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Artificial Intelligence as a Tool for the Development of Soft Skills: A Bibliometric Review in the Context of Higher Education

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Abstract. Skills such as communication, teamwork, adaptability and problem-solving are essential for professional and personal development. The integration of artificial intelligence (AI) in the process of building these skills in students represents a significant innovation in higher education. This is because AI offers new teaching methods that can be more effective and personalized than traditional approaches. Thus, it is relevant to investigate the bibliometric indicators that reflect the trends in which AI enables the development of soft skills in the context of higher education. The approach used is the mixed,

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exploratory-descriptive level. The total number of studies reviewed was 78, all of them extracted from the Scopus database. The results show that the most prevalent thematic areas are "Communication skills development", "Teamwork and collaboration" and "Critical thinking and problem-solving". This is a result of AI's ability to create more personalized, interactive and adaptive learning environments. However, it is concluded that scientific production in this field of study is still developing and requires greater attention from researchers. It is important to reflect that the implementation of AI in higher education must be supported by policies that regulate its effective integration and maximize its impact. Future studies should employ systematic reviews to address the impact of AI on soft skills according to the area of knowledge, such as engineering, social sciences or health sciences, identifying the skills to which AI is contributing most significantly.

Keywords: soft skills; artificial intelligence; university students; bibliometric review

1. Introduction

Soft skills refer to those interdisciplinary and transversal skills that are applied both in professional work and in daily life (Gilyazova et al., 2021). Thus, based on the recognized importance of these skills, researchers have been increasingly reflecting on the ways in which these skills should be addressed in curricular planning at the level of higher education (Fuentes et al., 2021). Soft and hard skills are both essential in professional training; therefore, universities must promote both soft skills that include emotional awareness and hard skills that include specialized knowledge (Chávez & Fuentes, 2022; Rodríguez et al., 2021). In many higher education institutions (HEIs), the teaching of soft skills is insufficient, since hard skills are more heavily prioritized. This is primarily due to the fact that HEIs lack a cohesive plan to develop these skills, which is a concerning omission in the comprehensive training of the student (Tipte, 2021). Therefore, today's students need to train under hybrid and complex profiles that combine both technical knowledge and communication skills, collaborative work and the integration of conceptual, procedural and attitudinal knowledge to help solve diverse problems (Zepeda-Hurtado et al., 2018). During the COVID-19 pandemic, there was an urgent need to develop soft skills in higher education, because it was necessary for students to manage their emotions and improve their social coexistence, strengthening their emotional intelligence to face the academic and personal challenges involved in the change of teaching modality (López & Lozano, 2021). Furthermore, educational institutions must prepare students in developing the soft skills necessary to face an increasingly challenging labor market (Herrera & Torres, 2020). Rapid technological advances are impacting all industries globally, making it crucial to update the skills of the workforce as soon as possible (Gómez-Gamero, 2019; Marrero et al., 2018). As a result, more requirements than ever are being placed on job applicants, who must possess not only the relevant knowledge, but also well-developed soft skills (Montes, 2019).

Characterized by their flexibility and versatility, information and communication technologies are now fundamental to the advancement of education (García, 2021). It is within this context that the trend in the use of artificial intelligence (AI) is rapidly changing various sectors of society, including higher education (Vera, 2023). In higher education, AI offers the advantage of personalizing learning by adapting it to the needs and preferences of each student (Cárdenas et al., 2023). Using machine learning algorithms, it can analyze each student's behavior, style, strengths and weaknesses, providing personalized feedback and recommendations (Delgado et al., 2024; García-Peñalvo et al., 2023). However, it is crucial to note that the incorporation of AI in higher education requires meticulous planning and adequate training for teachers and students (Salmerón et al., 2023). AI should complement, not replace, teachers' judgment, while encouraging curiosity and critical thinking. Students should use AI as a tool with which to support active and self-managed learning (González-Sánchez et al., 2023). In this way, the integration of AI presents both challenges and opportunities for educational institutions, teachers and students (Parra-Sánchez, 2022; Litardo et al., 2023); nevertheless, the applications and trends of AI in higher education offer a promising future (Cotrina-Aliaga et al., 2021).

Developing soft skills in students requires the use of curricular plans with an innovative didactic approach that encourages collaborative research and the use of active methodologies that promote student participation and the use of technological tools in learning (Hurtado et al., 2019). The contribution of AI lies here, in helping to personalize learning and offer relevant innovative experiences in a world that is increasingly characterized by rapid technological advances and social change (Durán et al., 2024). In this way, AI is having a significant impact on education by offering valuable tools with which to generate spaces in which collaborative groups can be promoted, while establishing leadership and teamwork roles (Hurtado et al., 2019). However, AI cannot achieve these aims autonomously; human intervention is required. In other words, it is the role of the teacher to apply AI appropriately in the university context in order to successfully foster students' soft skills (Olivera, 2023).

Therefore, the objective of this study is to explore and describe the trend of the themes covered in the literature in the period between 2019 and 2024, regarding the ways in which artificial intelligence allows for the development of soft skills in the context of higher education. Using a bibliometric review, various scientific documents were extracted from the Scopus database before being analyzed. In this way, this study seeks to identify gaps in the literature relating to AI's role in fostering soft skills, thereby providing a frame of reference to current knowledge and signposting areas for future research. The research questions (RQ) based on the established objective of the study are formulated as follows:

- RQ1: What is the trend in the number of scientific documents and what types of documents are contributing to the field of study on the contribution of AI to the development of soft skills?

- RQ2: What are the scientific documents with the highest number of citations that address the contribution of AI to the development of soft skills?
- RQ3: What are the most prevalent thematic areas in scientific publications that address the contribution of AI to the development of soft skills?

2. Conceptual framework

Soft skills comprise the attitudes and practices that influence the way in which a person learns and interacts socially; they play an essential role in differentiating university graduates in the labor market, complementing the formally acquired technical skills (Aquino & Romero, 2022). Despite being intangible, these skills are regarded as valuable assets in both professional and personal environments, especially in an increasingly diverse world (Hurtado & Castañeda, 2023). In order to provide new university graduates with relevant training that will allow them to adapt to the changing conditions of the labor market, it is essential to consider such skills as communication, leadership, and teamwork (Araya-Fernández & Garita-González, 2020). Increasingly, companies are placing a high value on the ability to quickly adapt to new trends and changes in the market. In addition, soft skills such as empathy, negotiation and creativity are essential, since they facilitate effective interaction, conflict resolution and innovation in a dynamic work environment (Cascante, 2023). Therefore, the development of these skills in higher education is essential, especially in leadership roles; In this sense, educational institutions must become aware and focus on perfecting these skills in students, through specific training programs; being vital in a context where AI advances rapidly (Durán et al., 2022).

As well as focusing on solving cognitive problems related to logic, reasoning and various types of learning, AI is also able to accurately diagnose the learning deficits of each student, proposing specific activities designed to improve their skills in a wide range of areas (Numa-Sanjuán et al., 2024). Associated with advanced systems that simulate human cognitive processes, AI allows for autonomous problem solving without human intervention; in the educational field, such systems improve the learning experience by providing personal and adaptable solutions, optimizing the educational process (Melo et al., 2023). Currently, a commonly used form of AI is the chatbot, an easy-to-use tool that interacts with people in a friendly way through natural language, providing answers to various requirements according to the field in which it is used (Castillo, 2020). Generative AI focuses on developing systems that are capable of creating new content, based on training data patterns; thus, in the educational field, chatbots have the potential to optimize learning processes and offer interactive support to students (González-González, 2023). However, AI is constantly improving; its errors and biases are continuously being reduced and perfected over time. Therefore, teachers and educational managers must be prepared to adapt to this evolving technology, using it in education immediately, rather than waiting for it to be completely consolidated (Hernández, 2023).

3. Methodology

3.1 Research focus and scope

This study adopts a mixed research approach, integrating both quantitative and qualitative methods to obtain a complete review of the topic under study. With regard to the quantitative aspect, bibliometric analyses will be performed to examine key indicators, such as the number and types of scientific publications, all of which were extracted from the Scopus database during the period 2019-2024. Such analysis will help to identify the trends in scientific production and the most cited articles related to the application of AI for the development of soft skills in higher education. In terms of the qualitative aspect, a content analysis of the scientific documents will be carried out to identify and describe the main thematic areas as well as the gaps in the current research.

The scope of this research will be exploratory-descriptive in nature, since it will focus on detailing and characterizing bibliometric indicators related to scientific production related to the use of AI in the development of soft skills in higher education. The exploratory scope of the study will contribute to the search for new perspectives in less studied areas in the indicated field of study; furthermore, the descriptive scope will help to detail and characterize the bibliometric indicators related to scientific production, through trends, type of documents and predominant areas. In summary, the present study seeks not only to evaluate the current state of knowledge in this area, but also to detect opportunities for future research.

3.2 Data collection

Data collection was carried out in three main phases, following the method validated in the study by Chamorro et al. (2023); this is described as follows.

Phase 1 - Identification and definition of the topic under study: The research topic was established, focusing on "AI and its contribution to the development of soft skills in the context of Higher Education". A search was carried out in the Scopus database on June 4, 2024, including studies from 2018 to the search date. Search fields included article titles, abstracts, and keywords.

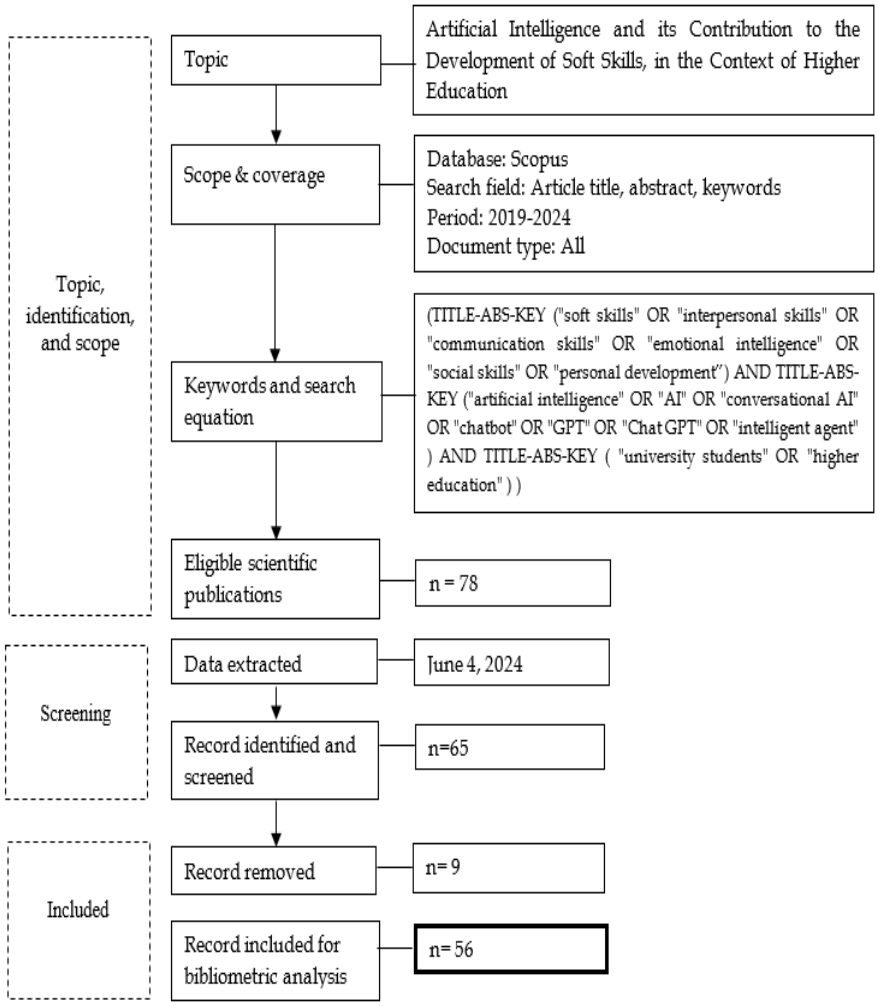

Figure 1. Method used for the compilation of scientific documents

Phase 2 – Search and selection of documents: Using a specific search equation that combines terms related to soft skills ("soft skills", "interpersonal skills", "communication skills", "emotional intelligence") and artificial intelligence ("artificial intelligence", "AI", "chatbot", "ChatGPT"), 78 eligible scientific documents were identified. After extracting the data, the documents were reviewed and filtered, resulting in 65 records initially.

Phase 3 – Screening and Inclusion: The documents were screened to ensure their relevance and quality, thus forming a more critical evaluation of the content of each publication As a result, nine records were eliminated, leaving 56 documents for bibliometric analysis.

4. Results and discussion

4.1 What is the trend in the number of scientific documents and what types of documents are contributing to the field of study on the contribution of AI in the development of soft skills?

The trend in the number of scientific documents being published on the contribution of AI to the development of soft skills shows a constant increase from 2019 to 2023, with a notable peak in 2023, when 20 scientific documents were published. In 2019 and 2020, the number increased to seven and eight

documents, respectively. Although there is a decrease in 2024, compared to the peak of 2023, a high number of publications is nevertheless maintained, with 13 documents being published, as shown in Figure 2. One might draw attention to the fact that since the search was conducted in early June 2024, the figure for 2024 represents less than half a year, compared to the years 2018 to 2023. This would explain the decline in numbers; one could reasonably predict that the figure would roughly double by the end of 2024, representing a continuing upward trend.

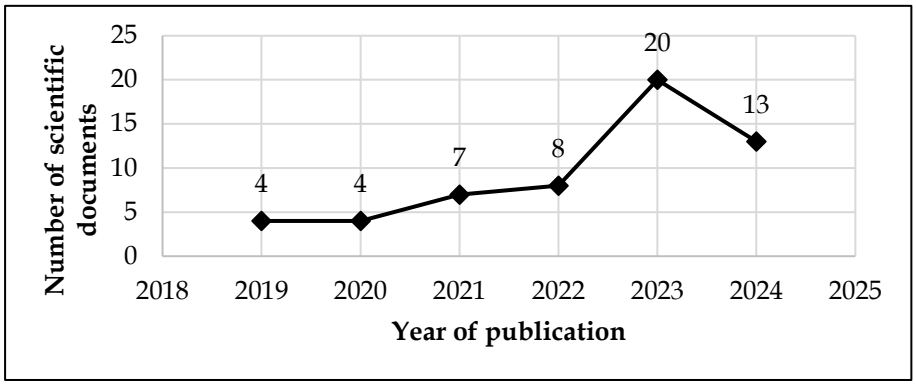

Figure 2. Number of scientific documents per year of publication

Regarding the types of scientific documents that are contributing to this field of study, most of the scientific production consists of scientific articles, with a total of 32 publications. This is followed by 16 conference papers, three conference reviews and four books and three book chapters, respectively. These results are shown in Figure 3, in which the documents are grouped by type. These data indicate that scientific articles are the predominant type of documents being published in this field, suggesting an academic and in-depth research approach to the topic, while conference papers and other types of publications also play an important role in the dissemination of knowledge in this area.

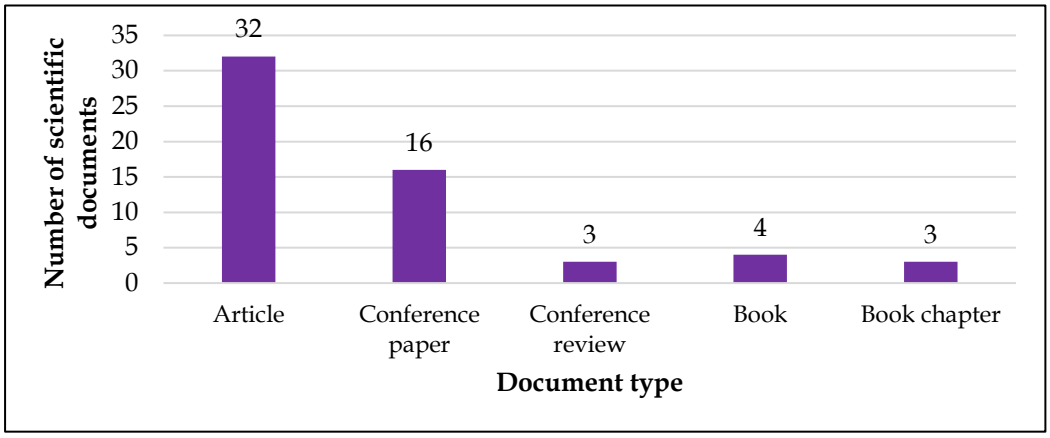

Figure 3. Number of documents grouped by type

With regard to the trend in the number of scientific documents as well as the types of documents that are contributing to the field of study on the contribution of AI in the development of soft skills, a significant increase in publications has

been observed from 2019 to 2023. Hwang et al. (2020) and Zawacki-Richter et al. (2019) point out that this growth is due to the recognition of the potential of AI to improve various aspects of higher education, including social-emotional competencies such as leadership and emotional intelligence. Similarly, the bibliometric review by Mena-Guacas et al. (2023) states that there is scientific evidence of an increasing trend relating to the integration of artificial intelligence in education, contributing to optimizing the learning process and providing tools that improve the communication and cooperation needed to face the challenges and demands of modern society. In the same vein, Forero-Corba and Negre (2024) point out that educational programs are constantly evolving in response to current demands, leading to an urgent need for curricular development to integrate topics and activities based on AI at all educational levels.

4.2 What are the scientific documents with the highest number of citations that address the contribution of AI to the development of soft skills?

The documents with the highest number of citations related to the contribution of AI to the development of soft skills in university students are highlighted in Table 1. An article by Chan and Hu (2023) titled "Students' voices on generative AI: perceptions, benefits, and challenges in higher education" leads with 75 citations, giving an average of 37.5 citations per year. Following this is the work of Wu and Yu (2023), with 41 citations per year. These documents reflect a significant influence on the topic of utilizing AI in the development of soft skills. In addition to these two main studies, other scientific documents include a study by Mgaiwa (2021) on employability in Tanzania, which has garnered 20 citations, and a scientific article by Hea-Suk et al. (2021) on the effects of chatbots on the development of communications skills in students, which has 25 citations. Overall, nine documents with more than 10 citations were identified, as well as nine documents with citations ranging from five to nine, 12 documents with citations ranging from one to four, and 25 documents without any citations. This distribution of citations demonstrates the relevance and variable impact of AI studies on the development of soft skills in higher education, providing a basis for future research.

Table 1. The nine documents with the highest impact on the topic of the contribution of AI in the development of soft skills

Author	Document title	TC	TC per year
Chan and Hu (2023)	Students' voices on generative AI: perceptions, benefits, and challenges in higher education	75	37.50
Wu and Yu (2023)	Do AI chatbots improve students' learning outcomes? Evidence from a meta-analysis	41	41.00
Mgaiwa (2021)	Fostering Graduate Employability: Rethinking Tanzania's University Practices	30	7.50

Hea-Suk et al. (2021)	Effects of AI chatbots on EFL students' communication skills	25	6.25
De Villiers (2021)	Seven principles to ensure future-ready accounting graduates – a model for future research and practice	16	4.00
Xu et al. (2022)	Hospitality and Tourism Higher Education in the Post-COVID Era: Is It Time to Change?	15	5.00
Tinmaz and Lee (2019)	A Preliminary Analysis on Korean University Students' Readiness Level for Industry 4.0 Revolution	13	2.17
Woods et al. (2021)	Technology-driven change in the retail sector: Implications for higher education	13	4.33
Khudhair et al. (2019)	The impact of emotional intelligence on work performance: Perceptions and reflections from academics in Malaysian higher education	10	1.67

In relation to the scientific documents with the highest numbers of citations, which address the contribution of AI in the development of soft skills, the study carried out by Chan and Hu (2023) stands out for its significant influence in the field of higher education and its focus on the ways in which students perceive and benefit from AI. Similarly, Wu and Yu (2023) analyze the impact of chatbots on student learning outcomes, providing analytical evidence of their effectiveness; both of these studies demonstrate the high relevance and continued interest in exploring AI's potential for improving the soft skills of university students. In addition, the publication by Mgaiwa (2021) on employability in Tanzania and the work of Hea-Suk et al. (2021) on the effects of AI on students' communication skills indicate a diversity of approaches within the field of study, addressing different aspects of the ways in which AI can contribute to the development of essential soft skills in university students, allowing them to quickly adapt to the demands of the labor market upon graduation.

4.3 What are the most prevalent thematic areas in scientific publications that address the contribution of AI to the development of soft skills?

Figure 4 shows the network of co-occurrences of keywords in publications on the contribution of AI in the development of soft skills. Most prominently recurring keywords include "students", "artificial intelligence", "soft skills", "e-learning", and "higher education". This suggests that the research is primarily focused on the way in which AI is integrated into higher education to improve students' soft skills through approaches such as online and collaborative learning. The high frequency of terms such as "curricula" and "education computing" indicates a significant interest in the adaptation of educational programs to incorporate technology linked to AI.

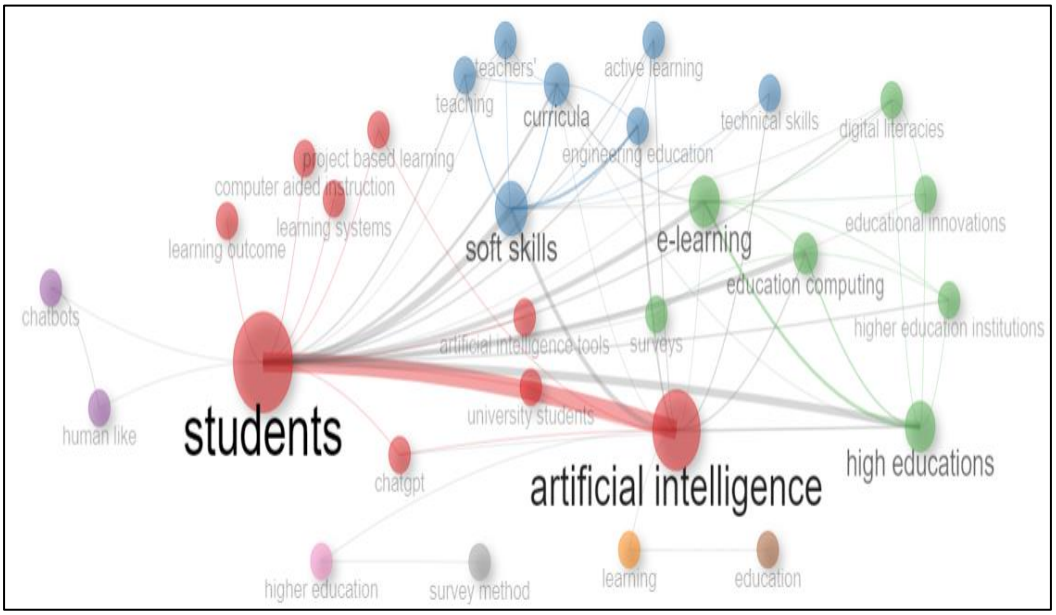

Figure 4. Keyword co-occurrence network on the contribution of AI in the development of soft skills

Furthermore, the results of the analysis of total link strength between the keywords with the highest co-occurrence reveal that the word "students" presents 17 occurrences with a total strength of 45, followed by "artificial intelligence" with 20 occurrences and a total link strength of 43. These results reinforce the prevalence of research focused on the application of AI for the direct benefit of students and their educational experience. The inclusion of terms such as "soft skills" and "e-learning" also emphasizes the importance of these areas in current studies, reflecting a trend towards the development of interpersonal skills and the use of digital platforms for education. Table 2 shows the total link strength between the keywords with the highest co-occurrence.

Table 2. Total link strength between keywords with the highest co-occurrence

Keyword	Occurrences	Total link strength
Students	17	45
Artificial intelligence	20	43
High education	7	28
Higher Education	14	28
e-learning	7	26
Soft skills	9	24
Curricula	5	17
Education computing	5	16
AI	6	15
ChatGPT	5	14
Education	5	8

Additionally, a further relevant result is identified in Figure 5, which depicts the network of co-occurrences of bigrams on the contribution of AI in the

development of soft skills, revealing the strong relationship between terms such as "artificial intelligence" and "soft skills", "university students" and "communication skills", and "emotional intelligence". This highlights four key topic areas linked to AI: a) Development of communication skills; b) Teamwork and collaboration; c) Critical thinking and problem solving; and d) Emotional intelligence and self-awareness. Thus, these areas are crucial to understanding the ways in which AI can be used to improve the development of students' essential soft skills in the context of higher education.

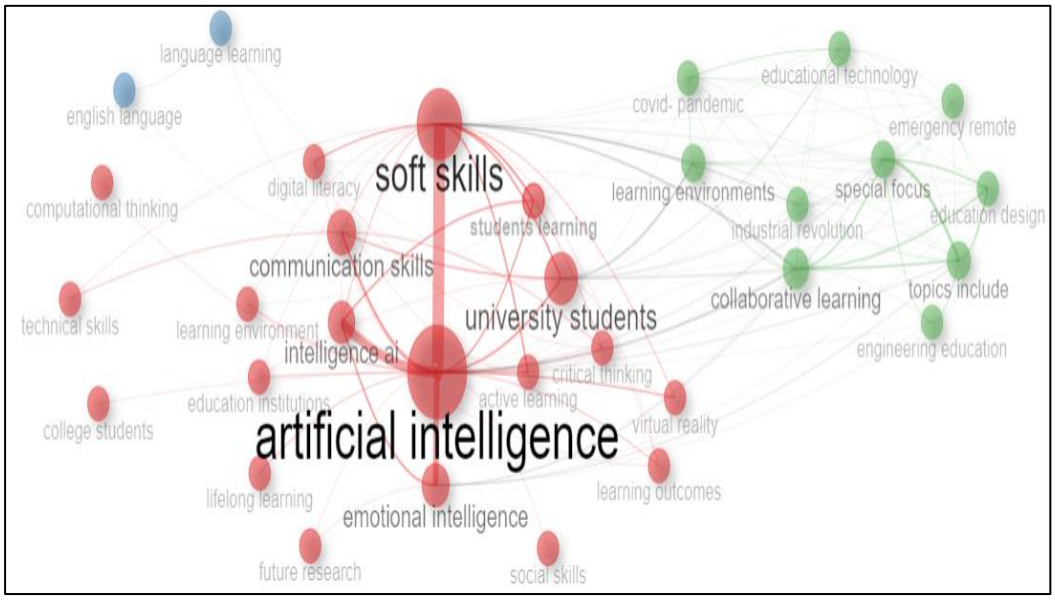

Figure 5. Bigram co-occurrence network on the contribution of AI in the development of soft skills

Regarding the most prevalent thematic areas in scientific publications that address the contribution of AI in the development of soft skills, Chassignol et al. (2018) point out that the integration of AI in education has a significant impact on the development of communication skills, allowing students to interact and receive feedback in real time, which improves their communication skills. Another study, conducted by Chan et al. (2020), highlights that AI facilitates teamwork and collaboration between students, providing platforms that allow for efficient project management and task coordination while overcoming time and space barriers. This is reflected in the high frequency of terms related to collaboration in the keyword co-occurrence analysis. Similarly, Holmes et al. (2021) highlight the importance of critical thinking and problem solving, noting that AI tools, such as machine learning algorithms, help students to address complex problems in a structured and efficient way. These technologies allow students to develop analytical and problem-solving skills, essential in the academic and professional environment. Furthermore Rasiah et al. (2021) examine in their study on emotional intelligence and job performance in higher education and the relevance of skills such as self-management, social awareness, and relationship management for academic performance and employability. This work highlights how AI can facilitate the development of these

competencies through personalized learning tools and data analysis, improving the preparation of graduates for an increasingly competitive and technologically ever-advancing labor market. Finally, Hénandez-Borroto and Medrano-Plana (2024) conclude that AI has transformed the development of soft skills in higher education, strengthening competencies such as empathy and communication, promoting a student-centered educational approach. This technological integration establishes a standard of collaboration between AI and human skills, marking a milestone in the comprehensive training of university students.

5. Conclusion

From the results obtained in this bibliometric review study related to the use of AI as a tool for the development of soft skills in higher education students, it can be seen that the most prevalent thematic areas are: "Development of communication skills", "Teamwork and collaboration", "Critical thinking and problem solving", and "Emotional intelligence and self-awareness". These findings highlight the relevance of AI in higher education, due to its ability to provide personalized learning, real-time feedback, and more interactive and adaptive environments; all of these features allow for the development of the relevant soft skills that are increasingly needed by graduates upon their entry into the labor market. In conclusion, it is clear that AI is contributing to the development of soft skills in higher education; however, neither its effective integration nor, moreover, its impact on higher education institutions is currently supported by regulatory policies. Future studies should include a systematic review study to address the impact of AI on students' soft skills in specific areas of knowledge—such as engineering, social sciences, and health sciences—since each of these areas involves particular conditions in which specific soft skill sets are necessary.

6. Limitations

Despite the importance of the findings of this study, it nevertheless has certain limitations. One limitation of the present study was that it focused on only one database. The Scopus database was selected due to its extensive coverage of artificial intelligence applications in the field of university education. Although this database stores various scientific documentation, indexed from high-impact journals and subjected to a rigorous review process, it is important to highlight that other databases—such as Web of Science, ERIC, and Google Scholar—could provide broader insights than those gleaned from the results of this study. Furthermore, the study only included publications from 2019 to June 2024; therefore, a broader temporal analysis could indicate additional topics to those identified in this research. Finally, a third limitation is that this study is framed in the context of higher education. Future studies could benefit from extending the research to include students at the technical, secondary or primary school levels.

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