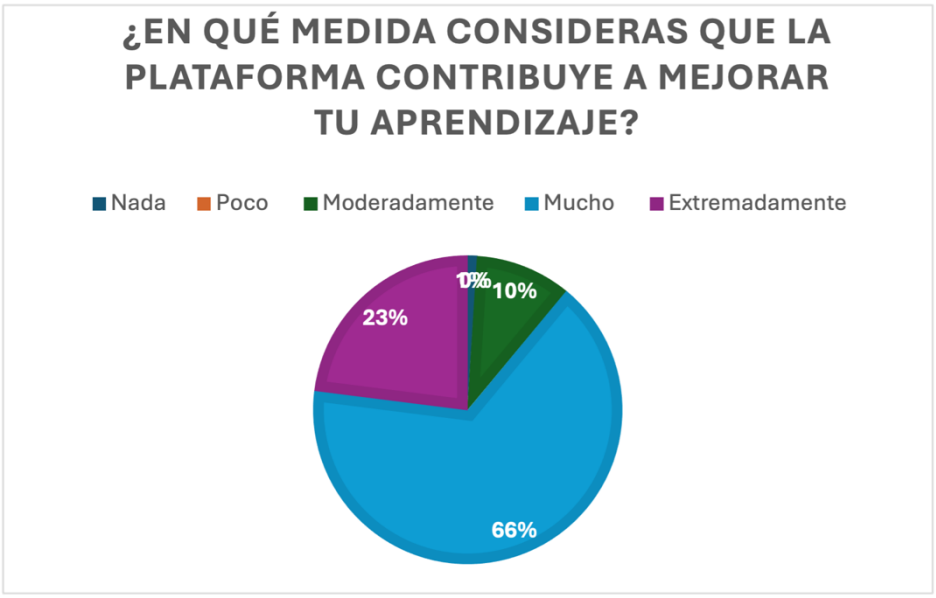
Figure 2. LMS experience



Source: Own elaboration

It was also observed that sixty-six percent of students claim that the use of platforms improves their learning, highlighting that twenty-two percent mention that learning through the platforms is extremely positive, only ten percent mention that their learning through the platform is moderate and one percent that it does not improve at all. (Figure 3).

Figure 3. Platform experience



Source: Own elaboration

Regarding feedback on activities uploaded to an educational platform, there are some points worth highlighting here, since thirty-five percent of students say that the feedback received after completing the activities is neutral, twenty-seven percent mention that it is not very timely, and nineteen percent that it is not at all timely, while eleven

percent say that it is timely and only eight percent say that it is very timely. In this variable, it is necessary to highlight the area of opportunity that exists in the use of the platforms, since more than fifty percent say that it is not very timely and not at all timely (Figure 4).

Figure 4. Activity feedback

Source: Own elaboration

Regarding communication with teachers and students through the platforms used, forty-three percent of students mention that it is neutral, nineteen percent mention that it is not very effective, sixteen say that it is effective and fourteen percent mention that it is not effective at all along with eight percent who say that it is very effective. In this figure it can be observed that the majority mention that it is neutral, effective or very effective, however a large percentage of thirty-three percent mention that it is not effective or slightly effective or neutral, here there is a point of improvement in the communication between teacher and student (figure 5).

Figure 5. Student-Teacher Communication

Source: Own elaboration

In the use of artificial intelligence tools incorporated into educational platforms, it can be observed that forty-six percent of students mention that it significantly improves their commitment and motivation to learn on the platform used in their course, thirty-six percent mention that it greatly improves their commitment and motivation and fifteen percent mention that it moderately improves their commitment and motivation to learn on the platform and only two percent say little and one percent say not at all (figure 6).

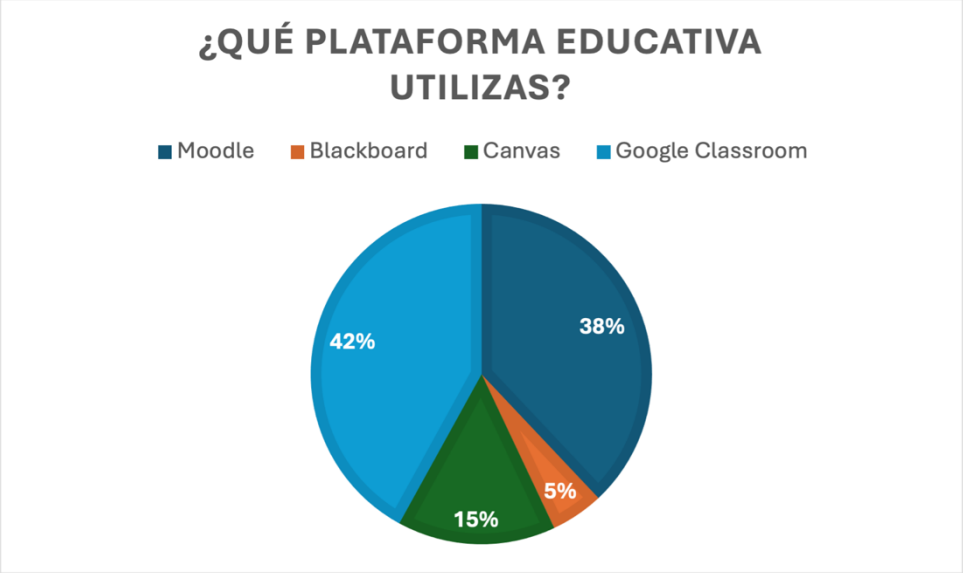
Figure 6. Artificial Intelligence in LMS

Source: Own elaboration

Regarding the tools used, it was observed that forty-two percent use *Google Classroom* and thirty-eight use *Moodle*, fifteen percent use *Canvas* and the remaining

five percent use *Blackboard*. This highlights the popularity of *Google Classroom*, as it is one of the official platforms along with *Moodle* at the university (figure 7).

Figure 7. Platform Usage



Source: Own elaboration

In interviews with the specific group of students, their experiences using educational platforms were analyzed, where they mentioned that it is very practical to use a platform for their learning, even if it is to upload their activities, tasks, sometimes the teacher generates multimedia content and presents it through said tools or platform.

Within the feedback on activities uploaded to some educational platform, the vast majority of students highlight that there is very little feedback on activities from the teacher to the student since on some occasions there is no feedback on the students' work, only the grade; on some occasions teachers apply an evaluation rubric.

The greatest communication with teachers and students through the platforms used is when notices or announcements are given, but the student needs to be checking their email or checking their mobile device in case they receive any notification from the platform.

Students who used AI tools on educational platforms, such as *Google Classroom*, employed guided practice to support their learning. This allowed them to automatically generate exercises and quizzes during activities. They reported that these tools reinforced their skills and knowledge through personalized exercises. In addition, they mentioned that the use of resources such as videos, images, and drawings not only made the assignments more engaging, but also facilitated real-time interaction with the teacher and improved efficiency, reducing the time the teacher spent grading the activities.

The results reflect widespread satisfaction with the use of artificial intelligence in learning, although there are still areas for improvement, such as teacher feedback.

Discussions

The use of learning management systems is becoming more common today as technology transforms education and suggests moving away from certain aspects of traditional education in favor of more innovative approaches. The integration of artificial intelligence (AI) into educational platforms has been widely analyzed by various authors, who highlight both its benefits and challenges. This mixed-methods approach is essential to fully understand the impact of AI on education.

Smith et al. (2020) argue that artificial intelligence has the potential to transform personalized learning by adapting content in real time to student needs. This adaptive capacity improves student retention and engagement. Similarly, Jones (2019) notes that adaptive systems use algorithms to analyze user behavior and optimize it, improving learning outcomes. Nevertheless, both authors emphasized that human intervention remains critical to monitor and manage these processes, ensuring that technology complements, but does not replace, the role of the educator.

Taylor et al. (2021) explored how AI can reduce the administrative burden on teachers by automating tasks such as grading and tracking student progress. This efficiency allows teachers to spend more time interacting with students and designing educational content. However, Brown (2018) warned that overuse of automated systems can lead to depersonalized learning, underscoring the need to balance technology with the human component.

The implementation of artificial intelligence in education raises serious ethical concerns, especially regarding the privacy and security of student data. Wilson and Lee (2019) discussed how the collection of large amounts of personal data, needed to feed AI algorithms, can pose significant risks if not handled properly, emphasizing the importance of establishing clear and transparent rules to protect student information.

On the other hand, Greenfield (2017) highlighted that access to advanced AI technologies is often limited by socioeconomic factors. This imbalance can widen the educational gap between students from different economic backgrounds, contravening the goal of achieving equitable education. To address this situation, it is essential for institutions to ensure equitable access to innovative technological tools, regardless of students' socioeconomic background.

In conclusion, AI in LMSs offers significant opportunities to personalise and streamline education. However, its implementation must be carefully planned to ensure that it complements, and does not replace, the fundamental role of the teacher. It is essential to maintain the human side of teaching, ensuring that feedback is pedagogically constructive and that technology acts as a support, not a replacement.

Conclusion

In this article, we analyzed how artificial intelligence supports the use of learning management systems in the community of the Faculty of Informatics at the Universidad Autónoma de Querétaro. The integration of artificial intelligence into learning platforms represents a significant step towards personalization and efficiency of learning, highlighting how students integrate these tools into their daily lives. In this article, we have examined how AI can support adaptive learning, automate administrative tasks, and provide real-time feedback, thus contributing to improving the learning experience for students.

Striking a balance between technological innovation and the protection of individual rights is critical to ensuring that these tools are used ethically and responsibly. Addressing challenges such as privacy, equity in access, and teacher training is also crucial to maximizing the positive impact of these technologies. Jones (2019) emphasizes that teacher training is a key factor in ensuring effective adoption of AI-based technologies.

In this article, we analyzed how artificial intelligence can support relevant information about the use of learning management systems in the community of the Faculty of Informatics at the Universidad Autónoma de Querétaro. As noted by Smith et al. (2020), the implementation of artificial intelligence in educational environments has proven to be a catalyst for personalization and improved efficiency in learning. The integration of these technologies represents a significant step towards the personalization of learning, highlighting how students integrate these tools into their daily lives.

Furthermore, it has been examined how AI can support adaptive learning, automate administrative tasks, and provide real-time feedback, which, according to Jones (2019), contribute significantly to improving the learning experience by reducing the cognitive load for both students and teachers. However, it is essential to consider the associated ethical challenges, such as privacy and equity in access, as highlighted by the study by Smith et al. (2020).

When implemented in a planned manner, artificial intelligence can completely transform education, making learning more interactive, comprehensive, and tailored to the individual needs of each student. This convergence between technology and pedagogy points to a promising future in which both areas are integrated to enhance their strengths. Smith et al. (2020) highlighted that strategic planning, and inclusive policies are essential to close the access gap and ensure that technologies are available to all institutions, regardless of their geographic location or financial resources.

Finally, investing in teacher training and ensuring inclusive policies is crucial. As Jones (2019) and Smith et al. (2020) point out, combining innovative pedagogical strategies and leveraging advanced technologies will maximize the potential of AI to enrich education and prepare students for an increasingly technology-dominated future.

Future Lines of Research

Future research into the use of AI in education can focus on several key aspects to optimize student learning. For example, educational environments could be designed using AI tools, considering ethical and social aspects to ensure their responsible implementation.

In addition, more advanced personalized learning methods could be developed, capable of adapting flexibly and in real time to the changing needs of students. This would allow their progress to be optimized and their educational experience to be improved.

New forms of interaction between students and AI systems could also foster collaboration and promote more active learning. It would also be relevant to explore the long-term impact of AI-based education on learning outcomes, students' employability, and their preparation for a technology-dominated future of work.

Finally, integrating emerging technologies, such as augmented reality and virtual reality, with artificial intelligence systems can open up new possibilities for creating immersive and adaptive educational experiences, further enriching learning environments.

Conducting this type of research is critical to maximizing the benefits and minimizing the potential downsides of AI in education. These areas offer significant opportunities to enrich higher education and ensure high-quality, inclusive learning for all students.

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