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RESEARCH ON THE USE OF ARTIFICIAL INTELLIGENCE AS AN EDUCATIONAL METHODOLOGY
Scientific research through social listening and scientometrics

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ABSTRACT

The main objective of this research is to explore the development and implementation of Artificial Intelligence (AI) in the context of university education at a scientific and social level, through a systematic methodology of review academic articles and scientific papers (scientometrics) from the Web Of Science database for the scientific part and a social listening analysis of the main social networks for the social field. It is concluded that researchers should begin to analyze the effects of the good use of AI tools as a teaching methodology, so that society can also highlight it in it mentions on social networks.

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1. Introduction

The use of Artificial Intelligence (AI) has been increasing in recent years, making its presence felt in various fields such as medicine, finance, law, industry and entertainment (Salas-Pilco & Yang, 2022); Therefore, the IoT (Internet of Things or collective network of connected devices that facilitates communication between devices and the cloud, as well as between the devices themselves) will continue to grow in the coming years, reaching 66 billion units in 2026, with 87% of users stating that once they have tried these devices, they will not go without their benefits, according to the second edition of Telefónica's Things Matter 2019 report. The second edition of Telefónica's Things Matter 2019 report shows that 87% of users say that once they have tried these devices, they will not give up their benefits, according to the second edition of Telefónica's Things Matter 2019 report.

AI has become synonymous with new promises, but also with the risks associated with the massification of digital technologies in the different areas of economic and social life in the 21st century, as there is a perception that it will jeopardize the jobs of those who do not adapt to this new technological revolution. Various studies are attempting to gauge the pace and depth of the coming changes, while many industries are automating processes thanks to the new machines available and testing prototypes of inventions that until recently seemed like science fiction (Kaku, 2012).

Given all these advances, we wonder how AI will affect education, which is considered a fundamental pillar for the progress of society and the development of individuals. In an increasingly digitalised and globalised world, AI has become an essential tool for improving and personalising the educational experience. AI refers to the ability of machines to learn, reason and make decisions autonomously, and its application in education is constantly growing and adapting (Halili, 2019).

Although artificial intelligence (AI) plays an increasingly important role in the field of education, the use of new AI technologies in the field of education is still incipient and exploratory in nature, with limited scope and modest impact. However, this could change as the latest advances are gradually integrated into existing computing systems and new ones emerge (Horizon Report, 2019; Zaidi, Beadle, and Hannah, 2018; OECD, 2018; Tuomi, 2018).

For now, here are some ways AI is being used in education:

1. The personalisation of learning. AI can tailor the content and pace of learning to the individual needs of each learner. This means that students can receive instruction and exercises specific to their skill level and learning style, which can increase the effectiveness of learning, generating the so-called adaptive learning systems.

In this sense, we must distinguish two types of Adaptive Learning (AA): the one considered as an educational method based on data analysis (learning analytics) that allows modifying the educational proposal in a personalized way based on "adaptability", which manually adapts the needs of the student to the learning environment, and Intelligent Adaptive Learning (AAI), which is based on "adaptativity", an automatic adaptation process based on AI (Duque Méndez et al, 2020),.

These learning systems seek to bring the type, difficulty, sequence and rhythm of learning materials, as well as their dialogues, questions and feedback, closer to the individual needs of students, with costs considerably lower than those of traditional media (Luckin et al., 2016).

2. Virtual tutoring. AI systems can act as virtual tutors, providing instant feedback to students as they work on problems or assignments. This can help students better understand concepts and correct errors immediately.

AI systems can act as virtual tutors, providing instant feedback to students as they work on problems or tasks. This can help students better understand concepts and correct mistakes immediately. AI-based virtual tutoring refers to the use of intelligent systems that interact with students in a similar way as a human tutor would. These systems use AI algorithms and models to understand students' needs, answer questions, provide detailed explanations, and offer individualized guidance (Acosta et al., 2018), transforming the way students receive support and feedback, providing significant benefits for their learning and academic development (Ospina-Gutiérrez & Aristizábal, 2021).

3. Data collection and analysis. AI can collect and analyse large amounts of data on student performance. Educators can use this information to identify areas for improvement, identify trends in learning and make informed teaching decisions. This promotes more effective and motivating learning, as it adapts to students' interests and abilities (Pimienta & Mosquera-Martínez, 2022). In this sense, an AI system can recommend a student additional reading resources related to a particular topic that

interests them or provide practice exercises adapted to their level of knowledge and skills (Acurio et al., 2022).

4. Automation of administrative tasks. AI can help automate administrative tasks such as managing grades, scheduling classes, and communicating with students and parents. This allows educators to focus more on individualised teaching and support.

5. Adaptive learning. AI systems can adjust learning content and activities based on each student's progress. This can ensure that students are constantly challenged and engaged.

6. Evaluation of open-ended responses. AI can score open-ended responses, such as essays and responses to developmental questions, using natural language processing algorithms. As a result, teachers can save time in the grading process and have more objective feedback.

7. Access to online learning resources. AI can help students find online learning resources that meet their specific needs by recommending relevant courses, tutorials and study materials.

In conclusion, specifically in education, educational artificial intelligence (EI) refers to the use of AI to support personalised and automated feedback and guidance in the education field (Song and Wang (2020)).

However, it is important to remember that the successful implementation of AI in education also raises challenges and ethical issues. These include concerns about the privacy of student data, equity of access to technology, and the need to maintain a balance between automation and human interaction in the educational process. AI in education is a powerful tool, but its use must be carefully considered and monitored to ensure that it is fairly and effectively of benefit to all students.

Based on the above, this study aims to conduct an empirical analysis of the evidence found in the AI literature and a social listening analysis to check whether academia and society are moving in the same direction. There have been previous systematic reviews on AI in education (Martínez-Comesaña et al, 2023; Jimbo-Santana et al, 2023; Fajardo Aguilar, 2023), but there are no studies that compare the opinion emerging from systematic reviews (scientific) with social listening (societal).

Focusing on Educational Artificial Intelligence (EAI), this study seeks to answer the following research questions. How is the use of artificial intelligence in higher education being approached, do scientists and society agree in their assessments, and is EAI growing equally in science and society?

2. Method

This study follows for scientometrics or bibliometrics the guidelines of the PRISMA Declaration, which consists of the use of search engines for indexed articles in order to obtain the necessary information required on studies that have already been carried out (Barquero Morales, 2022; Page et al., 2021). Arksey and O'Malley's (2005) five-step framework for mapping the scientific literature was followed, consisting of a) identification of the research question; b) systematised search for scientific evidence; c) selection of studies; d) data extraction; and e) collection, summarisation and dissemination of results.

The study focuses on scientific articles published in the Wos database in the period 2019 to 2023, which have been processed using the Bibliometrix application for R Studio Cloud, which allows for a complete bibliometric analysis, following the scientific mapping workflow (Aria and Cuccurullo, 2017).

The articles obtained were selected on the basis of the Boolean search e-learning and university or online learning and university and following the following exclusion criteria:

- Type of document: article.
- Years of publication: between 2019 and 2023.
- Language: English and Spanish
- Category of Wos: Education &Educational Research.
- Web of Science Index: ESCI, SSCI and ESCI-Expanded.

With these restrictions, a total of 36 articles were obtained, which after reading and evaluation following PRISMA have been reduced to 32, either because they were repeated or because their field of research is not directly related to education.

For research based on social listening, the methodology is used as a means to understand the perception that users have of a certain topic or issue (Herrera et al., 2022), as it not only works with the perception itself but with any anchor point that is established between the user and the topic under

study, based primarily on the use of technology and algorithms that automatically track and collect data from various online sources: social networks, blogs, forums, news and other types of websites. Once the data is collected, it is then analysed to identify patterns, trends and sentiment, applying techniques such as natural language processing (NLP) and text analysis (Cambria, 2016).

The emergence of social networks has allowed the generation of textual data in a massive way, which has led in recent years to the study and development of applications capable of exploiting this available data to extract analytics and implicit knowledge of great value (He et al., 2015; Batrinca and Treleaven, 2015; Chang, 2017).

In general, the social network analysis process is usually divided into four phases: (Stieglitz et al. 2018):

- Discovery: identification of content and its corresponding keywords, hashtags, etc. that will contribute to the definition of the objectives of the analysis and the main hypotheses to be tested.
- Monitoring: identification of data sources and data collection.
- Preparation: prepare the data for further analysis.
- Analysis: application of various analysis methods and techniques to the dataset prepared to answer the questions posed in the discovery phase.

In this research, as shown in Figure 1, we will follow the same steps proposed by Stieglitz, adding one more step that refers to the subsequent implementation, understanding as such the need to effectively communicate the results of the social network analysis, as proposed by the Brandwatch software, which is the platform used to carry out this social listening.

Figure 1. Mapping Brandwatch core functions to the network analysis process framework

Source: Brandwatch, 2024.

For the discovery stage, Brandwatch Search, an artificial intelligence-based search engine that uses sophisticated natural language processing techniques, is used. In this case, the search is linked to the use of social networks in research. In the follow-up phase, the so-called Query is formed, which refers to the set of words that allow information to be obtained from the platform's systems. For this purpose, Boolean operators have been used to combine the searched concepts and refine the results to be obtained, as shown below:

Image 1: Queries with Boolean search

```
1  <<<Ampliar este grupo de términos de busqueda con  maneras alternativas de
   referisrse a la inteligencia artificial, por  ejmeplo: "aprendizaje automatico",
   "machine learning", "modelo de lenguaje", etc>>>
2  ((( "inteligencia artificial" OR {AI} OR {IA} OR "inteligencia artificial" OR
   chatGPT  O "chat GPT" O  openAI  O "open AI" O "aprendizaje de maquina" O
   "aprendizaje automático" )
3
4  CERCA/20
5  <<<Ampliar este grupo de términos de busqueda con  palabras alternativas para
   se refiere a los estudios universitarios, por  ejemplo "ensenanza superior",
   carrera, facultad, etc>>>
6  (universidad  OR  universitari * OR "estudios superiores" OR "educacion superior" OR
   (estudi * NEAR/5  grado * )  O  posgrado * O  posgrado * O  maestria * O  maestría
   doctorado * OR  doctoral * OR "rendimiento academico" OR "innovacion docente" OR
   docente))
7
8  CERCA/20
9  <<<Ampliar este grupo de términos de busqueda con  palabras alternativas para
```

Source: Own elaboration based on Brandwatch, 2024.

This query returns only on the day of the study 2,150 mentions in the last 30 days, having filtered by language (Spanish) but searching anywhere in the world. Therefore, tools are needed to segment and filter this information, including a test preview to instantly assess the type of mentions that are retrieved from the current query logic, favouring the intended social analysis; in this search, it was decided to eliminate websites that mentioned the terms queried, but are not related to the objective of the study.

Finally, the query is maintained, filtered by language, invalid sites are eliminated and a date range of one year is marked to analyse whether the evolution of the content under study follows a certain pattern.

In the last two stages, the results achieved are analysed and implemented using so-called dashboards that monitor and visually examine the key indicators.

For this network analysis, a sampling rate of 100 % is used with an estimated 1,995 mentions per month.

3. Results

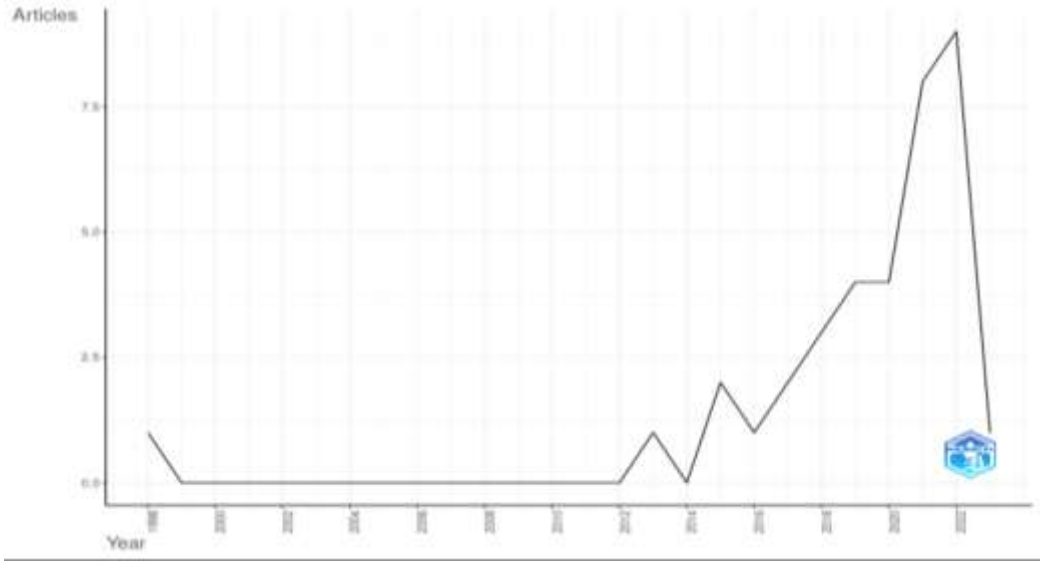
3.1. Statistical results of Bibliometrix for R Studio Cloud.

After the bibliometric study carried out with the R Studio Cloud programme, the results obtained are analysed at a scientific level in order to be able to answer the research questions posed.

3.1.1. Statistical Dataset

Figure 2 shows the annual scientific production and highlights the great scientific interest in IAC between 21 and 22. Although in 23 there seems to be a decrease in the scientific literature on this topic, it will be necessary to wait until the end of the year to have real data on the number of publications.

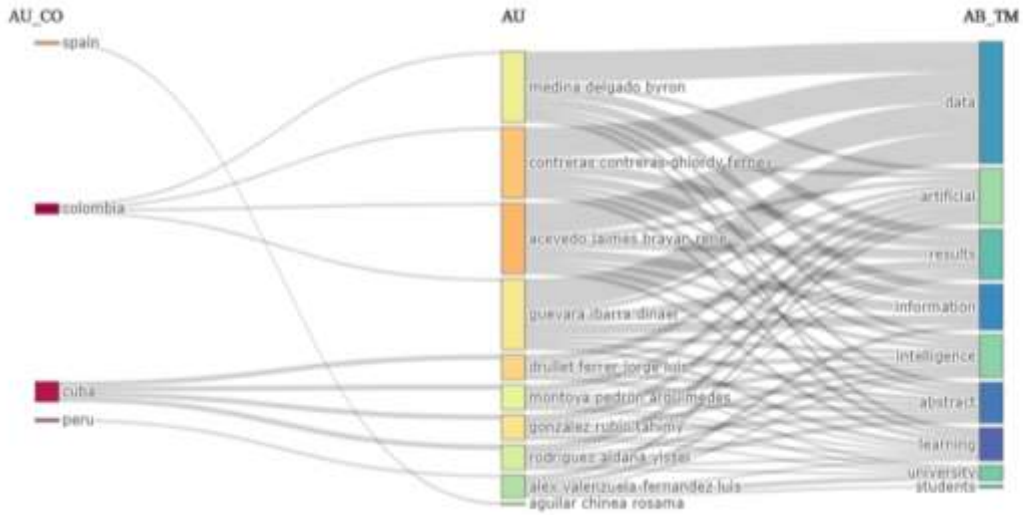
Figure 2. Annual scientific production



Source: Brandwatch, 2024.

Figure 3 shows the so-called three-field graph (Sankey diagram), in this case of country, author and abstract and their interactions with each other.

Figure 3. Sankey diagram



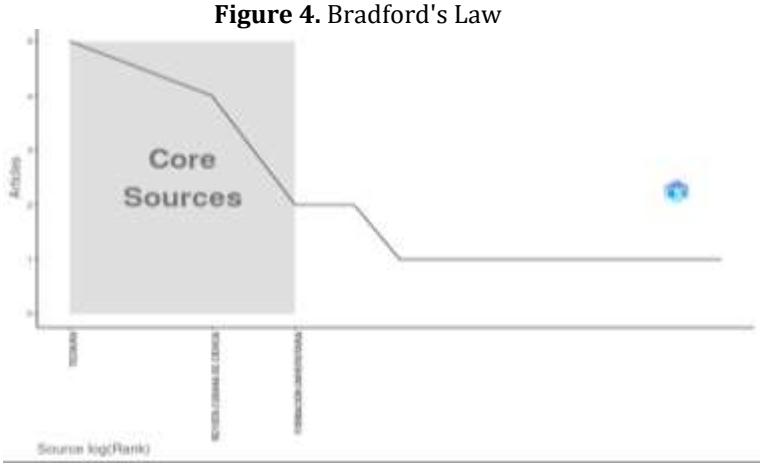
Source: Brandwatch, 2024.

It can be seen that Colombia and Cuba are the countries where there is the greatest scientific production of terms related in the abstracts themselves to EIA concepts, such as data, intelligence, or learning, and they are the countries that group together the main researchers, although in Spain and Peru there are also some researchers on this type of topic.

3.1.2. Sources

With regard to the dispersion of the scientific literature, also known as Bradford's law (Figure 4), it is observed that such dispersion does not exist, since almost all the frequency of publication is grouped in three journals: Tecnura, Revista Cubana de Ciencia, and Revista de Formación Universitaria, all Latin American, which shows that the scientific production on EIA has its origin in South America.

Figure 4. Bradford's Law



Source: Brandwatch, 2024.

3.1.3. Authors

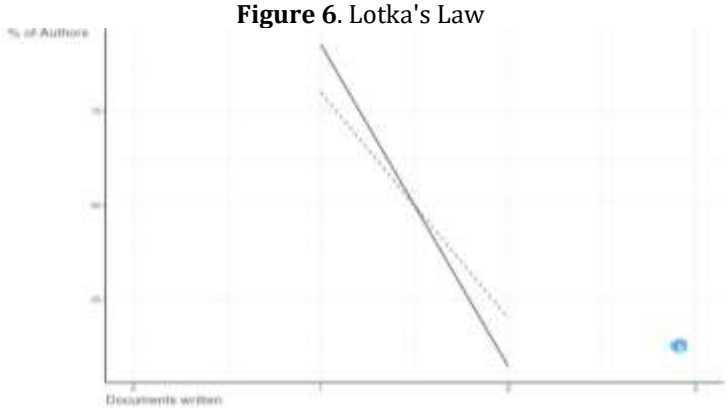
Figure 5 shows that scientific production basically starts in 2019, but that it is basically one author, Alex Valenzuela-Fernandez, who accounts for most of this production.

Figure 5. Authors Production over time

Source: Brandwatch, 2024.

In terms of personal productivity, Lotka's law (Figure 6), which states that a small number of authors publish a significant number of papers, i.e. it establishes a quantitative relationship between authors and the contributions produced in a given field over a given period of time, is not verified in this case, since in this case there are many authors (a total of 102 authors) who only sign two articles so that scientific productivity is low.

Figure 6. Lotka's Law



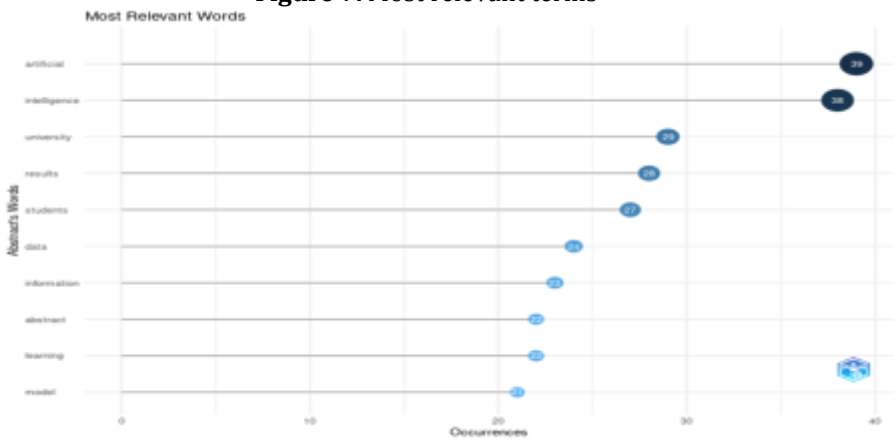
Source: Brandwatch, 2024.

Source: Brandwatch, 2024.

3.1.4. Documents

In the analysis referring to documents, figure 7 shows the most frequent words used by the authors in this case in the abstracts, with artificial intelligence being the most frequently used, together with university, results and students, although in a lower proportion.

Figure 7. Most relevant terms



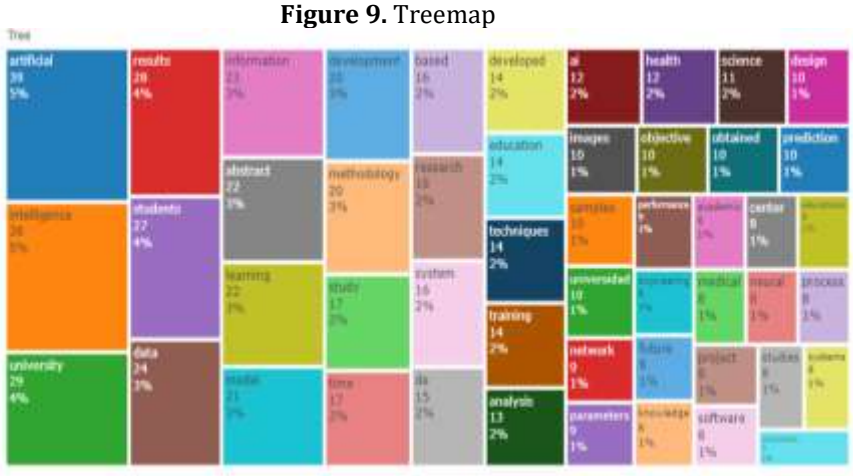
Source: Brandwatch, 2024.

Similar results can be seen in the figure for the most used word cloud (Figure 8) which is also considered a good formula for identifying research topics in a scientific domain (Li et al, 2021), in this case focusing on the 50 keywords, which include terms extracted from abstracts and in the Treemap (Figure 9), which arranges the data in a hierarchical way and has the structure of a tree in which the data are organised in nested rectangles (one inside the other). The size of the rectangle corresponds to the value of the category or subcategory.

Figure 8. Word cloud

Source: Brandwatch, 2024.

Figure 9. Treemap



Source: Brandwatch, 2024.

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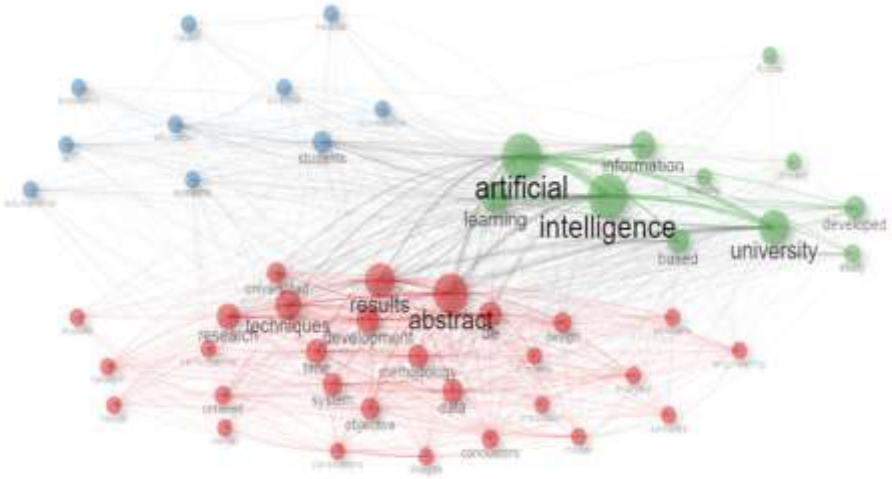
3.2. Bibliometrix Structural Analysis for R Studio Cloud

3.2.1. Conceptual structure

Figure 10 shows a word co-occurrence matrix, taking into account that two words co-occur when they appear simultaneously in the same document; and two words will be more closely linked or associated with each other the higher the co-occurrence between them. Therefore, the measure of the link between two words in a network will be proportional to the co-occurrence of those two words in the sample set of documents. In this case, three groups of co-occurrence emerge, which are represented by three different colours forming three clusters.

Figure 10. Co-occurrence of words.

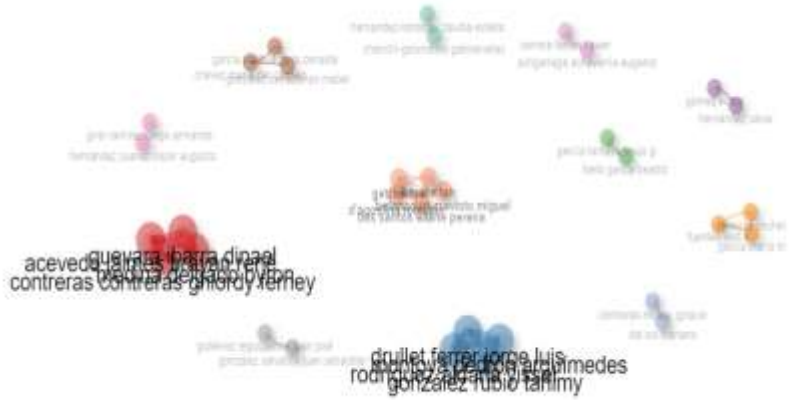


Source: Brandwatch, 2024.

3.2.2. Social structure

Figure 11 is based on the collaboration network or joint signature of publications, in this case between authors. It shows that there is very little collaboration between them, forming small collaborative subgroups, which does not favour research either.

Figure 11. Collaboration network.

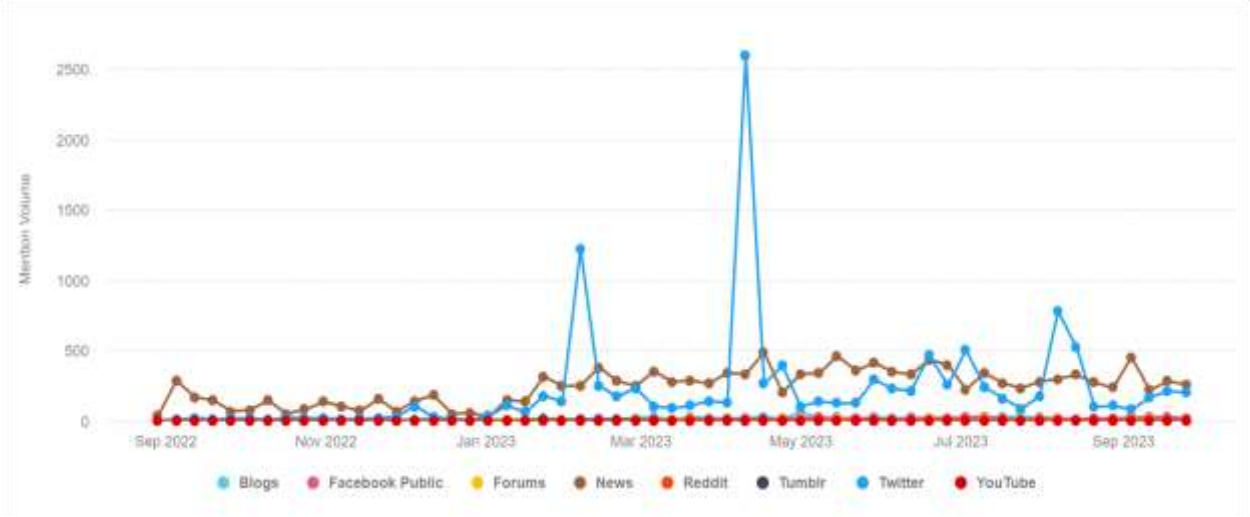


Source: Brandwatch, 2024.

3.3. Results obtained from the Brandwatch social listening software.

In order to carry out this part of the research, 13,107 authors were analysed and analysed a total of 27,735 mentions. With regard to the sources of content, Figure 12 shows the total number of mentions from September 22 to 23, showing that the highest volume of content (interactions) occurred in the month of May on the Twitter network, which can be justified because on 25 May 2023, UNESCO mobilised Ministers of Education from around the world for a coordinated response to ChatGPT, in response to the rapid emergence of powerful new generative AI tools to explore the immediate and far-reaching opportunities, challenges and risks that AI applications pose to education systems.

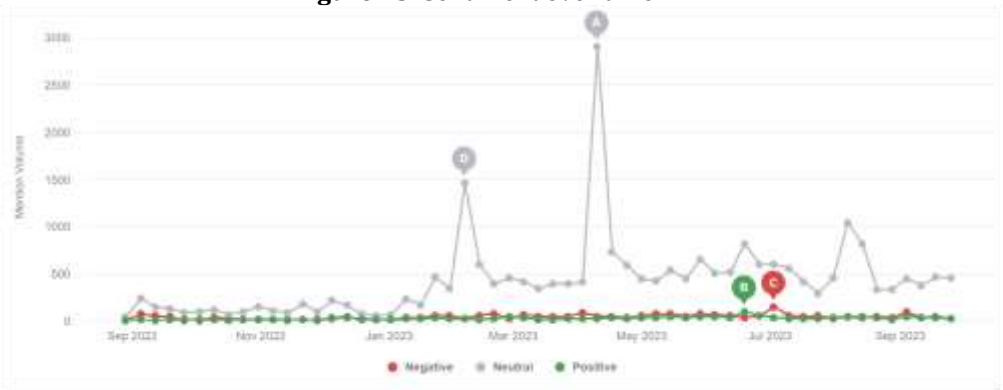
Figure 12. Sources of content.



Source: Brandwatch, 2024.

As for the sentiment generated by the EAI in society, understood as the total number of mentions over time broken down by sentiment, figure 13 shows how there are many oscillations at certain times of the year, but a neutral tone predominates in most of the mentions, with neither positive nor negative sentiments standing out in any of them, perhaps due to the fact that society has not tried AI and cannot evaluate it.

Figure 13. Sentiment over time.



Source: Brandwatch, 2024.

The topic wheel, in Figure 14, analyses frequently used words and phrases, making it easy to see how the main topics (the inner ring) are related to the subtopics (the outer ring), highlighting how AI is related in mentions of students, teachers and Chat, and something similar happens to Chat GOT, which is related to university.

Figure 14. Roundtable

Source: Brandwatch, 2024.

Figure 15 shows the word cloud of words, phrases and entities commonly found in the mentions of the selected time period, highlighting tools, technology, data, information and people, among others, none coinciding with the word cloud derived from the scientific studies.

Figure 15. Word cloud.

Source: Brandwatch, 2024.

In terms of words and phrases that are commonly found in the mentions of the selected time period, delineated according to whether they are trending or losing importance are shown in Figure 16, where we can see how all of them are in the trending topic zone, i.e. EAI is trending in the networks.

Figure 16. Trend of issues.

Source: Brandwatch, 2024.

4. Discussion and conclusions

Incorporating AI in university studies generates a wide debate among teachers-researchers, students and society in general.

Thus, at the scientific level, authors have approached this topic from different perspectives, discussing both the opportunities offered by AI and the ethical and social concerns associated with its implementation. The use of AI should be treated as a method of teaching innovation that can generate benefits for university students, derived in many cases from the personalised approach that enables highly personalised learning for the student, but it is also necessary to bear in mind the shortcomings, including how to control the misuse of AI.

However, few authors are researching on EIA in these aspects, since, in the last five years, scientific production has been scarce and has basically focused on the use and development of EIA in certain degrees related to medicine, electronics or linguistics, but not on how to apply this intelligence and its tools in new teaching methods.

It should also be noted that most of this scientific production is concentrated in Latin American countries and that in Europe there has been practically no research on AI and its use in education, with the authors having little relation to each other in terms of their work.

The concepts most studied by scientists are grouped into three clusters, where terms such as AI, outcomes, or learners stand out, but the tools that AI allows to handle are not studied, which also means that these published studies usually remain mere descriptions of the use of AI in certain learning.

On the contrary, social listening gives primacy to the tools, leaving aside concepts such as results or performance, which are not discussed in networks, nor their application in certain sectors, giving importance to how a tool such as Chat GPT should be used.

Feelings are neutral, which also indicates that there is still a long way to go on a scientific level to allow society to give its opinion in networks and to arouse emotions and feelings.

The study has several limitations, the main one being that it was carried out at a time when the use of some of the AI tools in specific fields of the university was beginning to be discussed, such as the development of the so-called Final Degree Projects or even in the performance of tests and exams, which began to generate a debate on the need to change teaching methodologies once again. Possibly in the near future, the lines of research derived from the EAI will focus on this, ignoring the misuse that students can make and the excessive control to be carried out by teachers so that this does not occur.

On the other hand, a quantitative analysis has not been carried out, but rather a bibliometric analysis referring to the WOS database and another analysis based on social listening, but despite these limitations, this study will allow a debate on EAI and, above all, how it is necessary for scientific studies to advance in terms of AI tools applicable to university studies so that society can also have a say in it.

In short, the balance is going to point to more benefits in terms of the use of EAI than disadvantages, but scientific studies are needed to prove it so that the entire university community starts to use AI tools on a regular basis in teaching processes, just as has happened years ago with other types of technological advances, which have then become true allies of teachers, such as m-learning, which knew how to take advantage of Internet content through mobile electronic devices and has incorporated them as a new educational strategy.

5. Links

https://bit.ly/4cKObqc
https://bit.ly/4cLoqWQ

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