Review article

Impacts of artificial intelligence on self-regulation in programming learning

Impactos de la inteligencia artificial en la autorregulación del aprendizaje de la programación

Impactos da inteligência artificial na autorregulação do aprendizado de programação

Yeran León Morejón[1] iD 0000-0002-5676-1496 ✉ yeranleonmorejon@gmail.com

Fernando Maia[1] iD 0000-0001-9689-6603 ✉ fdomaia2005@yahoo.es

Leidianys de la Caridad Álvarez Riol[2] iD 0009-0000-2186-6434 ✉ leidanys.alvarezr@upr.edu.cu

[1] Higher Polytechnic Institute of Bié. Angola.

[2] University of Pinar del Río "Hermanos Saíz Montes de Oca". Pinar del Río, Cuba.

ABSTRACT

Artificial intelligence has demonstrated its potential to transform numerous fields, and education is no exception. In the current digital age, it is emerging as a powerful resource that is revolutionizing the way it´s taught and learned. This article aims to present the impacts obtained through the use of artificial intelligence tools on the self-regulation of programming learning among Computer Engineering students at the Instituto Superior Politécnico do Bié in Angola. To this end, a descriptive literature review methodology was used, along with the application of theoretical methods such as analysis-synthesis and systematization. The main result is a proposed set of tools to streamline the self-regulation process of programming learning, which underscored the importance of these tools in

Translated from the original in Spanish

developing new methodologies that can revolutionize the way it has been learned, taught, and interacted with knowledge.

Keywords: artificial intelligence; self-regulation; learning; programming.

RESUMEN

La inteligencia artificial ha demostrado su potencial para transformar numerosos campos, y la educación no es una excepción. En la era digital actual, esta emerge como un recurso poderoso que está revolucionando la forma en que se enseña y se aprende. El presente artículo tiene como objetivo presentar los impactos obtenidos en el uso de herramientas de inteligencia artificial en la autorregulación del aprendizaje de la programación en los estudiantes de Ingeniería Informática del Instituto Superior Politécnico do Bié en Angola. Para ello se utilizó una metodología de revisión bibliográfica con alcance descriptivo y la aplicación de métodos del nivel teórico como: el análisis-síntesis y la sistematización. Como principal resultado se propone un grupo de herramientas para dinamizar el proceso de autorregulación del aprendizaje de la programación, lo que llevó a la importancia que presentan estas herramientas para desarrollar nuevas metodologías que puedan revolucionar la forma en que aprendemos, enseñamos y nos relacionamos con el conocimiento.

Palabras clave: inteligencia artificial; autorregulación; aprendizaje; programación.

RESUMO

A inteligência artificial demonstrou seu potencial para transformar vários campos, e a educação não é exceção. Na era digital atual, ela está emergindo como um recurso poderoso que está revolucionando a maneira como o ensino e a aprendizagem ocorrem. Este artigo tem como objetivo apresentar os impactos obtidos na utilização de ferramentas de inteligência artificial na autorregulação da aprendizagem de programação em alunos de Engenharia Informática do Instituto Superior Politécnico do Bié, em Angola. Para tanto, foi utilizada uma metodologia de revisão bibliográfica com escopo descritivo e a aplicação de métodos teóricos como: análise-síntese e sistematização. Como principal resultado, é proposto um grupo de ferramentas para dinamizar o processo de autorregulação da aprendizagem de programação, o que levou à importância dessas

ferramentas para o desenvolvimento de novas metodologias que podem revolucionar a forma como aprendemos, ensinamos e nos relacionamos com o conhecimento.

Palavras-chave: inteligência artificial; autorregulação; aprendizado; programação.

INTRODUCTION

The impact of artificial intelligence (AI) on education has revolutionized the way the world operates, but it also presents several obstacles that must be overcome to ensure quality education for all. For researchers such as Pedreño-Muñoz *et al.* (2024) and Páez-Paredes *et al.* (2023), AI is changing students' learning strategies, making it possible to adapt their experiences to their interests, in a personalized process adaptable to the individual needs and characteristics of each one.

Developing learning-to-learn skills in university students is a challenge for universities and for today's society, where lifelong learning is a necessity. The capacity for self-regulation is an essential element of this skill, so it is necessary to design teaching processes that promote it (Lluch-Molins & Cabrera-Lanzo, 2023).

By using adaptive platforms and intelligent tutoring systems, students can adjust their cognitive approach based on individual needs, which can help address gaps in their knowledge. Educators can benefit from tools such as ChatGPT, Gemini, and QuillBot, which help develop innovative ideas for active, formative, and self-regulated learning for university students.

The use of artificial intelligence in the training of Computer Engineering students should not simply be another link in technological development, but a paradigm shift in the way we conceive education, research, and university management. Self-regulated learning is not only a cognitive ideal, but also a tangible possibility thanks to systems capable of adapting and responding to the individual needs of each student (León-Morejón *et al.*, 2022).

In the instruction of programming languages and techniques, one of the primary challenges lies in addressing the step and initially slow learning curve, the high level of abstraction demanded of students, and the elevated dropout rates. These factors are often interrelated, with the learning curve´s initial intensity and cognitive demands of abstract conceptualization contributing significantly to attrition. Effective pedagogical strategies must therefore focus on scaffolding complex concepts,

reducing cognitive load, and fostering engagement to mitigate these barriers. Based on these problems, AI can help students adapt the content and difficulty of tasks to their needs and pace, resulting in a more personalized and effective learning experience.

AI does not replace teachers, but rather complements them. Teachers remain essential figures in the teaching process, as they can provide students with personalized guidance, motivation, and emotional support (Inglada-Galiana *et al.*, 2024). It is the key to find the right balance between the use of AI and traditional teaching, creating a learning environment that leverages the advantages of both approaches, to transform programming teaching, making it more dynamic and engaging for students.

According to García-Sánchez (2023), "there are questions to be resolved about possible implications that could aggravate socioeconomic inequalities in its use" (p. 101). However, it is important to use it responsibly and strategically, integrating it into an educational approach that values human interaction and creativity. The development of AI should be considered as a mechanism that facilitates the adjustment and reform of teaching, but not as a threat that replaces teaching functions (Pugliesi, 2024).

In this context, the following section examines a series of impacts associated with the use of artificial intelligence tools in self-regulated programming learning among computer engineering students at the Instituto Superior Politécnico do Bié in Angola, as well as their implications for development of professional competence in future engineers.

DEVELOPMENT

The use of AI is emerging as a promising tool for improving educational practices. The ability of these systems to create personalized content and materials, as well as deliver dynamic learning experiences, offers enormous potential.

This technology provides elements that can become dynamic factors in the teaching-learning process when used within an ethical, responsible, and well-informed framework. Its use in education raises several controversies that should be addressed before implementing it in the classroom.

The dehumanization of learning is a major controversy. For Martínez-Comesaña et al. (2023), "when you use a lot of AI frequently, you run the risk that students disconnect from human interaction and

relationship-based learning" (p. 96). It is therefore extremely important to use AI properly integrated into a comprehensive approach to learning, including both technology and human interaction. Its reliability is a major controversy, as it may be provided with incorrect or outdated information, and it is important as a teacher or student to verify the information provided before using it in the classroom.

Another controversy is the digital divide. The use of AI runs the risk of excluding students who do not have access to technology or who have difficulty using it. According to Luna *et al.* (2023), "it is important to ensure inclusive and accessible use for all students, regardless of their technological resources" (p. 107). To achieve this, it is imperative to define strategies that allow technology to be available to everyone, with their own devices, those of the institution, or by defining work groups for each available medium. Artificial intelligence tools can analyze student performance, provide them with real-time feedback, and inform teachers of any situations that require special attention.

The following is a set of academic tools with AI that are transforming education in a positive way, achieving higher levels of collaboration, Independence and self-regulation in computer engineering students during programming learning (Table 1):

Table 1. Academic tools with AI

Name	Description	Link
ChatGPT	Search and text generation chat, it can handle long and complex questions and generate reliable answers. It uses a fine-tuned language model with supervised and reinforcement learning techniques, allowing you to converse with an AI that understands, helps, and surprises you. It can generate coherent and creative texts based on given instructions and create content of all kinds.	https://chat.openai.com
Gemini	Chatbot developed by Google for writing, brainstorming, learning, and summarizing content. It's multimodal, processing and	https://gemini.google.com

	understanding information from multiple sources such as text, images, videos, and code. It's capable of capturing subtle nuances, understanding metaphors, and inferring intent, providing a more natural and engaging user experience.	
QuillBot	An application capable of correcting and rewriting texts to improve grammar, style, and clarity. It features tools for paraphrasing, summarizing, checking for plagiarism, translating, outlining, creating citations, and preparing the text for success in school, work, and personal life.	https://quillbot.com
Juliet	It's an intelligent platform that offers features for writing quality content quickly and accurately for emails, blogs, reports, and scientific articles so you can focus on developing your potential for job performance.	https://www.julliet.ai
Dall-E-3	It is an advanced language model that uses natural language processing and image generation techniques to translate textual descriptions into visual images. It can create images of realistic objects, as well as objects that don't exist in reality.	https://openai.com/dall-e-3
Calls	It's the AI language model launched by Meta. It provides text and answers to questions in a coherent, clear, and relevant manner, and offers image and animation generation. It performs tasks that normally require human intelligence, such as pattern recognition, decision-making, and problem-solving.	https://llama.meta.com
PaperBrain	An application to help students search, read, and learn faster. It aims to make exploring research	https://paperbrain.study

	articles easier and more accessible. It is a platform that helps researchers, students, and professionals navigate and better understand academic and scientific literature.	
Cactus AI	A learning platform that recognizes each student's unique needs and learning preferences and adjusts the pace. It can be used Caktus to write essays, solve math problems, and write programming code. Its CodeWriter feature is designed for easy code generation, making it a useful tool for software developers.	https://caktus.ai
Copilot	It's an AI assistant that improves productivity and creativity. It can be gotten real answers, inspiration, and solutions for the questions, projects, and to-do lists. It features online tools that help software developers solve problems and complete tasks in real time. Makes it easier and faster to write complex code.	https://github.com/features/copilot
Codeium	It's a coding platform that helps developers create and maintain high-quality code. It offers code completion in over 70 languages, with ultra-fast speeds and cutting-edge suggestion quality. Its algorithms make it easy to access its extensive library of code snippets and templates.	https://codeium.com
Duino Code Generator	It's a programming code generation platform for Arduino robotics boards. It offers a set of useful recommendations on parts and components for use with Arduino, as well as tutorials and a cookie management policy.	https://duinocodegenerator.com
Mutable	A tool for creating high-quality code, prototyping with AI and auto-completion features. It enables the transformation of prototypes into production-	https://mutable.ai

	quality code, enabling easy refactoring, documentation, and adding types.	
Durable	AI-powered website builder that uses natural language models and machine learning to create personalized and engaging websites in just seconds. Very useful for businesses or companies, it provides images and text based on the content described by the user.	https://durable.co
Roboflow	Powerful AI that offers robust dataset management, matrix search, labeling, and state checking tools. Use the search function to find images based on text descriptions or labels. It helps developers improve the accuracy and speed of their computer vision models.	https://roboflow.com
Wolfram /Alpha	It is an AI initially developed for engineering, but today offers applications in disciplines as diverse as mathematics, chemistry, physics, engineering, and medicine. It features tools that calculate expert-level answers using algorithms, a knowledge base, and artificial intelligence technology in a range of image filtering and color processing techniques.	https://wolframalpha.com

Source: authors' elaboration

With AI, for the first time it has been a universal access device capable of synthesizing and processing information, a capability that was unique to humans. It does not mean that the work of the teacher should be set aside. While the conceptual must be in the classroom, it is no longer sufficient, so it must be accompanied by teaching practices that ensure students spaces where they are challenged to continue developing as regards language and cognitive independence.

Understanding how to maximize its benefits while addressing its limitations is crucial to making the most of this emerging technology and improving the quality and equity of education in the 21st

century (Álvarez-Merelo & Morante, 2024). For Andreoli *et al.* (2024), "AI tools allow students to progress at their own pace, are additional resources, and provide teachers with a way to energize learning" (p. 64).

This adaptability is crucial to avoid the limitations of a student-based set pace. For Vincent-Lancrin & Van-Vlies (2020), "it may be too fast for some and not very stimulating for others" (p. 64). Having motivation to study does not guarantee the acquisition of in-depth knowledge. The key challenge for teachers is to identify factors influencing self-regulated learning and to guide students in using strategies that lead to improved academic performance and enjoyment of their learning process.

Impacts of AI on self-regulation in programming learning

A critically-thinking university student is someone who looks beyond what is taught in the classroom, asks questions, and seeks to answer their own questions, driven by their curiosity (Tramallino & Zeni, 2024); motivated by their desire to learn, they evaluate information and arrive at conclusions and solutions. For Terblanche & Clercq (2021), this exercise involves interpretation, explanation, analysis, inference, evaluation, and self-regulation.

It is impressive how artificial intelligence has become an indispensable tool in education, providing an opportunity to access the world of knowledge as an innovative way of managing different fields and offering a variety of opportunities to develop diverse activities (Diaz-Ancco *et al.*, 2024). Likewise, AI as a branch of computer science deals with the simulation of intelligent human behavior.

In relation to the possibilities in the didactic uses of AI for self-regulation of programming learning, Ouyang & Jiao (2021) identified the following pedagogical approaches in which various tools can be used:

- The behaviorist approach: AI is assimilated to knowledge and, from that perspective, directs learning processes, treating students as recipients of the services it provides.
- The approach of cognitivism and social constructivism: AI is used as a support tool, so that students collaborate with it, interacting in a learning situation predetermined by the teacher.
- The connectivism approach and the theory of complex adaptive systems: here, the aim is to extend human intelligence through the integration of AI, where it is seen as a useful tool to enhance human intelligence, with which students must lead their own learning process and pace.

A pragmatic approach is promoted that integrates the benefits of these three pedagogical approaches. The fundamental focus is on the student, while also considering the social, cognitive, emotional, philosophical, and ethical aspects associated with the use of AI in teaching.

Learning to program involves a complex mental process, which requires the university student to be able to clearly understand the problem to be solved or simulated by means of a computer, and understand the procedure by which the desired solution will be reached (Jones *et al.*, 2022). For Barragán-Perea (2023), "it is not easy to teach and learn; it requires dedication and effort on the part of students and teachers, particularly during the first years, in order to establish good work habits" (p. 782).

Learning programming requires a constant interest from the student due to its impact on cognitive abilities. It develops an intellectual activity that allows them to establish plans and strategies, build algorithms, structure instructions, and analyze and understand their own programs or those written by others. While programming language environments offer increasingly useful capabilities to programmers, they are still not sufficiently user-friendly, as is desirable.

The development of specific environments, using AI tools, is seen as an aid in effectively guiding students through the self-regulation process of programming learning, in a more graphic, diverse, and understandable way.

While AI offers numerous opportunities to improve education, it also poses significant challenges that must be carefully and thoughtfully addressed to ensure its effective and ethical application in education. To date, this adaptation has materialized in the creation of new core competencies linked, of course, to Information and Communications Technologies and the notion of lifelong learning; competencies that are now in place and have replaced the outdated objectives.

This requires teachers to acquire a combination of practical skills, knowledge, motivation, ethical values, attitudes, emotions, and other social and behavioral components that are mobilized together to achieve effective action. Transformations in learning processes in the training of IT professionals demand educational models that adapt to a training context that responds to the transformations generated, precisely, by the development and improvement of training in high-level programming languages.

It is necessary to emphasize training methods that focus primarily on knowledge, information, and technology; in this sense, educational improvement requires pedagogical and training processes as essential values for achieving changes in human behavior, so that those involved achieve exponential growth in their cognitive functions.

It's important to note that one of the advantages of AI is that it can improve efficiency by automating repetitive tasks and complex processes. Innovation stems from its ability to create solutions in fields such as medicine, research, education, and industry. It can help us make better decisions when analyzing large amounts of data.

The impact of AI on education is not only evident in its management, but also in the constant evolution of processes as it is applied in this field (Quinde-Rosales *et al.*, 2024).

Supranational organizations, aware of its transformative potential, have integrated Artificial Intelligence into their agendas. A prominent example is the United Nations Educational, Scientific and Cultural Organization (UNESCO), which conducted a global survey among its Associate Schools and University Chairs, seeking to determine which institutions have formal guidance on AI. This survey has been divided into the following categories worldwide:

- 44% Europe and North America
- 23% Asia and the Pacific
- 17% Latin America and the Caribbean
- 11% Africa
- 5% Arab States

The results led to the conclusion that AI needs to be leveraged to strengthen education and contribute to achieving the fourth Sustainable Development Goal of ensuring inclusive, equitable, and quality education and promoting lifelong learning opportunities for all.

While AI could be a valuable tool for improving education by addressing current problems and providing high-quality, personalized solutions for each student, there are several challenges. For Tuomi (2018), these challenges include access to data, as AI requires large volumes of data to learn and improve its performance.

In education, it can be difficult to gather enough data to train an AI. Furthermore, in many cases, the AI does not provide clear explanations about how it reached its conclusions, which can hinder students' understanding and confidence in the results (González-González, 2023)

Among the main impacts generated by AI on vocational training processes are summarized as follows:

- Changing demand for digital skills: AI is redefining the skills needed in the labor market; education systems must adapt to prepare students for these new needs. The ability to work with AI technologies and understand their operation will be crucial in the near future, where, in addition to technical knowledge, it is sure that skills such as critical thinking, creativity and the ability to solve complex problems will be increasingly valued.

- It is a technology with unique characteristics, particularly its ability to generate language analogous to that of human beings. It allows us to transcend simplistic views of the incorporation of technologies in education and the classroom, as well as transform conceptions that place the student as a mere recipient of knowledge in a relationship mediated by digital technologies (Ubal-Camacho *et al.*, 2023).

- Creation of dynamic learning models: This enables the creation of detailed learning models, providing new pedagogical opportunities. These models can help identify areas for improvement and personalize teaching methods to maximize each student's potential. Furthermore, AI can deliver more accurate and fair assessments based on objective and continuous data.

- Future vision: The need for a future-oriented vision in programming education is highlighted. Universities must rethink their role in a society where AI is increasingly present. This includes integrating it into the curriculum and promoting skills that cannot be easily automated, such as critical thinking and creativity (Su & Yang, 2023).

- Challenges and Ethical Considerations: Despite its benefits, the implementation of AI in education presents significant challenges. The privacy and security of student data are matters of concern to everyone; there is a risk that systems will perpetuate existing biases if not properly developed and monitored. For Almaraz-Rodríguez (2024), "it is essential to establish policies and regulations that ensure ethical and responsible use; the adoption of new technologies requires an investment in training and professional development to ensure that you can use these tools effectively" (p. 7).

When used appropriately, Artificial Intelligence has the potential to significantly change the quality of classroom learning, improving the performance of both students and teachers. New technologies seem to be gaining ground and have become one of the main tools in the educational process, aimed at motivating, engaging, entertaining, and generally improving student performance.

However, there are challenges generated by the advancement of society that require continued research to make the most of AI and address the challenges and concerns that may arise with the use of this type of technology. Thinking about and designing educational processes with the support of these tools will allow us to reach more students, with proposals more tailored to their levels and interests, reinforcing motivation and engagement in learning experiences (Ralda-Baiges *et al.*, 2024).

CONCLUSIONS

The future of AI in education is necessary and full of potential to enhance self-regulation in programming learning. As technology continues to advance, it is likely to see further development of more sophisticated and customized AI systems. These systems could revolutionize the way educational content is delivered and assessed in Computer Science Engineering.

However, it is essential to address the ethical and practical challenges that arise with the increasing adoption of AI in education. Data privacy, equity in access to technology, and quality are issues that must be carefully considered and regulated.

AI is a powerful tool that has the potential to transform knowledge by improving productivity, personalizing teaching, and offering self-regulated learning. However, it is essential to remember that AI should not replace teachers, but rather complement their transformative and educational work.

REFERENCES

Almaraz-Rodríguez, O. D. (2024). Apropiación de las TIC por los estudiantes de doctorado en educación: Un estudio a partir de las narrativas digitales. *Horizontes pedagógicos*, *26*(1). https://doi.org/10.33881/0123-8264.hop.26101

Álvarez-Merelo, J. C., & Morante, L. J. (2024). El impacto de la inteligencia artificial en la enseñanza y el aprendizaje: The impactof artificial intelligence onteaching and Learning.

LATAM Revista Latinoamericana de Ciencias Sociales y Humanidades, *5*(3). https://doi.org/10.56712/latam.v5i3.2061

Andreoli, S., Perillo, L., Aubert, E., & Cherbavaz, M. C. (2024). Entre humanos y algoritmos: Percepciones docentes sobre la exploración con IAG en la Enseñanza del Nivel Superior. *Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología*, *37*. https://doi.org/10.24215/18509959.37.e6

Barragán-Perea, E. A. (2023). Pensamiento computacional y programación en la formación de estudiantes desde edades tempranas. *Educación*, *47*(2), 1-18. https://doi.org/10.15517/revedu.v47i2.53645

Diaz-Ancco, F., Rodríguez-Gonzales, K., & Estrada-Chacón, L. H. (2024). El Impacto de la Inteligencia Artificial en la formación de estudiantes de Educación superior. *Yachay. Revista Científico Cultural*, *13*(1). https://doi.org/10.36881/yachay.v13i1.782

García-Sánchez, O. V. (2023). Uso y percepción de ChatGPT en la educación superior. *Revista de Investigación en Tecnologías de la Información*, *11*(23). https://doi.org/10.36825/RITI.11.23.009

González-González, C. S. (2023). El impacto de la inteligencia artificial en la educación: Transformación de la forma de enseñar y de aprender. *Qurriculum*, *36*. https://doi.org/10.25145/j.qurricul.2023.36.03

Inglada-Galiana, L., Corral-Gudino, L., & Miramontes-González, P. (2024). Ethics and artificial intelligence. *Revista Clínica Española*, *224*(3), 178-186. https://doi.org/10.1016/j.rceng.2024.02.003

Jones, E. A., Jiménez, C. A., Ormeño, P. I., & Poblete, N. A. (2022). Metodologías activas para la enseñanza de programación a estudiantes de ingeniería civil informática. *Formación universitaria*, *15*(3), 53-60. https://doi.org/10.4067/S0718-50062022000300053

León-Morejón, Y., Bonilla-Vichot, I. de la C., & Sierra-Barrios, A. (2022). Aprendizaje autorregulado en tiempos de pandemia: Bases psicológicas desde la teoría histórico-cultural. *Universidad y Sociedad*, *14*(5), 53-59.

Lluch-Molins, L., & Cabrera-Lanzo, N. (2023). *Competencia de aprender a aprender y autorregulación en la universidad. Evaluación entre iguales y propuestas metodológicas para su desarrollo*. Editorial Octaedro. https://octaedro.com/libro/competencia-de-aprender-a-aprender-y-autorregulacion-en-la-universidad/

Luna, A., Ortíz-Colón, A. M., & Rodríguez-Moreno, J. (2023). Tecnologías inmersivas en el aprendizaje autorregulado: Revisión sistemática de literatura científica. *Digital Education Review*, *44*, 105-113. https://doi.org/10.1344/DER.2023.44.105-113

Martínez-Comesaña, M., Rigueira-Díaz, X., Larrañaga-Janeiro, A., Martínez-Torres, J., Ocarranza-Prado, I., & Kreibel, D. (2023). Impact of artificial intelligence on assessment methods in primary and secondary education: Systematic literature review. *Revista de Psicodidáctica*, *28*(2), 93-103. https://doi.org/10.1016/j.psicoe.2023.06.002

Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, *2*. http://www.sciencedirect.com/science/article/pii/S2666920X2100014X

Páez-Paredes, M., Gilimas-Siles, A. M., & Avila-Beltran, D. (2023). Tendencias en educación: Análisis de la inteligencia artificial y otras tecnologías emergentes. *Mendive. Revista de Educación*, *21*(4).

Pedreño-Muñoz, A., González-Gosálbez, R., Mora-Illán, T., Pérez-Fernández, E. del M., Ruiz-Sierra, J., & Torres-Penalv, A. (2024). *La inteligencia artificial en las universidades: Retos y oportunidades*. Grupo 1millon Bot.

Pugliesi, M. (2024). Artificial Intelligence and society: A preliminary reflection. *Civitas: Revista de CiênciasSociais*, *24*(1). https://doi.org/10.15448/1984-7289.2024.1.43411

Quinde-Rosales, V. X., García-Estupiñán, S. B., & Tenelanda-Mora, D. B. (2024). La Inteligencia Artificial y su utilidad en el campo Académico. Un Análisis desde la perspectiva del Universitario. *Conrado*, *20*(99), 187-193.

Ralda-Baiges, A., Lázaro-Cantabrana, J. L., & Holgado-García, J. (2024). La mejora de la competencia digital docente, avanzando hacia la madurez digital institucional: Una revisión

sistemática. *Edutec. Revista Electrónica de Tecnología Educativa*, *88*. https://doi.org/10.21556/edutec.2024.88.3143

Su, J., & Yang, W. (2023). Unlocking the Power of ChatGPT: A Framework for Applying Generative AI in Education. *ECNU Review of Education*, *6*(3), 355-366. https://doi.org/10.1177/20965311231168423

Terblanche, E. A., & Clercq, B. (2021). A critical thinking competency framework for accounting students. *Accounting Education*, *30*(4), 325-354. https://doi.org/10.1080/09639284.2021.1913614

Tramallino, C. P., & Zeni, A. M. (2024). Avances y discusiones sobre el uso de inteligencia artificial (IA) en educación. *Educación*, *33*(64). https://doi.org/10.18800/educacion.202401.M002

Tuomi, I. (2018). *The Impact of Artificial Intelligence on Learning, Teaching, and Education: Policies for the Future*. Publications Office of the European Union. https://doi.org/10.2760/12297

Ubal-Camacho, M., Tambasco, P., Martínez, S., & García-Correa, M. (2023). El impacto de la Inteligencia Artificial en la educación. Riesgos y potencialidades de la IA en el aula. *RiiTE Revista interuniversitaria de investigación en Tecnología Educativa*, *15*, 41-57. https://doi.org/10.6018/riite.584501

Vincent-Lancrin, S., & Van-Vlies, R. (2020). Trustworthy artificial intelligence (AI) in education: Promises and challenges. *OECD Education Working Papers*, *218*. https://ideas.repec.org//p/oec/eduaab/218-en.html

Conflict of interest

Authors declare no conflict of interests.

Authors' contribution

The authors participated in the design and writing of the article, in the search and analysis of the information contained in the consulted bibliography.