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REVIEW

The application of Artificial Intelligence in rural education at the University level

La aplicación de la Inteligencia Artificial en la educación rural nivel Universitario

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ABTRACT

In recent times, Artificial Intelligence (AI) has begun to make its way in the educational field, especially in the context of virtual spaces. The great challenge currently is for AI to be used in any space regardless of geographical location. Additionally, it can be observed that rural education faces significant challenges, among them the lack of technological resources and limited access to internet connectivity. AI has emerged as a key tool to improve education at any educational level (primary, secondary, university). However, besides the lack of internet connectivity and technological equipment, there is a more complex challenge such as the lack of specialized and trained teachers in technology. The following article aims to show the impact of AI on rural education, with an analytical approach from recent studies that demonstrate how AI can improve the quality of education in communities with technological limitations. In addition, understanding that AI is redefining educational paradigms. The findings of this review support the idea that AI is an indispensable tool to prepare students for an increasingly digitalized future.

Keywords: Artificial Intelligence; Education; Rural Areas; Rural Education; Technological Resources; Connectivity.

RESUMEN

La inteligencia artificia (IA) en los últimos tiempos ha empezado abrirse camino en el ámbito educativo, especialmente en el contexto de los espacios virtuales, el gran reto en la actualidad es el que la IA pueda ser utilizada en cualquier espacio sin importar la ubicación geográfica, además se puede observar que la educación rural enfrenta desafíos importantes, entre esos esta la falta a los recursos tecnológicos y un acceso limitado a la conexión de internet, la IA ha aparecido como una herramienta clave para mejorar la educación de cualquier nivel educativo (primaria, secundaria, universitario) pero además de la falta de una conectividad redes de internet y falta de equipos tecnológicos se enfrenta a un desafío más complejo como la falta de docentes especializados y capacitados en el tema de la tecnología . El siguiente articulo busca mostrar el impacto de la IA en la educación rural, con un enfoque analítico de estudios recientes que evidencian como la IA puede mejorar la calidad educativa en comunidades con limitaciones tecnológicas. Además de entender que IA está redefiniendo los paradigmas educativos. Los hallazgos de esta revisión respaldan la idea de que la IA es una herramienta indispensable para preparar a los estudiantes para un futuro cada vez más digitalizado.

Palabras clave: Inteligencia Artificial; Educación; Áreas Rurales; Educación Rural; Recursos Tecnológicos; Conectividad.

INTRODUCTION

Artificial intelligence (AI) has proven to be a tool that has transformed education at all levels, from early childhood to higher education. This article seeks to analyze the application of AI in rural university education, exploring its benefits, challenges, and prospects.

In the educational context, AI uses algorithms and advanced technologies, such as machine learning and deep learning, to personalize teaching and optimize educational processes Li et al.[1]; Pei et al.[2] In turn, according to Kurz et al.[3] active methodologies are defined as an approach focused on meaningful learning, where students are the protagonists of their educational process, and the teacher acts as a facilitator. The teacher proposes activities for the class, group work, homework, and other dynamics that promote critical and creative thinking and communication. These methodologies allow students to develop essential skills, such as self-assessment and autonomy, through experimentation and collaborative learning. This fosters more meaningful learning and social construction of knowledge, which passive teaching cannot offer.[4]

One of the central problems higher education institutions face in rural areas is several challenges, such as a shortage of specialized teachers, inadequate transportation, technological infrastructure, and limited internet connectivity.[5] Advances in technology have radically changed the way education is delivered around the world. In urban areas, access to digital platforms, virtual libraries, and interactive resources has facilitated student learning. However, in rural regions, difficulties persist that limit access to quality education. In this instance, AI emerges as a potential solution to improve equity and quality of learning. [6] The use of AI in rural education at the university level has become indispensable for development and good educational quality. Given the digital divide between urban and rural areas, AI not only promises to innovate teaching methods but also offers specific solutions to the needs and challenges faced by educational institutions in rural areas.

It is essential to highlight that AI seeks to enhance and transform teaching methodologies in urban and rural areas, thus promoting different learning options among students.

The application of Artificial Intelligence (AI) in rural education at the university level has become a crucial element for developing and improving educational quality in these contexts. According to Alcocer et al.[7] AI has become an indispensable tool for academic development, allowing students and teachers to interact in new ways Alcocer et al.[7] This is especially relevant in rural education, where resources are often limited. Cruz et al[8] indicate that the integration of AI in teaching can redefine how knowledge is acquired and transmitted, offering opportunities that were not previously available. Thus, AI can adapt to individual learning styles, crucial in contexts where students may have very different learning rhythms.

In addition, AI helps to bridge not only the gaps between rural and urban areas but also the barriers posed by teacher shortages, as connectivity allows teaching staff to be present in any virtual space. Tito et al. mention that emerging advanced technologies in the education sector bring new benefits, with AI being fundamental in addressing the lack of human resources.[9] For example, determining factors such as high dropout rates in rural areas can be mitigated through the use of intelligent systems that offer academic support to students, allowing for more personalized monitoring and intervention.

AI tools also offer opportunities for distance learning, which is vital in many rural areas where the physical infrastructure of institutions may be poor. They discuss improving educational efficiency through AI technologies in law teaching, which can be used in different fields of teaching.[10] In this context, universities can implement different online learning platforms that incorporate different areas of knowledge and in which the use of AI is essential to provide educational experiences with a greater impact on rural students, as has been done in some initiatives in Latin America.[11,12]

For the successful implementation of AI in higher education, the development of inclusive educational policies Oliveira et al[13] and adequate teacher training are recommended. Providing adequate training to teachers in the use of AI is essential. Likewise, the need to promote a culture of ethics and responsibility in its application is emphasized, ensuring that automated decisions are transparent and equitable. Attention to ethical challenges, such as the risks of bias, is crucial to ensuring that AI benefits all students fairly.

This paper presents a comprehensive approach, addressing both the benefits of implementing AI in university education in rural areas and the ethical and practical challenges of doing so responsibly and fairly. It also provides an updated view of how higher education institutions in rural areas can balance technological advances with traditional education.

This study's relevance is based on its contribution to the field of educational technologies and its potential to guide educators and keep them at the forefront of new technologies, thereby enabling them to make good decisions about best practices for integrating AI into higher education.

This analysis's central question is: How does Artificial Intelligence influence equity and accessibility in rural university education? This work aims to evaluate the impact of the adoption of artificial intelligence within rural universities on higher education students, proposing practical and ethical recommendations for its usability within these institutions. In this context, the article promotes an informed discussion. It seeks to

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contribute to developing policies and practices that optimize the use of AI for the benefit of students, teachers, and educational institutions.

METHOD

This research adopts a qualitative approach with elements of documentary analysis, following the approaches of Hernández et al[14] as it seeks to understand and describe the application of Artificial Intelligence (AI) in rural university education. A systematic literature review design is used to identify patterns, trends, and gaps in the existing literature on the implementation of AI in rural educational settings.

In order to answer the research question, inclusion and exclusion criteria were generated before conducting the literature search; among these were considered some documents (books and articles) that address topics such as the use of AI in educational settings, which were published between the years 2018 and 2024 (see table 1).

Table 1. Inclusion and exclusion criteria for the bibliographic search

Criteria	Description
Year of publication	The selected papers were published between 2018 and 2024.
Language	Only articles and documents in English or Spanish were included.
Type of document	Peer-reviewed articles, books and book chapters, as well as reviewed conferences were considered.
Thematic relevance	• AI applications in rural university education. • Challenges and opportunities of AI implementation in rural areas. • Impact on teaching-learning processes. • Technological models and strategies applied..
Accessibility of the text	Only documents that could be accessed in their entirety in full format were included.
Quality of the study	Quality was assessed using the Mixed Methods Appraisal Tool (MMAT), selecting only studies with high scores.

The study is based on collecting, analyzing, and synthesizing indexed academic sources and governmental and international organizations' reports on education and technology. High-impact databases such as Scopus, Web of Science, IEEE Xplore, and Google Scholar have been considered, with a time range of the last ten years, to ensure the timeliness and relevance of the information. As this is research based on secondary sources, the application of data collection instruments with human participants was not required. However, the principles of academic integrity were respected, ensuring proper citation and avoiding plagiarism. This approach allowed us to identify 170 papers that met the inclusion criteria. After an exhaustive review, 27 articles were selected, classified, and interpreted using the PRISMA statement.[15]

To assess the quality of the studies analyzed, methodological criteria were applied to ensure rigor and reliability in the selection. Aspects such as the soundness of the methodology employed, the coherence between objectives and results, the clarity of the procedures, and the study's relevance to the research question were considered. Each study was assigned a score based on these parameters, and only those with the highest scores were considered in the final analysis. This evaluation process ensures that the review's conclusions are substantiated and significantly contribute to the application of Artificial Intelligence in rural education at the university level.

Subsequently, the information collected was organized using a thematic analysis approach, which allowed for identifying recurring trends and patterns in the research findings reviewed. In addition, comparisons were made to detect variations in the findings according to the type of artificial intelligence implemented and the educational environment in which it was applied. The results are presented descriptively, complemented by tables and graphs summarising the review's most relevant aspects.

In the application of AI in rural education at the university level, qualitative research is one of the pillars to understanding the impact that it can generate within educational institutions where access to the internet and, therefore, to the tools provided by AI are limited. Therefore, we seek to demonstrate its impact and how it influences the educational experience.[15]

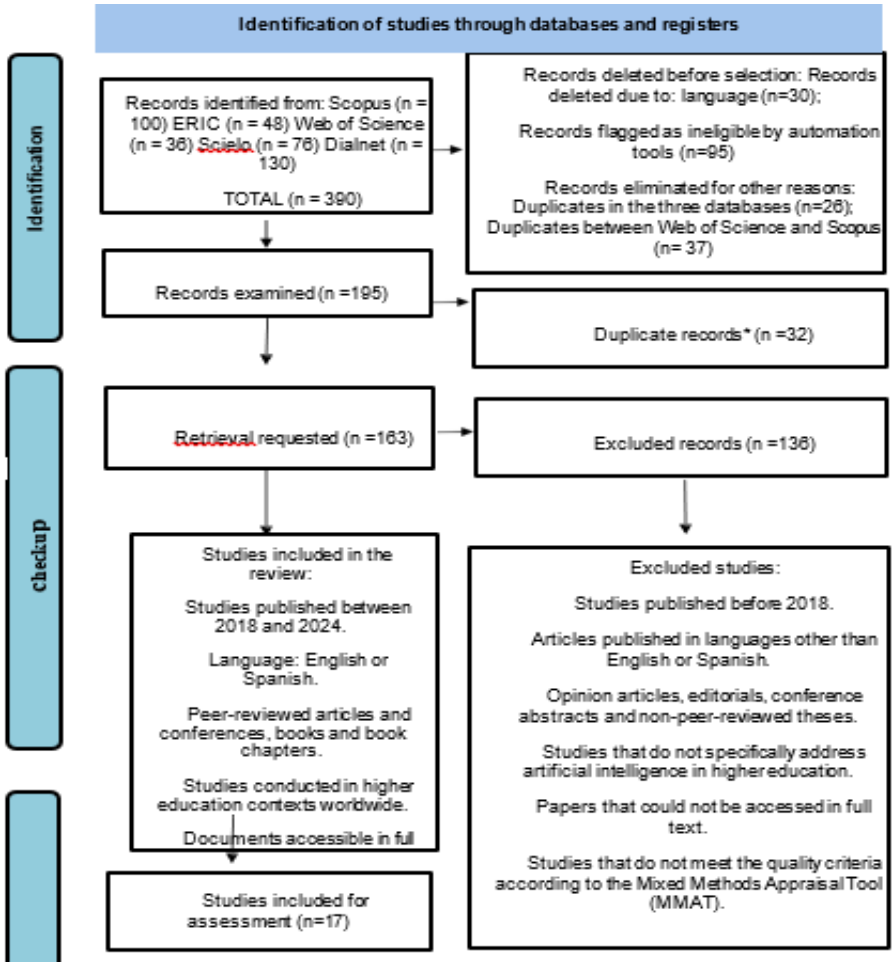

Figure 1. Flow diagram according to PRISMA methodology

Table 2. Contributions to research on the impact of AI on rural higher education

Author(s)	Relevance	Title	Country	Methodology	Findings
García et al.[5]	Challenges of digitisation in rural universities	Challenges of Rural Universities in the Digital Era	International	Qualitative analysis	Identifies technological barriers and proposes strategies to improve education in rural areas.
Smith et al.[6]	Accessibility of AI in higher education	The Role of Artificial Intelligence in Higher Education Accessibility	USA	Literature review	Examines how AI can improve educational inclusion for students with disabilities.
Li[1]	AI and deep learning	Network intelligent education system based on the deep learning algorithm	China	AI algorithms	Proposes a model based on deep learning to personalise teaching.
Pei et al.[2]	Educational assessment with AI	Design of an intelligent educational evaluation system using deep learning	China	Evaluation models	Explores how AI improves assessment systems in higher education.
Kurz et al.[3]	Contextualisation in chemistry teaching	The dicumba methodology and contextualisation in chemistry teaching	Brasil	Experimental study	Analyses innovative methods for teaching chemistry with technological support.
Sosa et al.[4]	Autonomous learning with flipped classroom	Inverted classroom as a tool for the achievement of autonomous learning in undergraduate students	Peru	Case studies	Demonstrates how the flipped classroom improves student autonomy.

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Oliveira et al.[13]	Review of AI in education	Inteligência artificial na educação: Uma revisão integrativa da literatura	Brazil	Systematic review	Analyses trends and challenges of AI in education.
Alcocer et al.[16]	AI and ethics in education	Artificial intelligence in education: ethical challenges and perspectives towards a new education	Mexico	Qualitative approach	Discusses the ethical dilemmas of AI in education.
Apolo et al.[11]	Virtual education in rural areas	The situation of virtual education in the Ecuadorian rural sector	Ecuador	Field study	Evaluates access to virtual education in rural communities.
Arias-Velandia et al.[12]	Gaps in virtual higher education	The beginning of virtual higher education in Colombia	Colombia	Geographical analysis	Identifies inequalities in virtual higher education between rural and urban areas.
Cruz et al.[8]	AI in economics and management education	The impact of artificial intelligence on economics and management education	International	Trend analysis	Highlights opportunities and challenges of using AI in these disciplines.
Garduza et al.[17]	Parental involvement in rural education	The importance of parental involvement in rural schools at the basic level	Mexico	Qualitative research	Explores the role of parents in rural education and its effects on learning.
Lassi[18]	Ethical implications of AI	Ethical implications of artificial intelligence	International	Critical review	It examines the ethical dilemmas of using AI in various fields.
Romero et al.[10]	AI in law education	Application of artificial intelligence tools in law teaching	Latin America	Case studies	Analyses the effectiveness and limitations of the use of AI in legal education.
Tito et al.[19]	AI applications in education	Artificial intelligence applied to the education sector	Venezuela	Case review	Evaluates how AI is being implemented at different educational levels.
Hernández et al.[14]	Research Methodology	Research Methodology (5th ed.)	México	Reference book	Fundamental guidance for research design and implementation.
Paiva[20]	Student perceptions of AI	University students' perceptions on the use of artificial intelligence as a learning tool	Paraguay	Quantitative survey	Analyses how students perceive the impact of AI on their learning.

RESULTS

From the analysis of the studies reviewed, several key trends and findings on the integration of artificial intelligence in higher education can be identified. First, AI can improve access and equity in learning, especially in rural or technologically challenged communities. Research highlights how AI tools can reduce educational gaps by facilitating access to digital resources and personalizing teaching to individual student needs.

In addition, AI is transforming assessment and teaching methods by incorporating deep learning models that optimize feedback processes and academic performance analysis. This translates into more accurate and adaptive assessment systems that provide real-time information on student progress.

On the other hand, AI's impact is not only technological but also ethical and methodological. Several studies highlight the need to establish regulatory frameworks governing the use of these technologies to avoid algorithmic biases and ensure fair implementation in educational settings. They also emphasize the importance of teacher training in artificial intelligence tools to maximize their benefits without compromising pedagogical quality.

Finally, students' perception of AI in their academic training varies according to the context and discipline. However, a favorable attitude towards its use is generally identified when it is used as a complement and not as a substitute for traditional teaching. Combining innovative methods, such as the flipped classroom and automated tutoring systems, has improved students' autonomy and engagement with their learning process.

These results suggest that artificial intelligence represents an opportunity to strengthen higher education, provided that its implementation is done strategically and considering its benefits and ethical and practical

challenges. Accordingly, the reviewed articles are synthesized, followed by classifying the findings into these categories.

Impact of AI on the development of critical thinking among university students

While there are studies on the use of AI in higher education, few analyze its effect on advanced cognitive skills, such as critical thinking. Most research focuses on task automation or personalized learning but not on whether these tools foster or limit students' capacity for independent analysis.[2,21] There is a risk that overuse of AI will create dependency in students, reducing their ability to critically question, analyze, and evaluate information. If AI provides immediate answers, how does it foster the development of analytical skills in students? It is necessary to study whether these tools are promoting passive learning or whether, on the contrary, pedagogical strategies can be designed to encourage critical thinking through interaction with intelligent systems.

Challenges of AI integration in universities with limited infrastructure

Much of the current literature focuses on the potential of AI in higher education without considering the structural limitations many institutions face. There is a need to explore how universities with limited access to technology can implement AI solutions without exacerbating existing inequalities.[5,22] Despite democratizing access to digital tools, a significant gap remains between universities in developed countries and those in less well-resourced contexts. Investigating how these institutions can adopt AI technologies without generating greater inequality among students is crucial.

University teachers' perceptions of and resistance to the use of AI in education

Although the adoption of AI in education has been researched from a student perspective, there is little evidence of teachers' perceptions of and resistance to these technologies. Lack of training, fear of automation of their functions, and the cognitive load associated with technological adaptation require further analysis Oliveira et al.[13] Some teachers may see AI as a threat to their traditional role, while others may face technical difficulties or lack of training to use these tools. Understanding these challenges is key to designing strategies that facilitate the adoption of AI in teaching without generating teacher rejection.

Ethics and regulation of the use of AI in academic assessment

Using artificial intelligence in automated assessment systems raises ethical concerns about privacy, algorithmic bias, and transparency in marking. Despite advances in deep learning models, there remains a gap in formulating regulatory frameworks to govern these processes.[8,18] There is a need to develop regulatory frameworks to govern the use of AI in education, ensuring that its implementation respects learners' rights and guarantees fair assessment.

Using AI to personalize learning strategies in higher education

While there are studies on personalization of learning through AI, most focus on basic levels of education. There is a lack of evidence on how these technologies can adapt pedagogical strategies at the university level based on individual learning styles, performance, and needs Paiva[15], Tito et al.[9] Every student has a different pace and learning style, so AI can be key in tailoring academic content to their specific needs.

These thematic gaps represent opportunities for future research and contributions at the intersection between artificial intelligence and higher education.

Here are the practical recommendations with correctly structured APA 7 format citations*:*

Practical Recommendations for the Ethical Implementation of Artificial Intelligence in Higher Education

Implementing artificial intelligence (AI) in university education should be approached with an ethical and practical focus to ensure its responsible use and positive impact on teaching and learning processes. Below are some key recommendations supported by academic literature and current regulations.

To ensure the responsible use of AI in education, the algorithms must be understandable to teachers and students. This implies that decisions made by automated systems should be explainable in accessible terms, allowing their processes to be audited.[1] Explainability also contributes to trust in these tools and facilitates the detection of possible biases or errors in their operation.[2]

The use of AI in education involves the collection and processing of large volumes of student data. Therefore, it is essential to ensure compliance with international data protection regulations, such as the General Data Protection Regulation (GDPR) in Europe. Implementing anonymization and encryption mechanisms to protect student information and prevent misuse of their data for commercial purposes without their consent is recommended.[6]

AI algorithms can reproduce or even amplify biases in the data they have been trained on. Therefore,

regular audits are recommended to assess the fairness and impartiality of the systems used in higher education García et al.[5] In addition, the involvement of ethics and technology experts in these processes will help to reduce discrimination in academic and assessment decision-making.

While AI can streamline academic assessment through automated corrections or detection of patterns in student performance, it is essential that teachers oversee final decisions. This will ensure that factors such as creativity, critical reasoning, and argumentation are considered in student grading, avoiding over-reliance on automated systems.[7]

One of the biggest challenges in AI implementation is the digital divide, especially in universities with limited infrastructure. To reduce this inequality, the development of AI platforms accessible from mobile devices and the promotion of partnerships between educational institutions, governments, and technology companies to provide access to advanced tools to all students is recommended.[22]

It is imperative that both teachers and students understand the implications of using AI in education. Training modules on AI ethics and its responsible application in education are recommended for university curricula Oliveira et al[13]. This will allow future professionals to develop critical thinking about the impact of these technologies in their field of study.

AI should be used to support and optimize teaching processes, not as a replacement for the teaching role. AI-based platforms can personalize learning strategies, offer automated tutoring, and improve classroom management, but always under the guidance of a professional who interprets the results and adapts methodologies according to the individual needs of students.[23]

Regulation of the use of AI in higher education is key to avoiding unfair practices and ensuring that its implementation is carried out ethically. Universities should establish clear policies on the use of these tools in teaching and academic assessment, ensuring their alignment with principles of fairness, equity, and transparency.[10]

Practical recommendations

To address the thematic gaps in integrating AI in higher education, it is essential to develop strategies that foster critical thinking in students, promoting active methodologies and assessments that require analysis and interpretation rather than automated answers. In addition, the technological gap in universities with limited infrastructure must be considered, as well as the promotion of open-source tools, strategic alliances with companies and governments, and platforms accessible from mobile devices. It is also crucial to address teachers' resistance to using AI, offer specialized training and pilot programs, and promote a culture of innovation where teachers actively implement these technologies. In terms of academic assessment, it is necessary to establish clear regulatory frameworks governing the use of AI, ensuring transparency and fairness in grading and protecting student data's privacy. Finally, using AI to personalize learning must consider students' cultural and academic diversity through adaptive platforms that analyze their performance in real-time and provide strategies tailored to their needs. Effective integration of AI in higher education requires applied research, ongoing audits of the systems used, and a collaborative approach involving teachers, students, educational administrators, and technology developers to ensure a positive and equitable impact on teaching and learning processes.

Ethical recommendations

Ethical implementation of artificial intelligence in higher education requires transparency in its operation, ensuring that teachers and students understand how automated decisions are made. It is essential to protect privacy and responsible use of data, avoiding excessive collection of data or collection for commercial purposes without consent. To prevent algorithmic bias, constant audits should be conducted to ensure fairness in access to these technologies, avoiding widening the digital divide. AI should act as a complement and not a substitute for the teacher, ensuring that critical decisions are supervised by humans, especially in academic assessment. In addition, the educational community should be trained in the responsible use of these tools. Their integration should be promoted without compromising the development of essential human skills, such as critical thinking and creativity. An ethical approach to AI will ensure that its impact on education is fair, inclusive, and beneficial to all students.

DISCUSSION

The Application of Artificial Intelligence in Rural Education at the University Level

Implementing Artificial Intelligence (AI) in rural education at the university level poses significant opportunities and structural challenges. In the rural context, higher education institutions face limitations in infrastructure, connectivity, and access to technological resources, which has hindered the adoption of digital innovations in the classroom .[5]

However, AI has proven to be a promising tool for improving educational quality and reducing access gaps in

these environments.[24]

One of the main benefits of AI in rural university education is the personalization of learning. Intelligent tutoring systems and adaptive learning allow students to receive individualized feedback and access learning materials tailored to their pace and learning style.[22] This is particularly relevant in rural communities, where the shortage of specialized teachers and geographical distance can affect educational quality.

AI also facilitates access to educational content through online learning platforms that employ natural language processing models and data analytics to optimize the user experience.[14] In this sense, tools such as educational chatbots and virtual assistants have been implemented to answer frequently asked questions, guide students, and provide academic support without constant interaction with a teacher.

However, applying AI in rural contexts also brings challenges that must be addressed. The digital divide remains one of the main barriers to effectively implementing these.[23] The lack of technological infrastructure and limited connectivity in rural areas restrict access to AI-based tools, generating inequalities in higher education. In addition, teacher training is a crucial factor, as many educators in these areas lack the necessary training to integrate AI into their pedagogical practices.[25]

Another aspect to consider is ethics and privacy when using AI in rural education. Student data collection raises concerns about information security and the appropriate use of personal data.[21] Establishing regulatory frameworks and security protocols that ensure privacy protection and promote responsible use of technology in education is essential.

In conclusion, the application of Artificial Intelligence in rural university education represents a significant advancement in transforming teaching and learning models. However, its implementation must be accompanied by strategies that address technological inequalities, teacher training, and ethical regulation. With proper planning, AI has the potential to improve access to higher education in rural areas and contribute to the academic development of marginalized communities.

CONCLUSION

Artificial Intelligence represents a transformative opportunity for rural education at the university level, offering innovative solutions to historical challenges such as lack of infrastructure, shortage of specialized teachers, and the need for personalization in learning. Through tools such as virtual tutors, adaptive recommender systems, and educational data analytics, AI can improve accessibility, strengthen educational quality, and foster the inclusion of traditionally marginalized communities.

However, its implementation requires a strategic approach that includes teacher training, the development of technological infrastructures, and the adaptation of pedagogical models to the needs of each context. It is also essential to ensure equitable access to these technologies and to promote an ethical use that respects cultural diversity and fosters critical thinking.

In this sense, Artificial Intelligence should not be seen as a substitute for teaching but as an ally that complements and enhances learning in rural environments. Its success will depend on the balanced integration of technological innovation and learner-centered pedagogical strategies, ensuring that knowledge is accessible, relevant, and meaningful to each community.

It is important to note that the review was based on studies published between 2018 and 2024, which may have excluded relevant research outside this time range. Also, variability in the quality of the studies reviewed may have influenced the results. Future research should focus on developing and testing specific methodologies for implementing AI in diverse educational contexts and exploring strategies to mitigate the ethical challenges identified. This study opens up new directions for research, inspiring other researchers to continue to explore how AI can improve higher education fairly and effectively.

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FINANCING

None.

CONFLICT OF INTEREST

None.

AUTHORSHIP CONTRIBUTION

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