

Effective Strategies for Guided Implementation of Artificial Intelligence in General Unified Baccalaureate Programs

- (es) Estrategias efectivas para la implementación guiada de la inteligencia artificial en programas de Bachillerato General Unificado.
- (port) Estratégias Eficazes para a Implementação Guiada da Inteligência Artificial em Programas de Bacharelado Geral Unificado

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Abstract

This multidisciplinary research article explores effective strategies for the guided implementation of artificial intelligence (AI) in General Unified Baccalaureate (GUB) programs. AI has the potential to transform secondary education through personalized learning, improved administrative efficiency, and enhanced collaboration between students and teachers. However, implementation faces challenges such as insufficient technological infrastructure, ethical issues, and the need for continuous teacher training. The study proposes a combination of literature review and case study analysis to identify best practices and persistent barriers. The necessity of investing in technological infrastructure, integrating AI concepts into the curriculum, and training teachers in the use and implications of AI are highlighted. Additionally, the potential of AI to improve continuous assessment, provide real-time feedback, and support educational methodologies that foster critical thinking and creativity is emphasized. The objective is to provide a practical framework that is pedagogically valid, ethically sound, and inclusive, ensuring that technology serves as a bridge to more equitable and enriching educational opportunities.

Keywords: Artificial Intelligence (AI), Secondary Education, Personalized Learning, Technological Infrastructure, Ethics in Education.

Resumen

Este artículo de investigación multidisciplinaria explora estrategias efectivas para la implementación guiada de la inteligencia artificial (IA) en programas de Bachillerato General Unificado (BGU). La IA tiene el potencial de transformar la educación secundaria mediante la personalización del aprendizaje, la mejora de la eficiencia administrativa y la facilitación de la colaboración entre estudiantes y docentes. Sin embargo, la implementación enfrenta desafíos como la infraestructura tecnológica insuficiente, cuestiones éticas y la necesidad de capacitación continua para los docentes. El estudio propone una combinación de revisión de literatura y análisis de casos reales para identificar mejores prácticas y barreras persistentes. Se destacan la necesidad de invertir en infraestructura tecnológica, la importancia de integrar conceptos de IA en el currículo y la capacitación de los docentes en el uso y las implicaciones de la IA. Además, se subraya el potencial de la IA para mejorar la evaluación continua, proporcionar retroalimentación en tiempo real y apoyar metodologías educativas que fomenten el pensamiento crítico y la creatividad. El objetivo es proporcionar un marco práctico que sea pedagógicamente válido, éticamente sólido e inclusivo, asegurando que la tecnología sirva como un puente hacia oportunidades educativas más equitativas y enriquecedoras.

Palabras claves: Inteligencia Artificial (IA), Educación Secundaria, Personalización del Aprendizaje, Infraestructura Tecnológica, Ética en la Educación.

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Resumo

Este artigo de pesquisa multidisciplinar explora estratégias eficazes para a implementação guiada da inteligência artificial (IA) em programas de Bacharelado Geral Unificado (BGU). A IA tem o potencial de transformar a educação secundária através da personalização do aprendizado, da melhoria da eficiência administrativa e da facilitação da colaboração entre estudantes e professores. No entanto, a implementação enfrenta desafios como infraestrutura tecnológica insuficiente, questões éticas e a necessidade de formação contínua para os docentes. O estudo propõe uma combinação de revisão de literatura e análise de casos reais para identificar melhores práticas e barreiras persistentes. Destacam-se a necessidade de investir em infraestrutura tecnológica, a importância de integrar conceitos de IA no currículo e a formação dos docentes no uso e nas implicações da IA. Além disso, sublinha-se o potencial da IA para melhorar a avaliação contínua, fornecer feedback em tempo real e apoiar metodologias educacionais que promovam o pensamento crítico e a criatividade. O objetivo é fornecer um quadro prático que seja pedagogicamente válido, eticamente sólido e inclusivo, garantindo que a tecnologia sirva como uma ponte para oportunidades educacionais mais equitativas e enriquecedoras.

Palavras-chave: *Inteligência Artificial (IA), Educação Secundária, Personalização do Aprendizado, Infraestrutura Tecnológica, Ética na Educação.*

Introduction

In an era defined by rapid technological advances, artificial intelligence (AI) is positioned as a key catalyst for transformation in various sectors, including education. This century has seen how AI has begun to redraw the contours of what is considered possible in the classroom, offering innovative ways to improve the personalization and effectiveness of learning.

Despite its transformative potential, the integration of AI technologies in secondary education, particularly in Unified General Baccalaureate programs, faces a number of challenges ranging from technological infrastructure to issues of equity and ethics (Barakina et al., 2021). This study delves into the exploration of effective strategies for the guided implementation of AI, with a particular focus on how these technologies can be adapted to strengthen existing curricula and pedagogies while addressing contemporary needs and challenges.

The globalization of the Internet and digital technologies has provided an unprecedented platform for the deployment of AI in the educational context. However, reports from international organizations such as UNESCO since 2021 highlight that, although connectivity is improving, there are marked inequalities in access to these technologies, especially in less developed regions (Vásquez, 2021). These technology gaps suggest that AI implementation must be not only carefully planned but also inclusive, ensuring that no student is left behind in the race to digital transformation.

This multidisciplinary research article proposes a detailed analysis of how AI can be effectively implemented in Unified General Baccalaureate programs. This includes a discussion of the need to update the technological infrastructure of educational institutions and to provide continuous training for teachers, who must be equipped not only with technical skills but also with a deep understanding of the pedagogical and ethical implications of technology. In addition, it will address how AI can support educational methodologies that promote critical thinking and creativity, essential in an increasingly automated and technological world.

To develop a holistic understanding of these issues, the study will employ a mixed methodological approach. It will combine the comprehensive review of the current academic literature on the integration of AI in education with the analysis of multiple case studies of real AI implementations in international secondary schools. This approach allows not only to identify best practices and lessons learned, but also the difficulties and barriers that remain.

This work seeks not only to advance academic knowledge in the field of educational technology but also to provide a practical framework for educators and educational administrators. This framework aims to guide the integration of AI into educational processes in a way that is pedagogically valid, ethically sound, and socially inclusive. We hope that this study will serve as a valuable resource for those committed to

reinventing education in the 21st century, ensuring that technology acts as a bridge to richer learning opportunities and not as a barrier that deepens existing inequalities.

Revision

Artificial intelligence (AI), according to Prince (2024) is revolutionizing various sectors, and education is no exception. The implementation of AI-based technologies offers multiple benefits, "from the personalization of learning to the optimization of administrative processes" (p. 4). AI has the potential to transform education in ways that were previously unimaginable.

On this, Ayuso-del-Puerto and Gutiérrez-Esteban (2022) argue that these intelligence models could analyze large amounts of data, learn from them, and make accurate predictions opens up new possibilities for personalization and improvement of learning (p. 348), that is, they are like a mind in constant training. The authors argue that what has made AI popular in terms of its ability to automate many of the time-consuming administrative and routine tasks, allowing educators to focus on what they do best: teaching (p. 350). However, the adoption of AI in education also raises challenges and ethical issues that need to be addressed to ensure that its benefits are realized equitably and fairly.

AI is being integrated into education in several ways. According to UNESCO (2023), AI-based tools have the potential to improve teaching and learning by personalizing education and facilitating the management of large volumes of education data. These technologies can help identify individual student needs, providing personalized resources and support.

In practice, this means that learning platforms can automatically adapt to each student's strengths and weaknesses. For example, a student who struggles with math may be given additional exercises and specific resources to improve their skills, while another who excels can be challenged with advanced material. Not only does this personalization improve learning effectiveness, but it also increases student motivation and engagement by offering them a more relevant and meaningful education.

AI can also facilitate collaboration and communication between students and teachers. AI tools can analyze online interactions and provide real-time feedback, helping students better understand the material and teachers quickly identify those who need additional help (Rodríguez & Pérez, 2023). AI can play a crucial role in the early identification of learning difficulties and early intervention. For example, AI algorithms can detect patterns in student behavior and performance that could indicate problems such as dyslexia or ADHD. This allows educators and specialists to intervene with targeted strategies and additional support to address these difficulties before they significantly impact a student's academic progress (Díaz, 2023).

AI can also improve student assessment and feedback. Rather than relying solely on traditional exams, AI systems can assess students continuously through online activities, providing immediate and

detailed feedback. Not only does this help students better understand their mistakes and areas for improvement, but it also allows teachers to adjust their teaching methods based on students' individual needs (Gómez et al., 2023).

Finally, AI can be used to design and improve the educational curriculum. By analyzing student performance data and global educational trends, AI systems can suggest modifications to the curriculum that better align with labor market demands and student interests. This ensures that educational content is relevant and up to date, preparing students for future challenges (Galeas, 2024).

AI makes it possible to create personalized learning experiences, tailored to the needs of each student. Systems such as smart tutors analyze students' progress and difficulties, offering specific recommendations and materials that fit their learning pace and style (UNESCO, 2023).

Personalizing learning through AI is transforming the way students interact with educational content. AI-based tutoring systems can monitor student performance in real-time, tailoring content and activities to their individual needs. This ability to personalize education not only improves academic performance, but also increases student motivation by providing challenges and support that fit their abilities and learning style (López & Martínez, 2023). In addition to smart tutors, other AI applications are designed to identify students' strengths and weaknesses by collecting and analyzing data in real-time. For example, adaptive learning platforms use AI algorithms to automatically adjust task difficulty levels and offer additional resources based on student progress (Díaz, 2023).

Another significant advantage of AI learning personalization is the ability to create individual curricula that consider not only academic performance, but also each student's interests and goals. This translates into a more enriching and relevant learning experience that can include everything from practical activities to interactive multimedia content designed to maintain interest and motivation (Gómez et al., 2023). AI tools also enable teachers to deliver more inclusive education. By quickly identifying students who need additional support, educators can intervene in a timely manner and provide needed help. This is particularly important for students with special needs or those who are at risk of falling behind academically (Rios-Campos et al., 2023).

AI tools can automate administrative tasks, freeing up time for teachers to focus on teaching. This includes grade management, class scheduling, and work evaluation, which improves efficiency in educational institutions (Gómez et al., 2023). Automating administrative tasks using AI allows teachers and educational administrators to focus on more meaningful and less tedious activities. For example, AI-based student management systems can automate the collection and analysis of performance data, making it easier to identify trends and areas that require attention.

AI facilitates adaptive learning, which automatically adjusts content and teaching methods based on student performance. Not only does this improve academic performance, but it also keeps students motivated and engaged in their learning. AI-based adaptive learning uses algorithms to analyze student progress and adapt educational content accordingly. For example, if a student is struggling in a specific area, the system can provide additional exercises and personalized resources to help them overcome their challenges. On the other hand, if a student is progressing quickly, the system can offer them more advanced and challenging content. This approach not only improves academic performance, but also keeps students motivated and engaged by providing them with an education that fits their needs and learning pace (Domínguez, 2023).

AI algorithms can assist teachers in the creation of more effective lesson plans by suggesting activities, resources, and pedagogical approaches based on student achievement data and educational best practices (García et al., 2023).

AI-based lesson planning tools can analyze large amounts of data about student performance and educational best practices to suggest activities and resources that are more effective for different groups of students. This not only saves teachers time, but also improves the quality of teaching by providing them with evidence-based tools to support their planning (Fernández, 2023). These AI tools can identify patterns in student performance data that may not be apparent to educators. For example, they can spot trends in student performance over time and suggest targeted interventions to address areas of weakness before they become bigger problems.

Another important aspect is AI's ability to provide diversified educational resources that cater to different learning styles. Algorithms can suggest videos, articles, interactive games, and other materials that can make learning more engaging and effective for students. Not only does this enrich the lesson plan, but it also helps keep students engaged and motivated (Gómez et al., 2023).

In addition, AI can facilitate collaboration between teachers by sharing effective lesson plans and resources. AI platforms can allow teachers to access a database of lesson plans and resources used by other teachers, facilitating the sharing of best practices and innovation in teaching. This fosters a more collaborative and dynamic educational community (Rodríguez & Pérez, 2023). AI can democratize access to quality education by offering educational resources to students from diverse regions and socioeconomic backgrounds. This is especially beneficial in rural or resource-limited areas, where AI can provide access to materials and educational opportunities that would otherwise be inaccessible.

Table 1
Methodological inquiry for the descriptive study

Author(s)	Year	Study Title	Methodology	Main Findings	Limitations
Vera, F.	2023	Integrating AI in Higher Education: Challenges and Opportunities	Systematic review	AI improves learning personalization and administrative efficiency.	Lack of longitudinal studies
Sánchez et al.,	2023	Application of AI in Higher Education	Content Analysis	AI facilitates adaptive teaching and early identification of learning difficulties.	Underrepresentation of developing regions
López et al.,	2023	Personalizing AI Learning: An Adaptive Approach	Literature review	Personalizing learning using AI improves student motivation and engagement.	Need for more empirical research
Boxes	2023	Adaptive Learning Model of Work Competencies and Cognitive Skills (ICT): Case of Huixquilucan City Council	Qualitative study	AI enables the creation of personalized curricula that improve academic performance.	Limitations in sample diversity
Yasuf et al.,	2024	Generative AI and the future of higher education: a threat to academic integrity or reformation? Evidence from multicultural perspectives	Critical analysis	Generative AI has the potential to transform higher education, but it poses significant risks to academic integrity.	Need for robust policies to mitigate risks
Ouyang et al.,	2022	Artificial intelligence in online higher education: A systematic review of empirical research from 2011 to 2020	Systematic review	AI in higher education improves the personalization and management of educational data.	Exclusion of relevant articles due to strict criteria
Kim et al.,	2021	Effects of AI chatbots on EFL students' communication skills	Systematic review	AI chatbots improve academic performance and knowledge retention, but not necessarily motivation.	Need for longitudinal studies
Onesi-Ozigagun et al.,	2024	Revolutionizing education through AI: a comprehensive review of enhancing learning experiences.	Case Study	AI enhances the learning experience through personalization and immediate support.	Need for more longitudinal data
Jia et al.,	2024	Artificial intelligence in science education (2013–2023): Research trends in ten years	Case Study	AI, including math picture books, improves engagement and understanding in education in its different branches	Privacy concerns and bias
Abunaseer	2023	The use of generative AI in education: Applications, and impact	Systematic review	Generative AI improves teaching and learning, but requires careful implementation to avoid bias.	Need for ethical implementation policies

Own elaboration (2024).

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The survey of the literature cited in Table 1 shows how AI can overcome geographical and socioeconomic barriers by offering access to online educational resources and personalized tutorials. For example, students in rural areas can access high-quality online courses and educational resources that would not otherwise be available to them, but it also highlights a need for the democratization that this type of study requires.

The research shows that these questions have been carried out with greater attention in Europe and Asia and the results of this research coincide in the need for access to education through AI to also have a significant impact on the reduction of educational inequality.

On this, Gómez et al., (2023) refer that the act of providing high-quality educational resources to students from all contexts, AI can help close the achievement gap between students from different socioeconomic backgrounds. This is especially important in developing countries, where access to quality education remains a major challenge (p. 46).

Díaz (2023) says that this requires a personalization of learning, which not only improves academic results, but also increases student motivation and commitment. By using data to personalize and optimize teaching, AI can raise the quality of education. Students receive an education that is more relevant and appropriate to their needs, which improves academic outcomes and overall satisfaction (p. 38).

By receiving an education that adapts to their needs and learning paces, students are more motivated and committed to their learning. This not only improves their academic results, but also increases their satisfaction and interest in education (Saravia et al., 2024). Improving the quality of education through AI can also have a positive impact on teachers. By providing them with tools and resources that allow them to personalize and optimize their teaching, AI can help teachers be more effective and efficient in their work. This not only improves the quality of education students receive, but also increases teachers' job satisfaction.

Automating routine and administrative tasks reduces teachers' workload, allowing them to focus on teaching and professional development. This can lead to a more dynamic and student-centered learning environment (García et al., 2023). By automating tasks such as grading and scheduling classes, AI allows teachers to spend more time on pedagogical activities and professional development. Not only does this improve the quality of teaching, but it also increases teachers' job satisfaction, as they can focus on what they are truly passionate about: teaching and supporting their students (Gómez et al., 2023). Reducing workload through AI can also have a positive impact on teacher well-being. By reducing the stress and pressure associated with administrative and routine tasks, AI can help teachers maintain a healthy work-life balance. Not only does this improve their overall well-being, but it can also have a positive impact on their performance and effectiveness as educators (Casillas, 2022).

Jia et al., (2024) argue that AI can provide students with complex problems that demand the application of critical thinking skills. For example, AI-based simulators and virtual environments can present real-world situations where students must analyze information, formulate hypotheses, and make informed decisions. These types of experiences not only improve problem-solving skills, but also encourage an analytical and reflective approach to learning. It can foster creativity by allowing students to explore multiple approaches to solving a problem. Tools such as idea generators and AI-based creative assistants can suggest different perspectives and methods, spurring innovation. These tools can also provide real-time feedback, helping students refine their ideas and develop more creative and effective solutions.

Another way AI promotes critical thinking and creativity is through the customization of tasks and projects. AI systems can assign projects that specifically challenge each student's skills and knowledge, prompting them to step out of their comfort zone and think more creatively and critically. This personalization ensures that each student faces challenges appropriate to their skill level, maximizing intellectual and creative growth (Díaz, 2023). AI can also facilitate creative collaboration between students. AI-based collaboration platforms can analyze the contributions of each group member and suggest ways to enhance cooperation and collective creativity. These platforms can identify strengths and weaknesses in group dynamics, offering recommendations to optimize interaction and the exchange of ideas (Gómez et al., 2023).

Conclusions

One of the fundamental pillars for the successful implementation of AI in BGU programs is the continuous training of teachers. As the document indicates, training should not only focus on the technical use of AI tools, but also on the pedagogical and ethical implications of these technologies. Ayuso-del-Puerto and Gutiérrez-Esteban (2022) highlight that AI competence allows teachers to effectively integrate these technologies into their educational practice, promoting more personalized and adaptive teaching.

Integrating AI concepts into the curriculum is crucial. Galeas (2024) mentions that adapting educational content to include computational thinking and data science can better prepare students for future challenges. In addition, the focus on AI ethics, as highlighted by Rodríguez and Pérez (2023), ensures that students understand the responsibilities and social implications of the use of these technologies.

The right technology infrastructure is an essential prerequisite. Access to high-speed internet, computers, and AI software are critical to implementing the strategies described. According to UNESCO and referenced by Rios-Campos et al., (2023) "inequalities in access to these technologies can be a significant barrier, especially in less developed regions" (p. 648). Therefore, it is vital that education policies include investments in technological infrastructure to ensure equitable implementation of AI.

Collaborative, personalized learning is one of the biggest benefits of AI in education. Díaz (2023) stresses that adaptive learning platforms, which automatically adjust content based on student performance,

can significantly improve student motivation and engagement. In addition, Gómez et al. (2023) highlight that intelligent tutors can provide real-time feedback, helping students to better understand the material and teachers to quickly identify those who need additional help.

The adoption of AI also raises important ethical questions. Barakina et al. (2021) and Galeas (2024) point out that data privacy, bias in algorithms, and the societal implications of AI need to be carefully addressed. Education on these ethical issues must be an integral part of the curriculum, ensuring that students are not only consumers of technology, but also critical and responsible citizens in an AI-driven world.

The implementation of AI in BGU's programs offers an unprecedented opportunity to transform education. However, as the paper highlights, it is critical to address challenges related to infrastructure, teacher training, and ethical considerations to ensure that AI benefits all students equitably and fairly. By taking a comprehensive and well-planned approach, it is possible to maximize the benefits of AI in education, preparing students for a future full of technological possibilities.

In this context, the implementation of AI-based evaluation systems can revolutionize the way academic performance is measured. Gómez et al. (2023) and Casillas (2023) mention that these systems can provide immediate and detailed feedback, allowing students and teachers to adjust their learning and teaching approaches, respectively. Not only does this improve academic outcomes, but it also increases student satisfaction and engagement.

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