Artificial Intelligence and chatbots for sustainable higher education: a systematic review

Inteligencia Artificial y chatbots para una educación superior sostenible: una revisión sistemática

Eva Jiménez-García
Universidad Europea de Madrid, UEM, España
https://orcid.org/0000-0001-6541-3517
Judit Ruiz-Lázaro
Universidad Nacional de Educación a Distancia, UNED, España
https://orcid.org/0000-0003-2036-0428
Sonia Martínez-Requejo
Universidad Europea de Madrid, UEM, España
https://orcid.org/0000-0001-6934-2664
Sara Redondo-Duarte
Universidad Complutense de Madrid, UCM, España
https://orcid.org/0000-0003-2012-8784

Recepción: 01 Diciembre 2024
Aprobación: 11 Marzo 2025

Acceso abierto diamante

Abstract

The influence of artificial intelligence and chatbots has significantly transformed teaching and learning processes in higher education. This study aims to analyze the scientific production on the role of AI-based chatbots in higher education and their connection to the Sustainable Development Goals (SDGs). To achieve this, a systematic review was conducted following the methodology established in the PRISMA Declaration. The initial search yielded 136 references, of which, after a screening process, 42 were selected for a detailed bibliometric analysis (co-word analysis, citations, and sources) and their relationship with the SDGs. The results reveal co-occurrence patterns in key topics, such as the use of chatbots in different areas of higher education, their challenges, and impact on student motivation. Regarding the SDGs, SDG 4 (Quality Education) is the most frequently addressed, followed by SDG 3 (Good Health and Well-being), SDG 7 (Affordable and Clean Energy), SDG 10 (Reduced Inequalities), and SDG 13 (Climate Action). In conclusion, this study provides an overview of trends in the use of chatbots in higher education, highlighting their impact and potential in university-level educational development. This study is expected to contribute to the development of educational policies that promote the sustainable integration of artificial intelligence in the university setting.

Keywords: artificial intelligence, chatbots, higher education, sustainability.

Resumen

La influencia de la Inteligencia Artificial y de los Chatbots han generado una transformación significativa en los procedimientos de enseñanza y aprendizaje en Educación superior. Este estudio tiene como objetivo analizar la producción científica sobre el papel que desempeñan los Chatbots basados en inteligencia artificial en el contexto de la educación superior y su vinculación con los Objetivos de Desarrollo Sostenible (ODS). Para ello, se lleva a cabo una revisión sistemática siguiendo la metodología establecida en la Declaración PRISMA. La búsqueda inicial proporcionó un conjunto inicial de 136 referencias, de las cuales, tras un proceso de

depuración, se seleccionaron 42 para un riguroso análisis bibliométrico detallado (co-palabras, citas y fuentes) y su relación con los ODS. Los resultados evidencian patrones de co-ocurrencia en temáticas clave, como el uso de Chatbots en diferentes áreas de educación superior, sus desafíos e impacto en la motivación del alumnado. En relación con los ODS, el ODS 4 (Educación de Calidad) es el más abordado, seguido por el ODS 3 (Salud y Bienestar), ODS 7 (Energía Asequible y No Contaminante), ODS 10 (Reducción de Desigualdades) y ODS 13 (Acción Climática). Como conclusión, este estudio ofrece una visión sobre las tendencias en el uso de Chatbots en educación superior, evidenciando su impacto y potencial en el desarrollo educativo universitario. Se espera que este estudio contribuya a la elaboración de políticas educativas orientadas a una integración sostenible de la inteligencia artificial en el entorno universitario.

Palabras clave: **inteligencia artificial, chatbots, educación superior, sostenibilidad.**

INTRODUCTION

In recent decades, educational technology has transformed teaching and learning procedures in higher education, being one of the most relevant innovations in this field (Zorrilla-Puerto et al., 2023). In this sense, the recent number of studies that endorse the influence of artificial intelligence (hereafter AI) in the university environment stands out and is marking a significant transformation in the way in which the educational process is conceived (Jiménez-García et al., 2024). This growing interest has been driven by the widespread availability of Large Language Models(LLM), which has created new opportunities to enrich teaching, adapt the learning process and provide more efficient support to both teachers and students (Okonkwo et al., 2023).

In this line, the introduction of intelligent systems such as Chatbots, Gemini, OpenAI's ChatGPT (Zou & Huang, 2023) and Microsoft's Copilot (Barrett & Pack, 2023), stands out, as they are capable of adapting to the individual needs of learners. These Generative AI (GenAI) tools, namely Chatbots based on natural language processing and machine learning algorithms, have the ability to interact with learners in a contextualized and personalized manner. They enable contextualised and tailored interactions between learners and automated learning systems (Redondo-Duarte et al., 2024), providing instant and customized responses that enhance learner-machine communication (Okonkwo & Ade-Ibijola, 2021).

In this sense, they offer users the ability to create immediate text, or other formats, on a variety of topics from simple prompts (Rahim et al., 2022). Chatbots play multiple roles in higher education, such as initial student orientation, online tutoring, technical assistance in the use of educational platforms, personalised academic support and academic counselling, among others (Anghelescu & Nicolaescu, 2018; Alkhoori et al., 2020; Allison, 2012; Dube & Jacobs, 2023).

Recently, research has shown that chatbots are having a significant impact on education (Ojeda, et al., 2023). For example, studies such as those carried out by Kuhail et al. (2023) and Pérez et al. (2020) have highlighted aspects such as improved learning experience and outcomes. Others have observed that users' perceived satisfaction with Chatbots directly influences their intention to continue using them, while personal innovation is a key factor in this process (Tian et al., 2024). In addition, Chatbots have been shown to enhance personalised and adaptive learning, increase student satisfaction and strengthen online services within higher education (Oqaidi et al., 2024). From an operational perspective, these tools have shown great potential to streamline administrative tasks and enrich learning experiences in university environments (Sain et al., 2024). Furthermore, their integration into educational recommendation platforms has resulted in a high level of influence on student decision-making, with 86.15% of students basing their choices on suggestions provided by these systems (Kingchang et al., 2024).

Another case is EduChat, developed by Dinh and Tran (2023), whose Chatbot answers university-related questions using a hybrid approach combining rule-based methods and machine learning techniques. Another case is the study by Rodriguez et al. (2021), which analyses the use of Chatbot for self-study, facilitating personalised education. Furthermore, Alt and Ibolya (2021) identified potential users of banking Chatbots, which can be extrapolated to higher education to design Chatbots that adapt to the specific needs of different groups of students. These examples illustrate how Chatbots can be integrated into various areas of higher education, from academic assistance to administrative management, thereby improving efficiency and student satisfaction.

Additional examples of these developments include studies such as Malik et al. (2021), which show improvements in academic performance, or Kuhail et al. (2023), which highlights the positive impact of Chatbots on student learning and engagement compared to traditional teaching methods. Research by Vázquez-Cano et al. (2021) also emphasises their pedagogical use in improving university access in the Subject of Spanish Language, while Romero-Rodríguez et al. (2023) underline the value of ChatGPT in fostering complex thinking. Additionally, Xiao and Zhi (2023) explore its contribution in Language Teaching. Weeks

et al. (2022) examine its usefulness in Public Health Communication, and Moldt et al. (2023) highlight its importance in Medical Training.

On the other hand, the integration of AI and Chatbots in higher education is directly linked to the 2030 Agenda and the Sustainable Development Goals (SDGs, Naciones Unidas, 2018) and, more specifically, to SDG 9 on Industry, Innovation and Infrastructure due to the promotion of innovation and technology in education. Thanks to scientific evidence, the use of educational chatbots can improve access to a more personalised and effective education, responding to SDG 4 on Quality Education. An example of this is the study by Robayo-Pinzon et al. (2023), who highlight their potential to co-create value in higher education, as these technologies can improve access to education, personalise the learning experience, provide instant feedback and offer tailored educational materials, thus promoting inclusive, equitable and quality education.

By enabling personalised interaction between learners and automated educational systems, the development and implementation of chatbots can help to reduce inequalities (SDG 10) and improve health and well-being (SDG 3). In this sense, Chatbots offer a number of educational benefits such as flexibility, accessibility and availability, although it is essential to ensure equitable, responsible and ethical implementation (Pack & Maloney, 2023; Tseng & Warschauer, 2023; Yeo, 2023), as well as an improved understanding of human emotions (Okonkwo & Ade-Ibijola, 2021). Finally, the positive impact of Chatbots in higher education can improve students' Skills and Competencies, preparing them for the labour market (Celik et al., 2024) and thus contributing to SDG 8 on Decent Work and Economic Growth.

Despite the growing interest in this Field, there are still gaps in the academic literature. To date, there has been no comprehensive review that identifies the main thematic trends in the use of educational chatbots, their sources of co-citation or their relationship with the 2030 Agenda and its connection to the SDGs. Moreover, there is a paucity of studies that provide rigorous evidence on their effectiveness and specific challenges in the university context. Therefore, this study seeks to address these gaps through a detailed analysis of Chatbots' interactions with students and a critical assessment of the existing literature. This approach will enable the development of a comprehensive, evidence-based framework to facilitate the effective implementation and assessment of these technologies in higher education. It is also hoped that this study will serve as a basis for future research and the formulation of educational policies to foster the sustainable integration of AI at the university level.

To achieve this, the following objectives are established:1) To analyse the chronological evolution of the scientific productivity of AI and Chatbots in higher education. 2) To identify the scientific production taking as a reference the country of origin of the publications. 3) To analyse the scientific production on AI and Chatbots in higher education and its connection with the SDGs. 4) To identify the main sources where AI and Chatbots in higher education are published taking into account the number of citations received and the number of scientific articles in each of them. 5) To analyse the co-occurrence associations between relevant keywords in academic articles on AI and Chatbots in the context of higher education.

METHODOLOGY

Protocol and registration

To address the research objectives formulated, this study conducts a systematic review following the guidelines outlined in the PRISMA Declaration, in its most updated version and focused on the field of education (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*; Sánchez-Serrano et al., 2022). This approach is considered a protocol for conducting detailed, systematic and rigorous research on scientific production (Uman, 2011).

Eligibility criteria

Table 1 shows the selection criteria used to identify the studies to be included in the systematic review.

Table 1

Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Initial filters	
Published articles with full text	Articles that do not have the full text
Research articles published in scientific journals.	Works that are not scientific publications Doctoral Thesis, books, conference proceedings...
Other filters	
Articles written in a university context	Articles not carried out in a university context
Search date: December 2023	

Source: elaborated by the authors.

Search strategy

The following search phrase was then applied: (AI OR Artificial Intelligence) AND (chatbot) AND ("Higher education" OR university) in the Web of Science (WoS) database to align the topics addressed in the articles with the SDGs. For the search we used the filter "topic" and all records in the Core Collection to ensure that all fields are covered in the study.

The study focuses on higher education due to its relevance in the context of sustainability and technological innovation. The terms used in the search, such as "Higher education" and "university", are aligned with the main objective of analysing the use of AI and chatbots in universities and higher education institutions. Other educational levels were excluded from this review, as they do not constitute the main focus of the analysis, which seeks to specifically assess the implementation of these technologies at university level. On the other hand, given that this is an area of research in continuous development, we have chosen to include studies without temporal restrictions in order to ensure the broadest and most representative review possible. This approach allows us to identify both pioneering research and emerging trends.

In the identification phase, 136 studies were retrieved from the established search equation. Subsequently, in the debugging phase, initial inclusion and exclusion filters were applied, eliminating 88 studies that did not meet the established criteria, such as not belonging to the field of higher education or not being related to Chatbots and AI. The remaining 48 studies were selected for assessment and, at this stage, no duplicate studies were identified.

In the screening phase, records were selected using Covidence software, specially designed to carry out systematic review analyses among several researchers in order to avoid selection bias (Kellermeyer et al., 2018). Assessment of the studies was performed by two reviewers independently, who analysed the Degrees, abstracts and full text of the articles following the previously established inclusion and exclusion criteria. Studies were classified into the following categories (include, exclude or undetermined) according to the predefined inclusion criteria, and any discrepancies were resolved by discussion. This approach guaranteed a systematic and rigorous analysis, minimising errors and ensuring transparency in the selection process. Thus, of the remaining 48 studies, 6 were excluded because they were not directly related to the university setting (reason 3). Finally, in the inclusion phase, 42 studies were selected for the systematic review and used in the bibliometric analysis.

Figure 1 shows the different phases carried out.

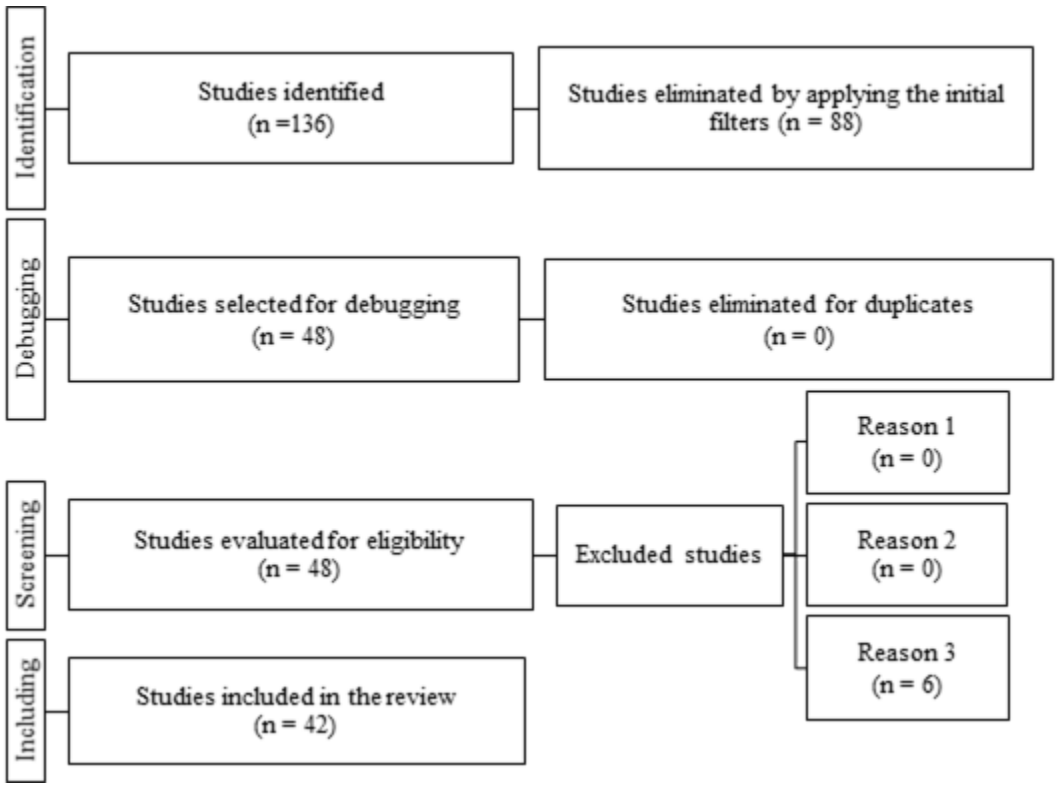

Figure 1
Flowchart
Source: elaborated by the authors adapted from Page et al. (2021).

Data analysis

On the one hand, a descriptive and comparative analysis is conducted of the temporal evolution of scientific productivity over the years, as well as of the scientific output based on the geographical location of each publication. This phase allows for a comparative analysis between countries to understand their relative contribution and the global distribution of research in higher education related to AI and Chatbots. Next, through a frequency analysis, the scientific output in relation to the SDGs is shown. This analysis involves identifying the topics addressed in the articles according to the classification provided by WoS, which facilitates alignment with the SDGs.

In addition, a detailed analysis is carried out to identify the main sources of publication in this field. This assessment is based on the number of citations received and the number of scientific articles published in specific journals, which allows us to determine the most influential and relevant sources in the dissemination of research on AI and Chatbots in higher education. Finally, a bibliometric analysis has been carried out using the VOSviewer software (Van-Eck & Waltman, 2013) applying the "Association Strength" method, which does not permit the automatic merging of data from multiple databases. Combining information from different sources requires a manual process of normalisation and elimination of duplicates, which could introduce biases and inconsistencies in the results. Therefore, it was decided to work with a single database to ensure homogeneity and rigour in the analysis of keyword co-occurrence networks.

This analysis allows not only to identify the most relevant keywords, but also to understand how these words relate to each other in the context of AI and Chatbots in higher education. Additionally, a co-occurrence network map has been generated to graphically visualise the relationships between the keywords in the study, as well as the interconnectedness and relevance of the keywords within the context of the research.

RESULTS

In this section, the results are shown in accordance with the objectives set.

Chronological evolution of scientific production

Regarding the first objective, to analyse the chronology of scientific productivity in relation to AI and Chatbots in higher education, a descriptive analysis is carried out to examine the growth and evolution of the number of articles published and their distribution over the years.

Figure 2 visually presents the chronological evolution observed over the years, highlighting a remarkable evolution in productivity over the years.

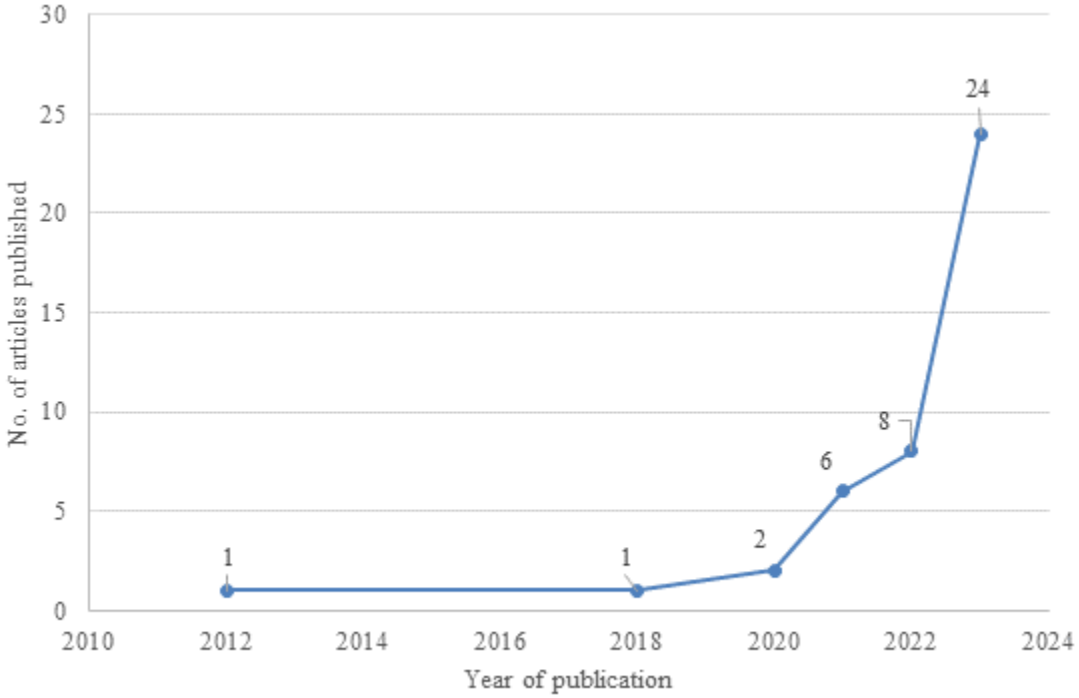

Figure 2
Number of publications per year
Source: elaborated by the authors.

Specifically, it highlights a noticeable increase in output from 2020 onwards, followed by a considerable increase in 2021 and an even more pronounced acceleration in 2022. However, 2023 proves to be a high point in terms of scientific productivity, representing a significant milestone in the number of published studies on AI and Chatbots in higher education. With a total of 24 articles during this period, this year experiences a remarkable growth compared to previous years, representing more than half (57.14%) of the total set of articles analysed.

Scientific productivity by country of publication

The analysis of the geographical distribution of scientific productivity in the field of AI and Chatbots in higher education shows a varied but not uniform distribution of scientific output at the international level, with a clear concentration in certain countries, as shown in Figure 3.

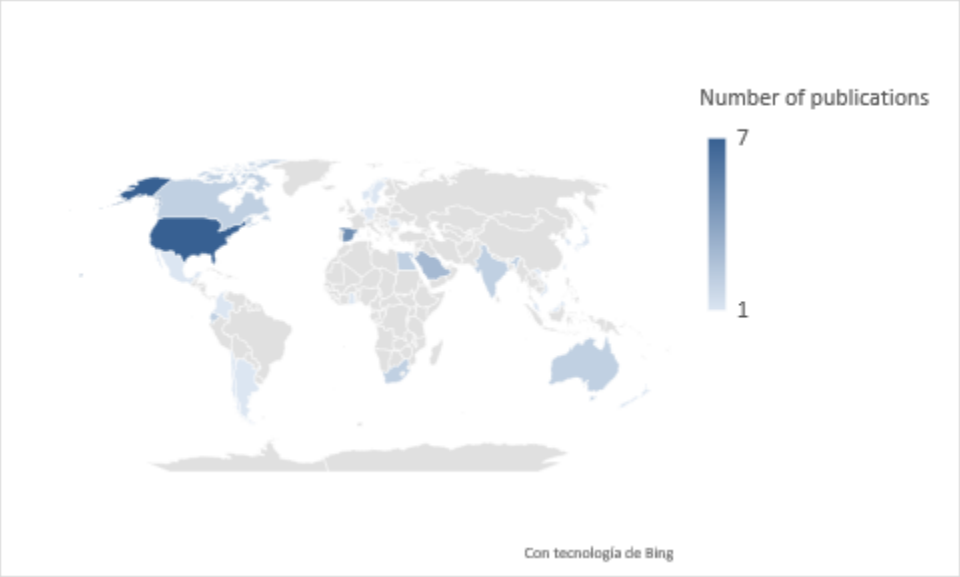

Figure 3
Number of publications per year
Source: elaborated by the authors.

The United States leads in terms of number of articles, with 7 research contributions from institutions or authors affiliated with US entities in this Field of study. On the other hand, countries such as Spain and China show a considerable presence with 5 and 4 articles respectively. However, several countries (Argentina, Chile, Colombia, England, Germany, Ghana, Israel, Japan, Malaysia, Mexico, New Zealand, Norway, Romania, Singapore, South Korea, Sweden, Switzerland, Taiwan, Vietnam) have a contribution of only one article, indicating a more limited but still existing participation in this research area.

Scientific output in terms of the Sustainable Development Goals (SDGs)

The following section analyses the scientific production on AI and Chatbots in higher education and their connection with the SDGs proposed by the United Nations. The aim of this analysis is to understand how the integration of AI and Chatbots in higher education can advance the SDGs.

To this end, of the 42 scientific articles, 21 articles have been identified in WoS with the record of the SDG to which they are associated. Figure 4 shows a summary of the total number of articles associated with each SDG.

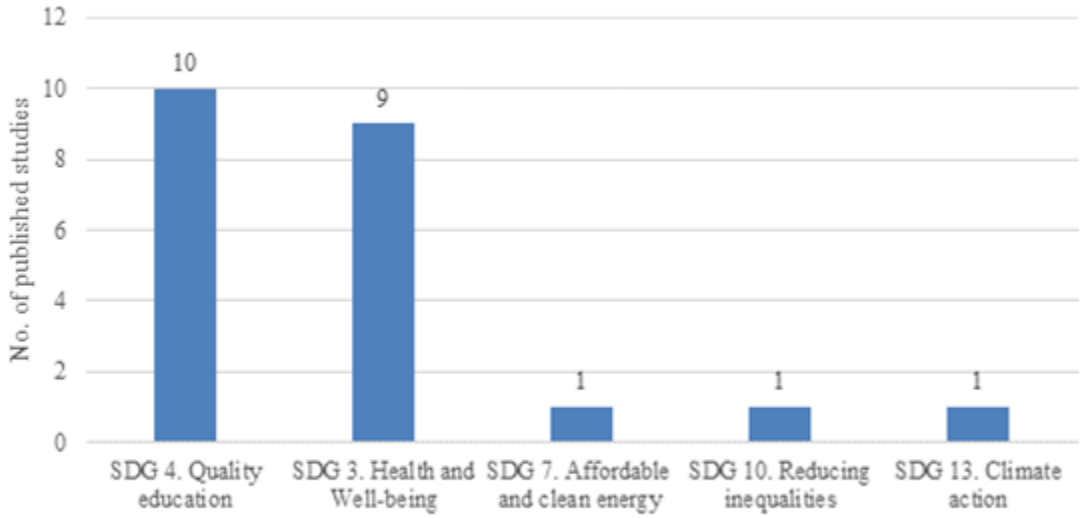

Figure 4
Number of publications per year
Source: elaborated by the authors.

The results show that the highest number of articles, with 10 associated articles, is aligned with SDG 4 (Quality Education), indicating a significant focus on improving educational quality through research in educational technologies, such as AI and Chatbots.

On the other hand, a smaller number of records related to the following SDGs are identified. One article is associated with SDG 3 (Health and Wellbeing) reflecting an interest and dedication in scientific research related to the implementation of AI and Chatbots in the promotion of support systems for health, preventative medicine and general wellbeing within educational settings. Another article is associated with SDG 7 (Affordable and clean energy) showing how the use of AI and Chatbots in higher education can contribute to awareness and education on the importance of sustainable and clean energy. With regard to SDG 10 (Reducing inequalities) there is an article aligned with the reduction of existing educational gaps. Finally, an article associated with SDG 13 (Climate action) shows an interest in climate change awareness and education.

Analysis of sources and citations

In order to find out the sources where AI and Chatbot are most frequently published in the field of higher education, a frequency analysis has been carried out based on the citations received by the 42 references published in a total of 35 sources.

Table 2 shows the sources that have received at least 1 citation in relation to the number of articles associated with each of them.

The results show the distribution of citations and the number of articles related to AI and technology applied to higher education and mental health in various academic journals. JMIR Mental Health leads with a high number of citations, with exactly 161 citations, despite having only one associated article (Fulmer et al., 2018). This article, focusing on the use of AI to mitigate symptoms of anxiety and depression in university students, has become a significant contribution to the field.

Journals such as *Sustainability* and *International Journal of Educational Technology in Higher Education* also stand out, accumulating between 50 and 54 citations each through three associated articles. Their contributions, in the case of *Sustainability* (Park & Kim, 2023; Rahim et al., 2022; Villegas-Ch et al., 2020) and in the case of *International Journal of Educational Technology in Higher Education* (Barrett & Pack, 2023; Essel et al., 2022; Vázquez-Cano et al., 2021) address relevant topics in the application of AI in higher education.

Table 2

Sources, citations and number of articles

Sources	No. of appointments	No. of articles
JMIR Mental Health	161	1
Sustainability	54	3
International Journal of Educational Technology in Higher Education	50	3
Journal of University Teaching and Learning Practice	28	1
Library Hi Tech	24	1
Internet Interventions-The Application of Information Technology in Mental and Behavioural Health	24	1
Jmir Formative Research	20	1
Open Praxis	18	1
International Journal of Emerging Technologies in Learning	14	1
European Journal of Engineering Education	11	1
Future Internet	9	1
Journal of Medical Internet Research	8	2
Medical Education Online	7	1
Library Management	5	1
Journal of King Saud University-Computer and Information Sciences	5	1
Processes	4	1
Jmir Research Protocols	4	1
ACM Transactions on Interactive Intelligent Systems	4	1
Wmu Journal of Maritime Affairs	3	1
Frontiers in Psychology	2	2
Pixel-Bit. Media and Education Magazine	2	1
Education Sciences	2	2
Languages	2	1
Market-Trziste	2	1
Telecommunications Policy	1	1
Assessment & Evaluation in Higher Education	1	1
Education and Information Technologies	1	1
JMIR Medical Education	1	1

Source: elaborated by the authors.

Other sources, such as the *Journal of University Teaching and Learning Practice, Library Hi Tech, Internet Interventions, JMIR Formative Research*, among others, have also received a considerable number of citations, indicating the relevance and impact of their research in this area.

Keyword co-occurrence analysis

The second objective is to identify and analyse the co-occurrence associations between relevant keywords in academic articles on AI and Chatbots in the context of higher education.

For this analysis, 42 articles were examined, considering all keywords, including author keywords and PLUS keywords. This enabled for a detailed study of the co-occurrence relationships between key terms, resulting in a total of 82 words being analysed.

In Figure 5, the larger nodes indicate the keywords with the highest citation frequency in the analysed articles.

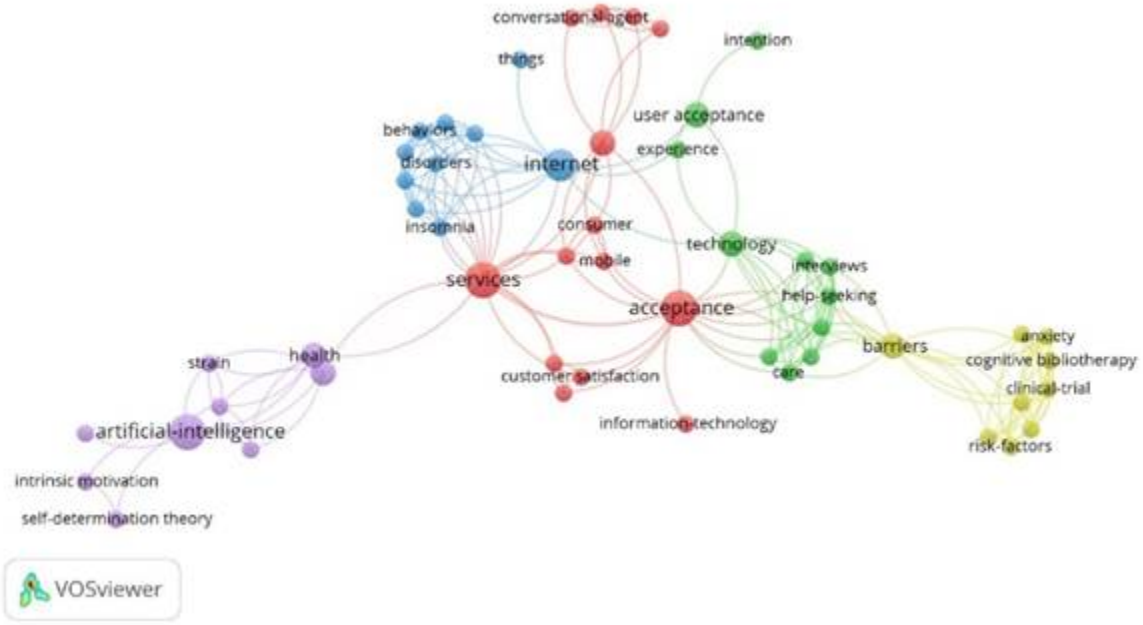

Figure 5
Keyword network (VOSviewer)
Source: elaborated by the authors.

From this map, four clusters were identified, each marked with a different colour (red, green, blue and yellow), highlighting the interrelationships in the research domain. Table 3 below presents the details of the network, showing the thematic categories derived from the keywords.

Table 3
Thematic categories of keywords according to co-occurrence

Category	Cluster description	Key words
Technology in higher education (red cluster)	This cluster focuses on perceptions, attitudes and behaviours related to the adoption and acceptance of AI and chatbot technologies in higher education.	acceptance; services; model; consumer; conversational agent; customer satisfaction; design; display; information-technology; internet banking; mobile; quality; science; utaut2.
Assistive technologies in higher education (green cluster)	This cluster addresses students' willingness and acceptance of assistive technologies, including AI and Chatbots, highlighting the importance of their acceptance for their effective implementation in educational settings.	technology; user acceptance; care; conversational agents; experience; help-seeking; information; intention; interviews; self-disclosure; online agent.
Chatbot in health and wellness (blue cluster)	This cluster is focused on the application and use of AI and chatbot in applications related to health, both physical and mental, as well as interventions and prevention in the university environment.	internet; behaviors; community-health; disorders; framework; insomnia; older-adults awareness; randomised controlled-trial; things; web
Challenges in educational integration with AI and Chatbots (yellow cluster)	This cluster analyses the psychological challenges and barriers associated with the integration of technology, specifically AI and chatbots, in higher education, including aspects such as anxiety, risk factors and systemic issues.	barriers; anxiety; clinical-trial; cognitive bibliotherapy; psychometric properties; risk-factors; symptoms; system; working alliance.
Impact of AI on student health and motivation (purple cluster)	This cluster is focused on understanding how AI affects mental health, motivation and university dynamics, highlighting its influence on students' intrinsic motivation and general well-being.	artificial-intelligence; health; stress; education; higher-education; intrinsic motivation; prevalence; self-determination theory; strain

Source: elaborated by the authors.

DISCUSSION AND CONCLUSIONS

The in-depth analysis carried out within the framework of this study has focused on the detailed exploration of the role played by AI-based Chatbots within the field of higher education. The following lines show the most relevant conclusions of the conducted study.

First, the data reveal a significant increase in the publication of articles on AI and Chatbots in higher education in recent years, particularly in 2022 and 2023, indicating a growing research trend on the topic. This dynamic is consistent with that reported by Redondo-Duarte et al. (2024), who identified a transition towards more specialised areas within the field, such as personalisation of learning and intelligent tutoring.

In addition, the use of Chatbots in different areas of higher education can be seen, for example, Noble et al. (2022), who presented a Chatbot aimed at navigating mental health resources for healthcare workers and their families, highlighting the potential of AI for emotional wellbeing. Similarly, Sharma et al. (2023) developed a Chatbot specialising in Collision Prevention Regulations Training for the maritime industry, highlighting the ability of these systems to adapt to specific sectors and enhance teaching and learning processes. In the pedagogical domain, Shim et al. (2023) evaluated the effectiveness of Chatbots workshops as experiential learning tools, showing how they can strengthen students' engagement with their learning. Similarly, Tamayo et al. (2020) designed a Chatbot as a distance learning assistant, highlighting its potential in online education and in improving the accessibility of educational content.

Another relevant aspect is the use of Chatbots with more advanced approaches, such as the one developed by Trappey et al. (2022), which incorporates sentimental dialogue analysis to offer empathic counselling to users. Such applications highlight the Ability of Chatbots to adapt to more complex interactions and respond to emotional and psychological needs in education. In addition, Villegas-Ch et al. (2021) implemented an online AI-enabled virtual assistant for academic management at a university, showing the usefulness of these tools to improve administrative efficiency and optimise internal processes in educational institutions.

Secondly, the analysis of scientific production according to geographical distribution shows the participation of different countries and regions. The United States is the leader in this field with a strong contribution and presence of US institutions and authors in the development and study of AI and Chatbots in higher education. The prominence of US studies in educational research supports their influence on the development and adoption of AI-based solutions in the higher education environment. However, as mentioned by Kuhail et al. (2023), the increasing involvement of European countries such as Spain or Asian countries such as China should not be overlooked, indicating a growing interest and involvement in this area.

This geographical diversity underlines the importance of international collaboration and the multiplicity of perspectives and approaches, thus enriching the development of AI and Chatbots applications in higher education globally.

Third, the analysis of studies related to AI and Chatbots in higher education within the framework of the SDGs highlights the disparity in the attention given to different SDGs. SDG 4, focusing on Quality Education, emerges as the main focus of scientific research, indicating considerable interest in understanding and harnessing the potential of AI and Chatbots for improving the quality of the education system. This approach is consistent with the strategic importance of education in achieving sustainable development (United Nations, 2018). However, Howell and Potgieter (2023) warn of the need to address the potential misuse of AI and Chatbots to ensure academic integrity and compliance with the principles of SDG 4.

SDG 3 (Health and Wellbeing) also benefits from the integration of Chatbots into educational platforms, as they can provide information on emotional wellbeing, disease prevention and promotion of healthy habits among students. In addition, they can facilitate healthy educational environments through resources on mental health, stress reduction and preventive medical guidance (Koulouri et al., 2022).

In terms of SDG 7 (Affordable and Clean Energy), Chatbots play a key role in raising awareness of responsible energy use by providing educational information on renewable energy and sustainability in academic environments. Through these tools, practices and knowledge on energy efficiency and carbon footprint reduction can be disseminated (United Nations, 2020).

The impact on SDG 10 (Reducing Inequalities) with the use of Chatbots in online education platforms facilitates the overcoming of geographical and socio-economic barriers. This enables more equitable access to higher education, especially in resource-constrained communities, helping to reduce gaps in quality education (UNESCO, 2021).

Finally, SDG 13 (Climate Action) links to the use of chatbots in raising awareness of climate change and promoting sustainable behaviour. The study by Menkhoff and Gan (2023) shows that chatbots can engage students in an interactive way, providing relevant and personalised information on environmental and climate

issues. This not only raises awareness of the importance of climate action, but also encourages sustainable behaviours among students.

It is important to note the complete absence of articles related to several SDGs (1, 2, 5, 6, 8, 9, 11, 12, 14, 15, 16 and 17). This lack of specific research underscores the insufficient exploration of the application of AI and chatbots in Core fields for Education for Sustainable Development (ESD).

Fourthly, the conclusions drawn from the analysis of sources and citations show the importance and differential impact of various sources in the field of AI applied to higher education, most notably: *JMIR Mental Health, Sustainability and International Journal of Educational Technology in Higher Education*. These results show a significant diversity of publications from a variety of sources interested in fostering and promoting research in this growing area. These findings support the importance of continuing to encourage and support interdisciplinary and collaborative research to ensure continued progress in the effective use of AI in higher education (Jiménez-García et al., 2024; Kuhail et al., 2023; Redondo-Duarte et al., 2024).

Fifth, the analysis of keyword co-occurrence in the identified clusters reveals the relevance and potential of AI and Chatbots in higher education, but emphasise the need to address challenges and psychological aspects for a proper implementation and positive impact on the educational environment. Along these lines, Clusters 1 "Technology in Higher Education" and 2 "Assistive Technologies in Higher Education" highlight the importance of understanding the perceptions, attitudes and willingness of students (Al-Abdullatif, 2023) and teachers (Farazouli et al., 2023) towards the adoption of AI technologies and Chatbots in the university environment. Likewise, Cluster 3 "Chatbot in Health and Wellness" highlights a specific interest in the application of Chatbots and AI technologies in healthcare (Guckenberger et al., 2023; Hirosawa et al., 2023; Huang et al, 2023), both physical and mental (Liu et al., 2022), as well as interventions and prevention in the university context (Jackson-Triche et al., 2023). This indicates an emphasis on the application of these technologies to enhance students' holistic wellbeing (Liu et al., 2022).

Finally, Clusters 4 "Challenges in educational integration with AI and Chatbots" and 5 "Impact of AI on student health and motivation" address psychological challenges (Crawford et al., 2023; Hasanein & Sobaih, 2023) and the impact of AI on student health and motivation (Al-Abdullatif et al., 2023). These clusters highlight the importance of overcoming challenges such as anxiety, risk factors and systemic issues associated with the integration of AI and Chatbots in higher education. They also highlight the importance of understanding the impact of these technologies on the mental health and motivation of students in the university environment.

Based on these results, it is concluded that AI-based chatbots have a significant impact on higher education, with concrete applications in academic assistance, mental health and automation of educational processes.

However, significant challenges remain in their design and implementation. In terms of barriers and challenges, the implementation of Chatbots in higher education faces technological, ethical and psychological limitations. From a technological perspective, the lack of interoperability between educational systems and the need for large volumes of data for training AI models remain major obstacles (Kuhail et al., 2023). Singh and Beniwal (2022) show some limitations of Chatbots in terms of consistency and naturalness of interactions.

On the ethical side, there are concerns about data privacy and fraud (Lozano & Fontao, 2023), as well as academic integrity and authorship (Nam & Bai, 2023). The study by Nikolic et al. (2023) analyses the impact of ChatGPT on assessment. In particular, the results show the need to modify current assessment practices in order to maintain academic integrity. In psychological terms, the acceptance of Chatbots by students and teachers is variable, influenced by trust in the technology and perceptions of its effectiveness (Hasanein & Sobaih, 2023).

Finally, it is worth noting some limitations of this study, centered on the exclusive use of the WoS database. While this ensured a structured analytical framework aligned with the SDGs, the exclusion of other databases may have limited the coverage of the literature analysed. In addition, the use of VOSviewer restricted the possibility of combining data from multiple sources, as this tool does not allow automatic merging of records.

Manual integration could have introduced biases, so we opted to work with a single database to ensure consistency in the analysis. While these limitations do not affect the validity of the results obtained, future research could explore strategies for integrating multiple data sources, which would expand the scope of bibliometric analysis in this field.

In this context, it is suggested that future research be oriented towards the impact of these technologies in other educational stages, in order to broaden the scope of the analysis. Furthermore, it is proposed to delve deeper into the gap identified in the study, particularly in the field of Education for Sustainable Development, highlighting the need to expand the scientific approach in less explored areas of the application of AI and chatbots.

The exploration of these strategic areas could provide the educational and scientific community more comprehensive technological solutions, contributing significantly to the achievement of the SDGs and global wellbeing. With regard to the implementation of Chatbots, AI also presents challenges, such as the need to ensure effective interactions and concerns about users' privacy. In addition, research is suggested on strategies to improve acceptance and trust in these technologies, as well as to assess their impact on academic performance and student well-being.

REFERENCES

Al-Abdullatif, A. M. (2023). Modeling students' perceptions of chatbots in learning: Integrating technology acceptance with the value-based adoption model. *Education Sciences*, *13*(11), 1151. https://doi.org/10.3390/educsci13111151

Al-Abdullatif, A. M., Al-Dokhny, A. A., & Drwish, A. M. (2023). Implementing the Bashayer chatbot in Saudi higher education: Measuring the influence on students' motivation and learning strategies. *Frontiers in Psychology*, *14*, 1129070. https://doi.org/10.3389/fpsyg.2023.1129070

Alkhoori, A., Kuhail, M. A., & Alkhoori, A. (2020). Unibud: A virtual academic adviser. In *2020 12th Annual Undergraduate Research Conference on Applied Computing (URC)* (pp. 1-4). IEEE. https://doi.org/10.1109/URC49805.2020.9099191

Allison, D. (2012). Chatbots in the library: Is it time? *Library Hi Tech*, *30*(1), 95-107. https://doi.org/10.1108/07378831211213238

Alt, M. A., & Ibolya, V. (2021). Identifying relevant segments of potential banking chatbot users based on technology adoption behavior. *Market-Trziste*, *33*(2), 165-183. https://doi.org/10.22598/mt/2021.33.2.165

Anghelescu, P., & Nicolaescu, S. V. (2018). Chatbot application using search engines and teaching methods. In *2018 10th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)* (pp. 1-6). IEEE. https://doi.org/10.1109/ECAI.2018.8678948

Barrett, A., & Pack, A. (2023). Not quite eye to AI: Student and teacher perspectives on the use of generative artificial intelligence in the writing process. *International Journal of Educational Technology in Higher Education*, *20*, Artículo 59. https://doi.org/10.1186/s41239-023-00427-0

Celik, I., Gedrimiene, E., Siklander, S., & Muukkonen, H. (2024). Las posibilidades de las herramientas basadas en inteligencia artificial para apoyar las habilidades del siglo XXI: Una revisión sistemática de la investigación empírica en la educación superior. *Australasian Journal of Educational Technology*, *40*(3), 19-38. https://doi.org/10.14742/ajet.9069

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT: Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching and Learning Practice*, *20*(3), Artículo 2. https://doi.org/10.53761/1.20.3.02

Dinh, H., & Tran, T. K. (2023). EduChat: An AI-based chatbot for university-related information using a hybrid approach. *Applied Sciences-Basel*, *13*(22), 12446. https://doi.org/10.3390/app132212446

Dube, T. V., & Jacobs, L. (2023). Academic library services extension during the COVID-19 pandemic: Considerations in higher education institutions in the Gauteng Province, South Africa. *Library Management*, *44*(1/2), 17-39. https://doi.org/10.1108/LM-04-2022-0039

Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., Johnson, E. E., & Baah, P. K. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. *International Journal of Educational Technology in Higher Education*, *19*, Artículo 55. https://doi.org/10.1186/s41239-022-00362-6

Farazouli, A., Cerratto-Pargman, T., Bolander-Laksov, K., & McGrath, C. (2023). Hello GPT! Goodbye home examination? An exploratory study of AI chatbots impact on university teachers' assessment practices. *Assessment & Evaluation in Higher Education*. https://doi.org/10.1080/02602938.2023.2241676

Fulmer, R., Joerin, A., Gentile, B., Lakerink, L., & Rauws, M. (2018). Using psychological artificial intelligence (Tess) to relieve symptoms of depression and anxiety: Randomized controlled trial. *JMIR Mental Health*, *5*(4), Artículo e10118. https://doi.org/10.2196/mental.9782

Guckenberger, M., Andratschke, N., Ahmadsei, M., Christ, S. M., Heusel, A. E., Kamal, S., Kroese, T. E., Looman, E. L., Reichl, S., Badra, E. V, von der Grun, J., Willmann, J., Tanadini-Lang, S., & Mayinger, M. (2023). Potential of ChatGPT in facilitating research in radiation oncology? *Radiotherapy and Oncology*, *188*, 109894. https://doi.org/10.1016/j.radonc.2023.109894

Hasanein, A. M., & Sobaih, A. E. (2023). Drivers and consequences of ChatGPT use in higher education: Key stakeholder perspectives. *European Journal of Investigation in Health Psychology and Education*, *13*(11), 2599-2614. https://doi.org/10.3390/ejihpe13110181

Hirosawa, T., Kawamura, R., Harada, Y., Mizuta, K., Tokumasu, K., Kaji, Y., Suzuki, T., & Shimizu, T. (2023). ChatGPT-generated differential diagnosis lists for complex case-derived clinical vignettes: Diagnostic accuracy evaluation. *JMIR Medical Informatics*, *11*, Artículo e48808. https://doi.org/10.2196/48808

Howell, B. E., & Potgieter, P. H. (2023). What do telecommunications policy academics have to fear from GPT-3? *Telecommunications Policy*, *47*(7), 102576. https://doi.org/10.1016/j.telpol.2023.102576

Huang, R. S. T., Lu, K. J. Q., Meaney, C., Kemppainen, J., Punnett, A., & Leung, F. H. (2023). Assessment of resident and AI chatbot performance on the University of Toronto family medicine residency progress test: Comparative study. *JMIR Medical Education*, *9*, Artículo e50514. https://doi.org/10.2196/50514

Jackson-Triche, M., Vetal, D., Turner, E. M., Dahiya, P., & Mangurian, C. (2023). Meeting the behavioral health needs of health care workers during COVID-19 by leveraging chatbot technology: Development and usability study. *Journal of Medical Internet Research*, *25*, Artículo e40635. https://doi.org/10.2196/40635

Jiménez-García, E., Orenes-Martínez, N., & López-Fraile, L. A. (2024). Rueda de la Pedagogía para la Inteligencia Artificial: Adaptación de la Rueda de Carrington. *RIED-Revista Iberoamericana de Educación a Distancia*, *27*(1), 87-113. https://doi.org/10.5944/ried.27.1.37622

Kellermeyer, R., Heydman, L. M., Mastick, G. S., & Kidd, T. (2018). *The role of apoptotic signaling*. Preprints.org. https://doi.org/10.20944/preprints201809.0281.v1

Kingchang, T., Chatwattana, P., & Wannapiroon, P. (2024). Artificial intelligence chatbot platform: AI chatbot platform for educational recommendations in higher education. *International Journal of Information and Education Technology*, *14*(1), 1-7. https://doi.org/10.18178/ijiet.2024.14.1.2021

Koulouri, T., Macredie, R. D., & Olakitan, D. (2022). Chatbots to support young adults' mental health: An exploratory study of acceptability. *ACM Transactions on Interactive Intelligent Systems*, *12*(2), Artículo 13. https://doi.org/10.1145/3485874

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973-1018. https://doi.org/10.1007/s10639-022-11177-3

Liu, H., Peng, H. M., Song, X. Y., Xu, C. Z., & Zhang, M. (2022). Using AI chatbots to provide self-help depression interventions for university students: A randomized trial of effectiveness. *Internet Interventions-the Application of Information Technology in Mental and Behavioural Health*, *27*, 100495. https://doi.org/10.1016/j.invent.2022.100495

Lozano, A., & Fontao, C. B. (2023). Is the education system prepared for the irruption of artificial intelligence? A study on the perceptions of students of primary education degree from a dual perspective:

Current pupils and future teachers. *Education Sciences*, *13*(7), 733. https://doi.org/10.3390/educsci13070733

Malik, R., Sharma, A., Trivedi, S., & Mishra, R. (2021). Adoption of chatbots for learning among university students: Role of perceived convenience and enhanced performance. *International Journal of Emerging Technologies in Learning*, *16*(18), 200-212. https://doi.org/10.3991/ijet.v16i18.24315

Menkhoff, T., & Gan, B. (2023). Involucrar a los estudiantes a través de chatbots conversacionales y contenido digital: Una perspectiva de acción climática. *Human Interaction and Emerging Technologies (IHIET)*, *70*, 334-347. https://doi.org/10.54941/ahfe1002960

Moldt, J. A., Festl-Wietek, T., Mamlouk, A. M., Nieselt, K., Fuhl, W., & Herrmann-Werner, A. (2023). Chatbots for future docs: Exploring medical students' attitudes and knowledge towards artificial intelligence and medical chatbots. *Medical Education Online*, *28*(1), 2182659. https://doi.org/10.1080/10872981.2023.2182659

Naciones Unidas. (2018). *La Agenda 2030 y los Objetivos de Desarrollo Sostenible: Una oportunidad para América Latina y el Caribe*. CEPAL.

Naciones Unidas. (2020). *Energía asequible y sostenible en la educación*. https://www.un.org/sustainabledevelopment/es/energy/

Nam, B. H., & Bai, Q. (2023). ChatGPT and its ethical implications for STEM research and higher education: A media discourse analysis. *International Journal of STEM Education*, *10*(1), Artículo 61. https://doi.org/10.1186/s40594-023-00452-5

Nikolic, S., Daniel, S., Haque, R., Belkina, M., Hassan, G. M., Grundy, S., Lyden, S., Neal, P., & Sandison, C. (2023). ChatGPT versus engineering education assessment: A multidisciplinary and multi-institutional benchmarking and analysis of this generative artificial intelligence tool to investigate assessment integrity. *European Journal of Engineering Education*, *48*(4), 559-614. https://doi.org/10.1080/03043797.2023.2213169

Noble, J. M., Zamani, A., Gharaat, M., Merrick, D., Maeda, N., Foster, A. L., Nikolaidis, I., Goud, R., Stroulia, E., Agyapong, V. I. O., Greenshaw, A. J., Lambert, S., Gallson, D., Porter, K., Turner, D., & Zaiane, O. (2022). Developing, implementing, and evaluating an artificial intelligence-guided-mental health resource navigation chatbot for health care workers and their families during and following the COVID-19 pandemic: Protocol for a cross-sectional study. *JMIR Research Protocols*, *11*(7), Artículo e33717. https://doi.org/10.2196/33717

Ojeda, A. D., Solano-Barliza, A. D., Alvarez, D. O., & Cárcamo, E. B. (2023). Análisis del impacto de la inteligencia artificial ChatGPT en los procesos de enseñanza y aprendizaje en la educación universitaria. *Formación universitaria*, *16*(6), 61-70. https://doi.org/10.4067/S0718-50062023000600061

Okonkwo, C. W., & Ade-Ibijola, A. (2021). Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*, *2*, 100033. https://doi.org/10.1016/j.caeai.2021.100033

Oqaidi, K., Aouhassi, S., & Mansouri, K. (2024). Are chatbots the future of higher education? Unveiling their impact, challenges, and prospects. In *2024 4th International Conference on Innovative Research in Applied Science, Engineering and Technology (IRASET)* (pp. 1-6). IEEE. https://doi.org/10.1109/IRASET60544.2024.10548820

Pack, A., & Maloney, J. (2023). Using generative artificial intelligence for language education research: Insights from using OpenAI's ChatGPT. *TESOL Quarterly*. https://doi.org/10.1002/tesq.3253

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu,

M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas. *Revista Española de Cardiología, 74*(9), 790–799. https://doi.org/10.1016/j.recesp.2021.06.016

Park, D. Y., & Kim, H. (2023). Determinants of intentions to use digital mental healthcare content among university students, faculty, and staff: Motivation, perceived usefulness, perceived ease of use, and parasocial interaction with AI chatbot. *Sustainability*, *15*(1), 872. https://doi.org/10.3390/su15010872

Pérez, J. Q., Daradoumis, T., & Puig, J. M. M. (2020). Rediscovering the use of chatbots in education: A systematic literature review. *Computer Applications in Engineering Education*, *28*(6), 1549-1565. https://doi.org/10.1002/cae.22326

Rahim, N. I. M., Iahad, N. A., Yusof, A. F., & Al-Sharafi, M. A. (2022). AI-based chatbots adoption model for higher-education institutions: A hybrid PLS-SEM-neural network modelling approach. *Sustainability*, *14*(19), 12726. https://doi.org/10.3390/su141912726

Redondo-Duarte, S., Martínez-Requejo, S., Jiménez-García, E., & Ruiz-Lázaro, J. (2024). The potential of educational chatbots for the support and formative assessment of students. In M. Ibrahim, M. Aydoğmuş & Y. Tükel (Eds.), *New trends and promising directions in modern education,* (pp. 113-148). Palet Yayinlari.

Robayo-Pinzon, O., Rojas-Berrio, S., Rincon-Novoa, J., & Ramirez-Barrera, A. (2023). Artificial intelligence and the value co-creation process in higher education institutions. *International Journal of Human-Computer Interaction*. https://doi.org/10.1080/10447318.2023.2259722

Rodríguez, J. A., Santana, M. G., Perera, M. V. A., & Pulido, J. R. (2021). Embodied conversational agents: Artificial intelligence for autonomous learning. *Pixel-Bit. Revista de Medios y Educacion*, *62*, 107-144. https://doi.org/10.12795/pixelbit.86171

Romero-Rodríguez, J. M., Ramírez-Montoya, M. S., Buenestado-Fernández, M., & Lara-Lara, F. (2023). Use of ChatGPT at university as a tool for complex thinking: Students' perceived usefulness. *Journal of New Approaches in Educational Research*, *12*(2), 323-339. https://doi.org/10.7821/naer.2023.7.1458

Sain, Z., Vasudevan, A., & Lama, A. (2024). The emerging future of AI chatbots in higher education. *Jurnal Ilmiah Didaktika: Media Ilmiah Pendidikan dan Pengajaran*, *25*(1), 93-107. https://doi.org/10.22373/jid.v25i1.25583

Sánchez-Serrano, S., Pedraza-Navarro, I., & Donoso-González, M. (2022). ¿Cómo hacer una revisión sistemática siguiendo el protocolo PRISMA? Usos y estrategias fundamentales para su aplicación en el ámbito educativo a través de un caso práctico. *Bordón. Revista de Pedagogía*, *74*(3), 51-66. https://doi.org/10.13042/Bordon.2022.95090

Sharma, A., Undheim, P. E., & Nazir, S. (2023). Design and implementation of AI chatbot for COLREGs training. *WMU Journal of Maritime Affairs*, *22*(1), 107-123. https://doi.org/10.1007/s13437-022-00284-0

Shim, K. J., Menkhoff, T., Teo, L. Y. Q., & Ong, C. S. Q. (2023). Assessing the effectiveness of a chatbot workshop as experiential teaching and learning tool to engage undergraduate students. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11795-5

Singh, S., & Beniwal, H. (2022). A survey on near-human conversational agents. *Journal of King Saud University-Computer and Information Sciences*, *34*(10, Part B), 8852-8866. https://doi.org/10.1016/j.jksuci.2021.10.013

Tamayo, P. A., Herrero, A., Martín, J., Navarro, C., & Tránchez, J. M. (2020). Design of a chatbot as a distance learning assistant. *Open Praxis*, *12*(1), 145-153. https://doi.org/10.5944/openpraxis.12.1.1063

Tian, W., Ge, J., Zhao, Y., & Zheng, X. (2024). AI chatbots in Chinese higher education: Adoption, perception, and influence among graduate students-An integrated analysis utilizing UTAUT and ECM models. *Frontiers in Psychology*, *15*, 1268549. https://doi.org/10.3389/fpsyg.2024.1268549

Trappey, A. J. C., Lin, A. P. C., Hsu, K. Y. K., Trappey, C. V. & Tu, K. L. K. (2022). Development of an empathy-centric counseling chatbot system capable of sentimental dialogue analysis. *Processes*, *10*(5), 930. https://doi.org/10.3390/pr10050930

Tseng, W., & Warschauer, M. (2023). AI-writing tools in education: If you can't beat them, join them. *Journal of China Computer-Assisted Language Learning*, *3*(2), 258-262. https://doi.org/10.1515/jccall-2023-0008

Uman, L. S. (2011). Systematic reviews and meta-analyses. *Journal of the Canadian Academy of Child & Adolescent Psychiatry*, *20*(1), 57-59.

UNESCO. (2021). *Recomendación sobre la Ética de la Inteligencia Artificial*. https://unesdoc.unesco.org/ark:/48223/pf0000381137_spa

Van-Eck, N. J., & Waltman, L. (2013). *VOSviewer manual*. Leiden University Centre for Science and Technology Studies (CWTS).

Vázquez-Cano, E., Mengual-Andrés, S., & López-Meneses, E. (2021). Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments. *International Journal of Educational Technology in Higher Education*, *18*, Artículo 31. https://doi.org/10.1186/s41239-021-00269-8

Villegas-Ch, W., Arias-Navarrete, A., & Palacios-Pacheco, X. (2020). Proposal of an architecture for the integration of a chatbot with artificial intelligence in a smart campus for the improvement of learning. *Sustainability*, *12*(4), 1500. https://doi.org/10.3390/su12041500

Villegas-Ch, W., García-Ortiz, J., Mullo-Ca, K., Sánchez-Viteri, S., & Roman-Cañizares, M. (2021). Implementation of a virtual assistant for the academic management of a university with the use of artificial intelligence. *Future Internet*, *13*(4), 97. https://doi.org/10.3390/fi13040097

Weeks, R., Cooper, L., Sangha, P., Sedoc, J., White, S., Toledo, A., Gretz, S., Lahav, D., Martin, N., Michel, A., Lee, J. H., Slonim, N., & Bar-Zeev, N. (2022). Chatbot-delivered COVID-19 vaccine communication message preferences of young adults and public health workers in urban American communities: Qualitative study. *Journal of Medical Internet Research*, *24*(7), Artículo e38418. https://doi.org/10.2196/38418

Xiao, Y. Y., & Zhi, Y. Y. (2023). An exploratory study of EFL learners' use of ChatGPT for language learning tasks: Experience and perceptions. *Languages*, *8*(3), 212. https://doi.org/10.3390/languages8030212

Yeo, M. A. (2023). Academic integrity in the age of artificial intelligence (AI) authoring apps. *TESOL Journal*. https://doi.org/10.1002/tesj.716

Zorrilla-Puerto, J., Lores-Gómez, B., Martínez-Requejo, S., & Ruiz-Lázaro, J. (2023). El papel de la robótica en Educación Infantil: Revisión sistemática para el desarrollo de habilidades. *RiiTE Revista Interuniversitaria de Investigación en Tecnología Educativa*, (15), 188-194. https://doi.org/10.6018/riite.586601

Zou, M., & Huang, L. (2023). To use or not to use? Understanding doctoral students' acceptance of ChatGPT in writing through technology acceptance model. *Frontiers in Psychology*, *14*, 1259531. https://doi.org/10.3389/fpsyg.2023.1259531

Notes

1 This article has been carried out within the framework of the research project XSAN002310 "Chatbot for the support and formative Assessment of students. Analysis, Design, Implementation" funded by Universidad Europea de Madrid and Banco Santander.

Información adicional

How to cite: Jiménez-García, E., Ruiz-Lázaro, J., Martínez-Requejo, S., & Redondo-Duarte, S. (2025). Artificial Intelligence and chatbots for sustainable higher education: a systematic review. [Inteligencia Artificial y chatbots para una educación superior sostenible: una revisión sistemática]. *RIED-Revista Iberoamericana de Educación a Distancia, 28*(2), 81-104. https://doi.org/10.5944/ried.28.2.43240

Información adicional

redalyc-journal-id: 3314

Eva Jiménez-García, Judit Ruiz-Lázaro,
Sonia Martínez-Requejo, Sara Redondo-Duarte

Artificial Intelligence and chatbots for sustainable higher education: a systematic review
Inteligencia Artificial y chatbots para una educación superior sostenible: una revisión sistemática

RIED-Revista Iberoamericana de Educación a Distancia
vol. 28, núm. 2, p. 81 - 104, 2025
Asociación Iberoamericana de Educación Superior a Distancia, España
ried@edu.uned.es

ISSN: 1138-2783
ISSN-E: 1390-3306

DOI: https://doi.org/10.5944/ried.28.2.43240