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Do the scientific community and society agree on the use of Artificial Intelligence in education?

¿Coinciden la comunidad científica y la sociedad sobre el uso de la Inteligencia Artificial en educación?

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ABSTRACT

The main objective of this research is to explore and understand the development and implementation of AI in the context of higher education at a scientific and social level, using a systematic methodology of reviewing scientific papers from the Web Of Science (WOS) database for the scientific part and a social listening analysis for the social field. The bibliometric study, through the Rstudio Cloud application, allows us to extract a meta-analysis on the topic of IA in higher education, from 2019 to the present, achieving an evaluation of 32 articles according to the guidelines of the PRISMA declaration.

For its part, the Brandwatch platform allows us to find out what is being said online about the use of AI in higher education, studying a total of 27,735 mentions, only from the last year.

By comparing the scientific and social results, conclusions are drawn on the current challenges of AI in universities, highlighting the need for researchers to start analysing the impact of the good use of AI tools as a teaching methodology, so that society can also highlight it in its mentions on the networks.

RESUMEN

El objetivo principal de esta investigación es explorar y comprender el desarrollo y la implementación de la Inteligencia Artificial (IA) en el contexto de la educación universitaria a nivel científico y a nivel social. Se va a usar una metodología sistemática de revisión de documentos científicos a partir de la base de datos Web Of Science (WOS), para la parte científica y un análisis de social listening para el ámbito social. El estudio bibliométrico, a través de la aplicación Rstudio Cloud, permite extraer un metaanálisis sobre el topic IA en educación superior, desde el año 2019 hasta la actualidad, consiguiendo, según directrices de la declaración PRISMA, una valoración de 32 artículos.

Por su parte, la plataforma Brandwatch permite conocer lo que se habla en la red sobre el uso de IA en la educación superior, estudiando un total de 27.735 menciones, solo del último año. Comparando los resultados científicos y sociales, se alcanzan conclusiones sobre los desafíos actuales de la IA en la universidad, destacando que es necesario que los investigadores empiecen a analizar los efectos del buen uso de las herramientas de la IA como metodología docente, de forma que la sociedad pueda destacarlo también en sus menciones en redes.

KEYWORDS · PALABRAS CLAVES

Inteligencia artificial; educación superior; cienciometría; menciones; escucha social
Artificial intelligence; higher education; scientometrics; mentions; social listening

1. Introduction

The use of Artificial Intelligence (AI) has been increasing in recent years, making a name for itself in various fields such as medicine, finance, law, law enforcement, business, and industry and entertainment (Salas-Pilco & Yang, 2022); therefore, the IoT (Internet of Things) is a thing or a collective network of connected devices that facilitate communication between connected devices, devices and the cloud, as well as between the devices themselves) will continue to grow in the coming years to reach 66 billion units in 2026, with 87% of the total number of units in the next few years to reach 66 billion units in 2026. Users state that, once they have tried such devices, they will no longer give up their benefits, according to the second edition of the Things Matter 2019 Report, produced by Telefónica.

The technological evolution of the last few years has had a positive and/or negative impact on societies around the world so that people's *modus vivendi* are affected. Health, the economy, and, obviously, in education and training (Alonso-de-Castro & García-Peñalvo, 2022). This means that AI has become a synonym for new promises, but it is also necessary to take into account the risks that come with the massification of digital technologies in the different spheres of economic and social life and social problems of the 21st century, as there is a perception that it will put jobs at risk of those who do not adapt to this new technological revolution.

Many studies attempt to gauge the pace and depth of the changes that are taking place as many industries are automating processes thanks to new technologies and new innovations. Machines are available and prototypes of inventions are tested that until recently seemed to be science fiction (Kaku, 2012). In the face of all these developments, we wonder how AI will impact education, which is considered a fundamental pillar for society's progress and individuals' development. In an increasingly digitised and globalised world, AI has become an increasingly important tool and essential tool for enhancing and personalising the educational experience, understanding the ability of machines to learn, reason, and autonomously make decisions, and its application in education is constantly growing and adapting (Halili, 2019).

Artificial intelligence (AI) is playing an increasingly important role in the field and the educational environment is affected by all the changes it generates, ranging from preschool stages to higher or post-graduate levels (Moreno & Pedreño, 2020), as their application has the potential to transform how we teach and learn.

Here are some of the ways in which AI is being used in education:

1. Personalisation of learning. AI can adapt the content and pace of learning to each learner's individual needs. This means that students can receive specific instruction and exercises according to their level of proficiency, learning ability, and learning style, which can increase the effectiveness of learning.
2. Virtual tutoring. AI systems can act as virtual tutors, providing instant feedback to students as they work on problems or tasks. This can help learners to understand the concepts and correct errors better immediately.
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, to identify trends in learning and to make informed decisions about teaching.

4. Automation of administrative tasks. AI helps automate tasks administrative tasks, such as grade management, class scheduling, and communication with students and parents. This allows educators to focus more on individualised teaching and support.
5. Adaptive learning. AI systems help to adjust the content and the learning activities according to the progress of each student. This can ensure that students are constantly challenged and engaged.
6. Evaluation of open-ended responses. AI allows for the evaluation of open-ended responses, such as tests and answers to developmental questions, using algorithms of natural language processing. This can save educators time in correction and provide more objective feedback.
7. Access to online educational resources. AI helps students find online learning resources that are tailored to their specific needs, recommending relevant courses, tutorials and study material.

In conclusion, we can affirm that specifically in education, the artificial intelligence education refers to its use in support of feedback and guidance and automated systems in the field of education (Song & Wang (2020). In this scenario, the teacher has to be the protagonist in the classroom, analysing the information provided by the AI, and guiding and articulating the work of the students. The challenge relates more to the capacities of teachers to carry out these tasks, as relatively few have the necessary skills to perform these tasks to process the sheer volume of individual information that the new systems provide, and/or to translate it into the personalised responses they are supposed to provide (Lu& Harris, 2018).

In addition, 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 in 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 needs to be carefully considered and monitored to ensure that it benefits all stakeholders and students fairly and effectively.

Based on the above, this study aims, on the one hand, to conduct an empirical analysis of the evidence found within the scientific literature on the use of AI in education and, on the other hand, a social listening analysis for the use of AI in education to see whether scientists and society are moving in the same direction. There are some previous systematic reviews on AI in education (Martinez-Comesaña et al., 2023; Jimbo-Santana et al., 2023; Fajardo Aguilar, 2023), although they are very limited in comparison to AI research, but there are no studies that have been conducted that compare the opinion that emerges from (scientific) systematic reviews with the social listening (society).

For Zawacki-Richter et al (2019) there is a lack of critical reflection on the challenges and risks of AI in education in the majority of scientific articles and a weak connection

between AI and education with theoretical pedagogical perspectives, so the need arises to follow up on the exploring ethical and educational approaches in the application of their use in higher education; Along the same lines, Hinojo-Lucena et al. (2019), after carrying out a bibliometric study stressed that more empirical, research-based results are needed in order to understand the potential of AI in higher education.

In summary, this study attempts to address the following research questions:

- How do you approach the use of artificial intelligence for university education?
- Do scientists and society agree in their assessments and has there been the same growth as in the past in both communities?

2. Methodology

For scientometrics or bibliometrics, this study follows the guidelines of the Declaration of the European Parliament and the Council of Europe, PRISMA, which consists of the use of search engines to search 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). The five-step framework of Arksey and O'Malley (2005) for mapping the scientific literature, consists of: a) identification of the research question; b) systematised search for scientific evidence; c) selection of the most appropriate (d) data extraction; and (e) data collection, summarisation and dissemination of results.

The study focuses on the 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 a complete bibliometric analysis to be performed, following the flow of scientific mapping work (Aria & Cuccurullo, 2017). The articles obtained were selected based on a Boolean search generalist "Artificial Intelligence AND university studies", following these criteria of exclusion:

- 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 the number of projects evaluated following PRISMA has been reduced to 32, either because they are 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 of to understand users' perceptions of a given topic or issue (Herrera et al., 2022), as it works not only with one's own perception but also with any other perception (Herrera et al., 2022) anchor point to be established between the user and the subject under study, based on primarily in the use of technology and algorithms that track and compile automatically gather data from various online sources: social networks, blogs, forums, news, etc. and other types of websites. Once the data is collected, it is then analysed in order to identify patterns,

tendencies and feelings, applying techniques such as processing natural language (NLP) and text analysis (Cambria, 2016).

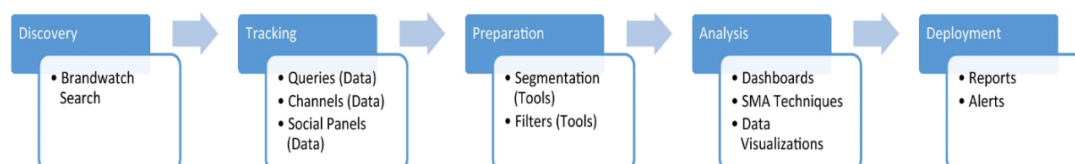
In general, the social media analysis process is usually divided into four phases: (Stieglitz et al. 2018):

- Discovery: identification of content and 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: preparing the data for further analysis.
- Analysis: application of various analysis methods and techniques to the data set prepared to answer the questions posed in the discovery phase.

In this research, as shown in Figure 1, the same steps will be followed as proposed by Stieglitz, adding one more, which refers to the implementation of the need for effective communication of the results of the project, including the need of 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



Brandwatch Search, a search engine, is used for the discovery stage based on artificial intelligence, which uses sophisticated computer processing techniques to process natural language. 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 used to retrieve information from the platform's systems. For this purpose, Boolean operators have been used to combine the concepts and refine the results to be achieved, as shown below:

```

1 <<<Ampliar este grupo de términos de búsqueda con maneras alternativas de
referirse a la inteligencia artificial, por ejemplo: "aprendizaje automatico",
"machine learning", "modelo de lenguaje", etc>>>
2 ((( "inteligencia artificial" OR {AI} OR {IA} OR "inteligencia artificial" OR
chatGPT 0 "chat GPT" 0 openAI 0 "open AI" 0 "aprendizaje de maquina" 0
"aprendizaje automático" )
3
4 CERCA/20
5 <<<Ampliar este grupo de términos de búsqueda con palabras alternativas para
se refiere a los estudios universitarios, por ejemplo "enseñanza superior",
carrera, facultad, etc>>>
6 (universidad OR universitari * OR "estudios superiores" OR "educacion superior" OR
(estudi * NEAR/5 grado * ) 0 posgrado * 0 posgrado * 0 maestria * 0 maestría
doctorado * OR doctoral * OR "rendimiento academico" OR "innovacion docente" OR
docente))

```

This query returns 2,150 mentions on the day of the survey alone in the last 30 days, having filtered by language (Spanish) but searching in anywhere in the world. Therefore, tools are needed to segment and filter this information, among others, a test preview to instantly assess the kind of mentions that are retrieved from the current consultation logic, favouring the intended social analysis; in this search, it has been decided to remove websites that mentioned the terms consulted, 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 used to analyse whether the evolution of the content object of study follows a certain pattern.

In the last two stages, the results are analysed and implemented through the use of so-called dashboards which monitor and examine visually the key indicators.

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

3. Analysis and results

3.1. Statistical results of Bibliometrix for R Studio Cloud

Following the bibliometric study carried out with the R Studio Cloud programme, we proceed to analyse the results obtained at the scientific level in order to be able to respond to the questions of research.

3.1.1. Dataset

Figure 2 shows the annual scientific production and highlights the high interest the scientific awakening of AI in education in the years 21 and 22 there appears to be a decline in the scientific literature on this subject, we will have to wait for the end of the year in order to have real data on the publications produced.

Figure 2

Annual scientific production

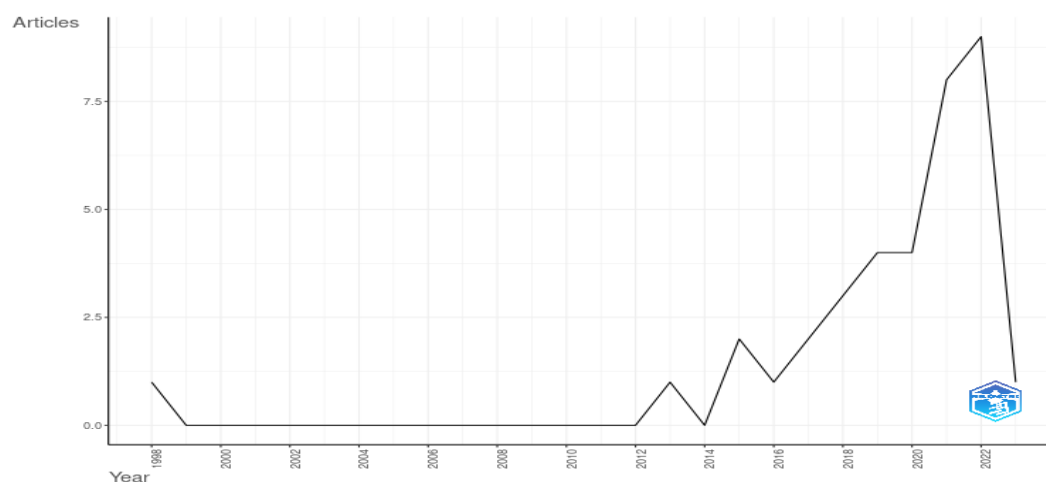
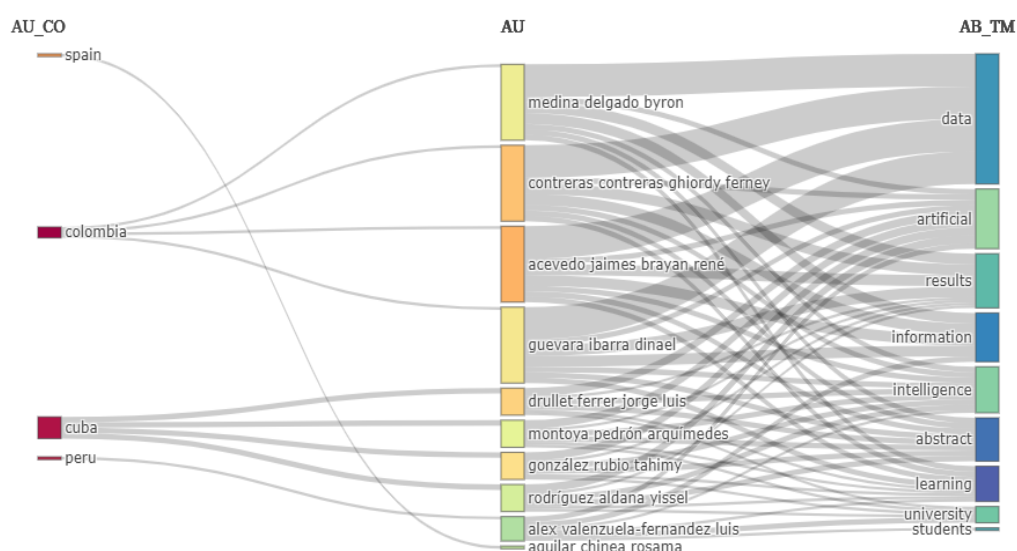


Figure 3 shows the so-called three-field graph (Sankey diagram), in this case, country, author and abstract and their interactions with each other. The graph highlights visually the main transfers between countries, actors and concepts which have in the summaries. The width of the arrows in the chart is proportional to the amount of flow.

Figure 3

Sankey diagram



It can be seen that Colombia and Cuba are the countries where there is the highest production of scientific use of terms related in the abstracts themselves to AI concepts, such as data, artificial, intelligence, or learning and are the countries that bring together the

leading researchers, although in Spain and Peru, there are also some researchers in this field type of issues.

3.1.2. Sources

Concerning the dispersion of scientific literature, Bradford's Law confirms that if scientific journals are ordered in a decreasing sequence of productivity from articles on a specific field, these can be divided into a core of journals that The Bradford core area (Bradfordcore-zone 1) and various clusters or zones (zones 2 and 3) containing approximately the same number of items as the kernel, where the number of journals in the core and successive zones is in a ratio relationship of 1: n: n², as shown in Table 1.

Table 1

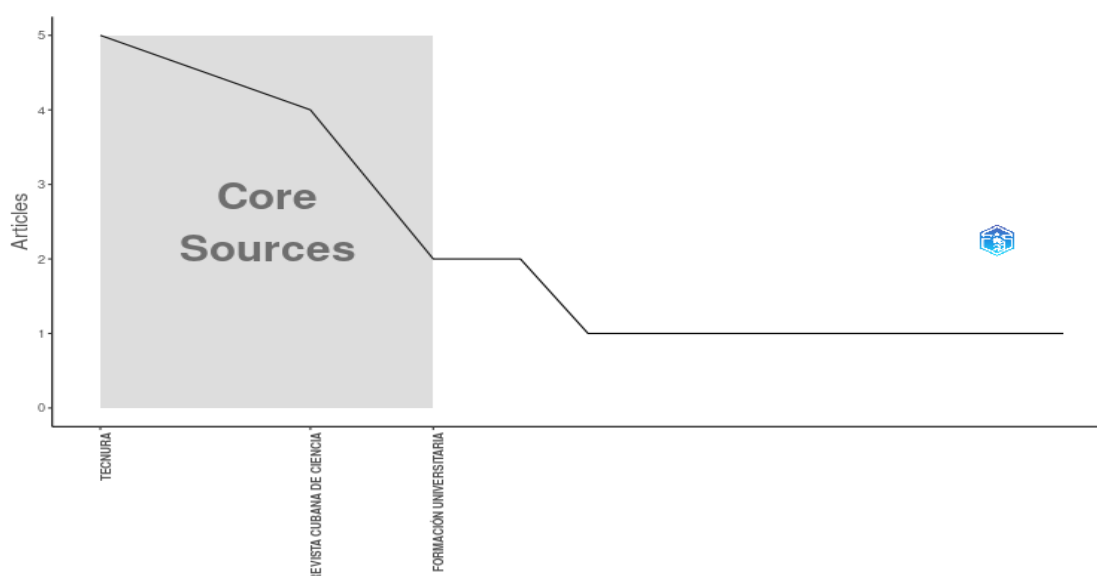
Bradford Core

MAGAZINE	Ranking	Freq	Freq Acum	Zone
Tecnura	1	5	5	Zone 1
Revista cubana de ciencias informáticas	2	4	9	Zone 1
Formación universitaria	3	2	11	Zone 1
Revista universidad y sociedad	4	2	13	Zone 2
Academio (asunción)	5	1	14	Zone 2
Actualidades investigativas en educación	6	1	15	Zone 2
Diseases of the colon & rectum	7	1	16	Zone 2
Educación	8	1	17	Zone 2
Fem: revista de la fundación educación médica	9	1	18	Zone 2
Horizontes revista de investigación en ciencias de la educación	10	1	19	Zone 2
Información tecnológica	11	1	20	Zone 2
Ingeniería electrónica, automática y comunicaciones	12	1	21	Zone 2
Ingeniería industrial	13	1	22	Zone 2
Ingeniería y desarrollo	14	1	23	Zone 2
Inter disciplina	15	1	24	Zone 3
International Journal of Morphology	16	1	25	Zone 3
Propósitos y representaciones	17	1	26	Zone 3
Revista científica	18	1	27	Zone 3
Revista cubana de educación superior	19	1	28	Zone 3
Revista cubana de informática médica	20	1	29	Zone 3
Revista digital de investigación en docencia universitaria	21	1	30	Zone 3
Revista iberoamericana de tecnología en educación y educación en tecnología	22	1	31	Zone 3
Revista panamericana de salud pública	23	1	32	Zone 3
Revista peruana de ginecología y obstetricia	24	1	33	Zone 3

According to this law (Figure 4), it is observed that such a dispersion does not exist, since almost all of the publication frequency is grouped into three journals (those of the Bradford core): Tecnura, Revista Cubana de Ciencia, and Revista de Formación Universitaria, all Latin American. This shows that scientific production on AI has its origins in South America.

Figure 4

Bradford's Law



3.1.3. Authors

Figure 5 demonstrates that scientific production basically starts at the beginning of 2019, but it has only one author: Alex Valenzuela-Fernandez, the one who accounts for most of this annual production.

As far as personal productivity is concerned, Lotka's law is not verified in this case (Fig. (6), which states that a small number of authors publish a significant amount of documents, i.e. it states a quantitative relationship between the authors and the documents, and contributions produced in a given field over a given period of time, since in a given field the in this case, there are many authors (a total of 102 authors) who only sign two articles, scientific productivity is therefore low.

Figure 5

Scientific production of the authors in recent years

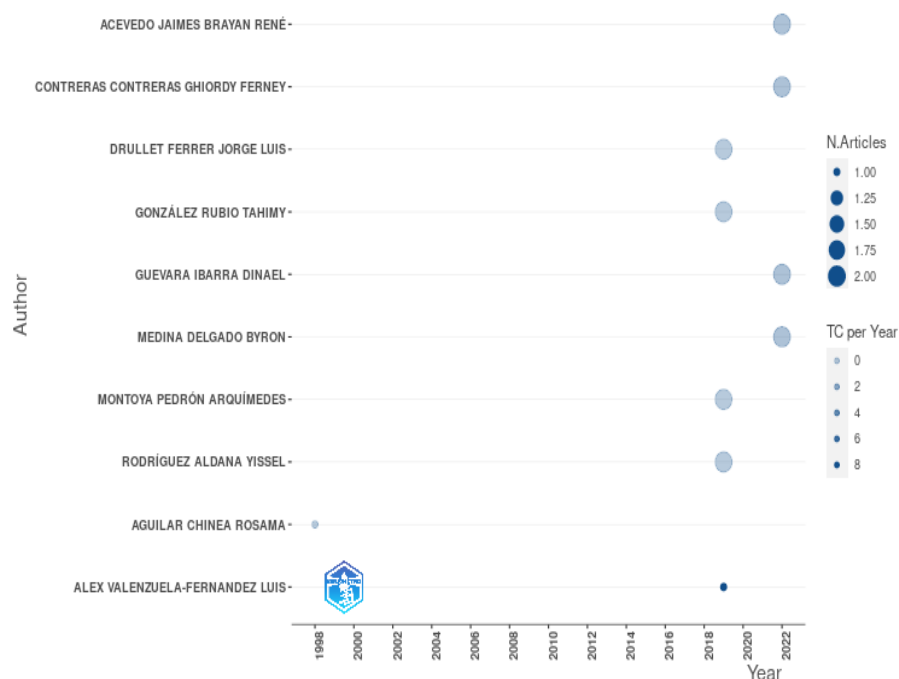
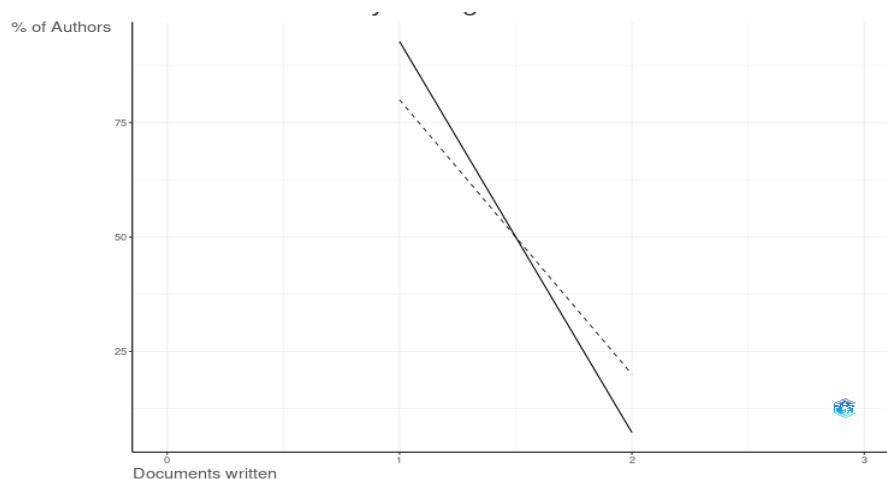


Figura 6

Lotka's Law

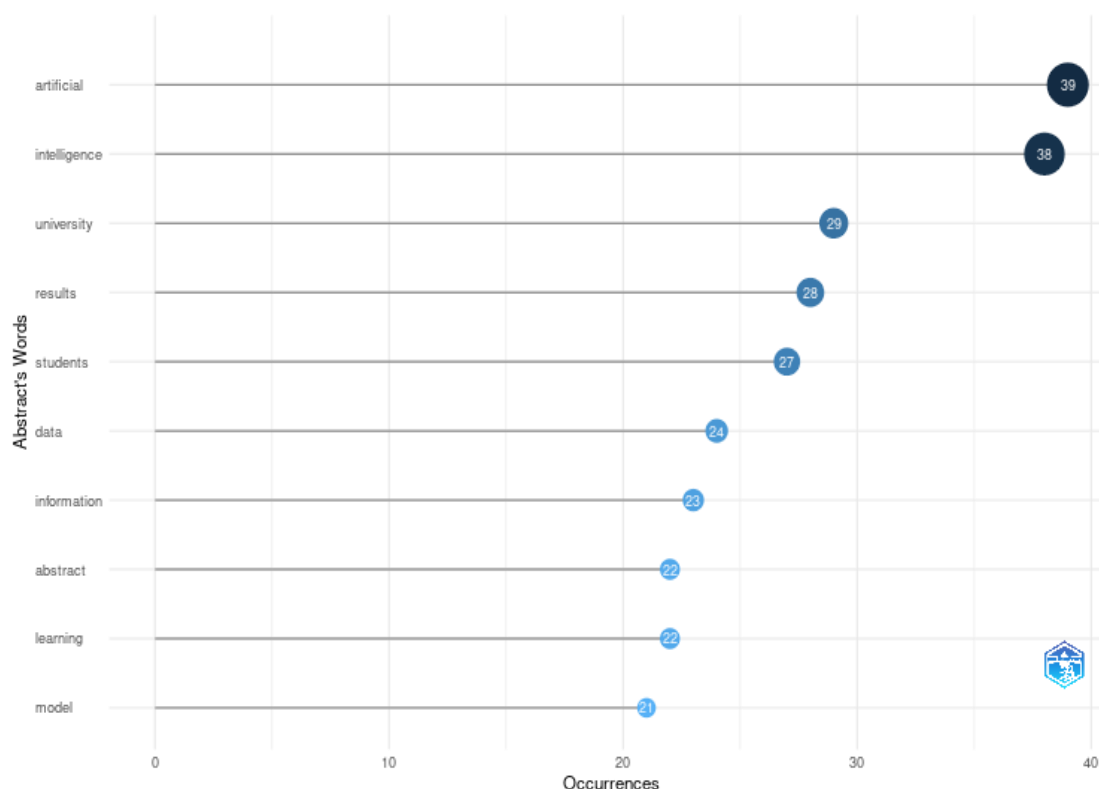


3.1.4. Documents

In the analysis concerning documents, figure 7 shows the most frequent words used by the authors in this case in the abstracts, with artificial and intelligence being the most important most commonly used, along with university, results and students, although in a smaller proportion lower.

Figure 7

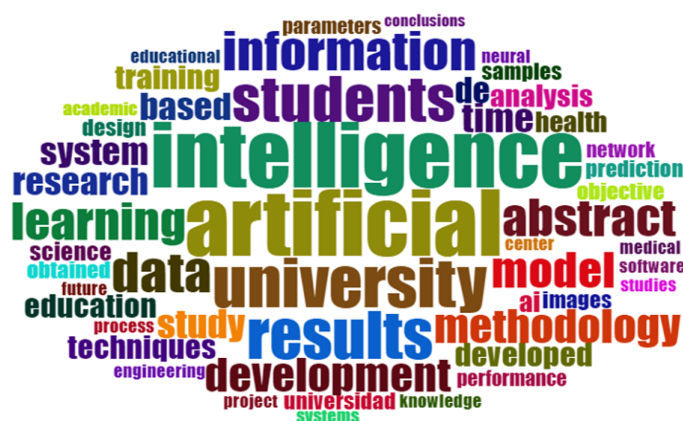
Most relevant terms



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

Figure 8

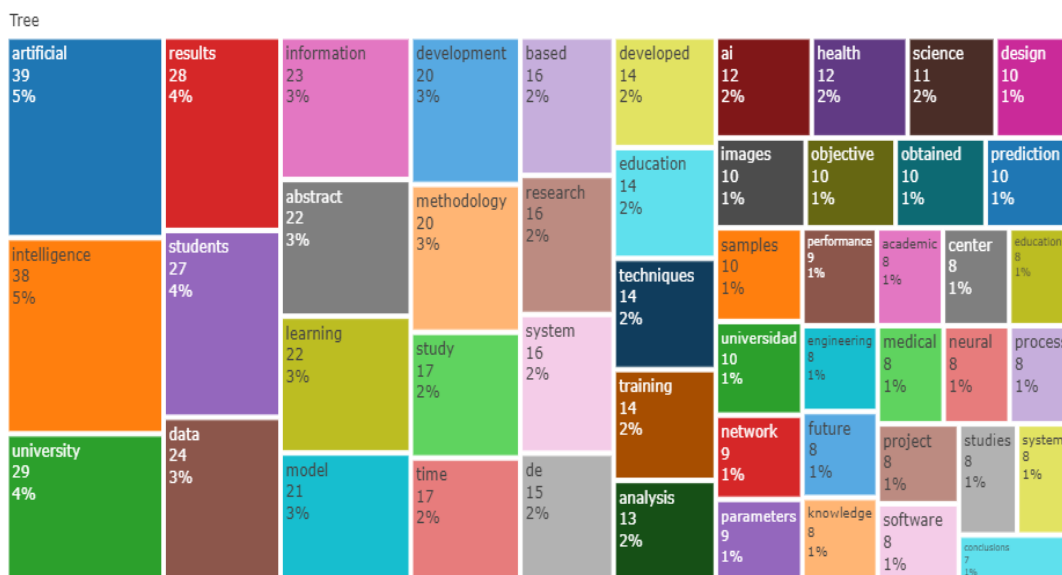
Word cloud



In the word cloud, "artificial" (39 times), "intelligence" (38 times) stand out, "University" (29 times) and others such as "results" or "students" are also important, although they have fewer repetitions. It is relevant to note that the three most common words are the variables investigated in this study.

Figure 9

Treemap



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; two words co-occur when they appear simultaneously in the same document, and when two words co-occur when they appear simultaneously in the same document, words will be more closely linked or associated with each other the greater the co-occurrence between the words.

Therefore, the size of the link between two words in a network will be proportional to the co-occurrence of these two words in the set of documents to be taken as the basis for the sample. In this case, three co-occurrence groups emerge, which are represented by three different colours in three clusters.

Cooccurrence of words

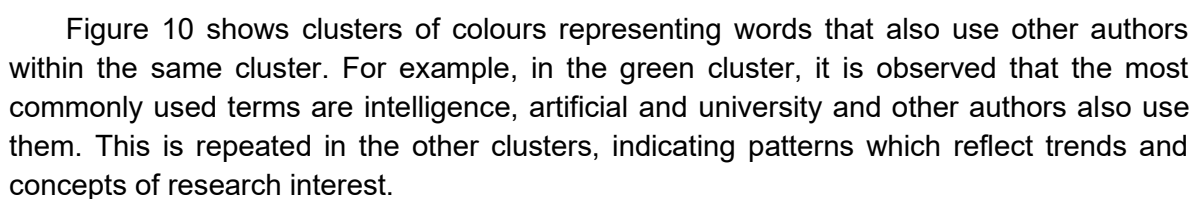


Figure 11 is based on the collaborative network or co-signing of publications, in this case between authors. It shows that there is very little collaboration between them. The fact that they form small collaborative sub-groups is not conducive to research either.

Collaboration network



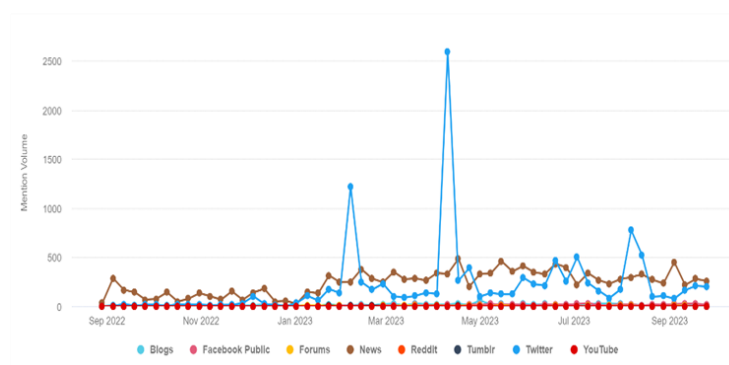
3.3. Results obtained from the Brandwatch social listening software

In order to carry out this part of the research, 13,107 authors were analysed and one total of 27,735 mentions in networks.

As for 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) in May on the Twitter network, which can be justified by the because on 25 May 2023, UNESCO mobilised Ministers of Education from all over the world for a coordinated response to ChatGPT, in response to the rapid emergence of powerful new generative AI tools to explore the opportunities, immediate and far-reaching challenges and risks that AI applications pose to the education systems.

Figura 12

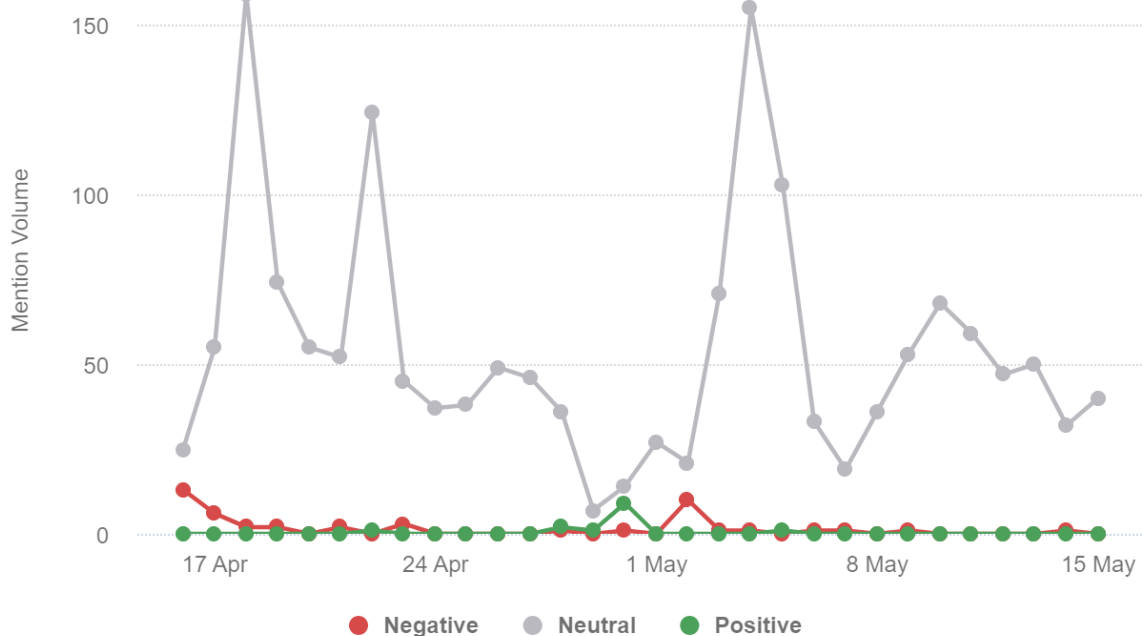
Sources of content



In terms of the sentiment that AI generates in society, understood as the number of total mentions over time broken down by sentiment, figure 13 shows how there are many oscillations at certain times of the year, but the tone is predominantly neutral in most of the mentions, not standing out in any of them, nor did it have any strong feelings of positive or negative, perhaps because society has not tested AI and cannot value.

Figure 13

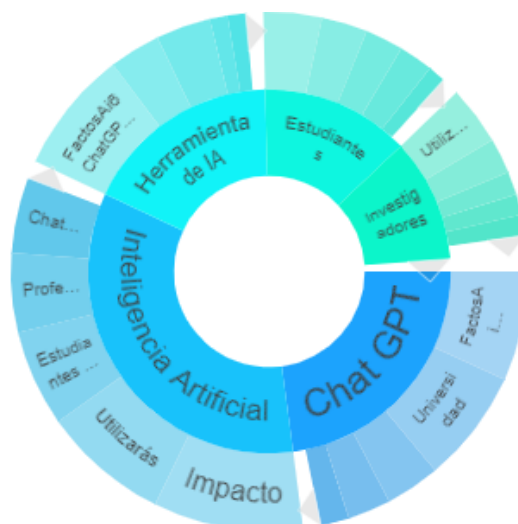
Sentiment over time



The topic wheel, in Figure 14, analyses frequently used words and phrases in networks, allowing one to easily see how the main themes (the inner ring) are related to the sub-themes (the outer ring), highlighting how the AI relates to the sub-themes (the outer ring), and highlighting how the AI relates in mentions made with students, teachers and Chat Gpt, and something similar happens to Chat Gpt which is related to university. In any case, terms do not arise studied by the scientific community as AI and Chat GPT tools, and therefore it is noted that the concern in networks and in the scientific community about the use of AI in education goes in different directions.

Figure 14

Topic Roundtable



Word cloud



Figure 16

IA generativa #ucab
 Universidad de Pensilvania
 #inteligenciaartificial
 Estados Unidos
 estudiantes de la Universidad Regiomontana
 ChatGPT es increíble
 herramientas de IA
 investigadores de la Universidad
 herramientas de inteligencia artificial #colmexparati
 educación superior
 Universidad de Stanford
 docencia universitaria
 tecnología de IA
 #inteligenciaartificialumu

4. Discussion and Conclusions

The incorporation of AI in university studies generates a broad debate between teachers-researchers, students and society in general.

Thus, it has been found that at the scientific level, authors have addressed this issue from different perspectives, discussing both the opportunities offered by AI and the challenges it offers 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 students and teachers. Students, in many cases, stem from the personalised approach that allows for highly personalised learning for the learner, but it is also necessary to have.

The Commission has identified some shortcomings, including how to control misuse, however, few authors are researching AI in these areas. Scientific production over the last five years has been low and the number of scientific papers produced has been the main focus on the use and development of the same in certain areas of degrees related to medicine, electronics or linguistics, but not in how they apply this intelligence and its tools in new teaching methods.

It is also worth noting that most of this scientific output is concentrated in Latin American countries and that there has been virtually no research in Europe on AI and its use in education, with the authors bearing 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 students are highlighted, but no study is done on the tools that allow AI to be managed, which also means that these published studies usually remain mere descriptions of the use of AI in certain learning situations.

On the contrary, social listening gives primacy to the tools, leaving aside concepts such as results or yields, which are not talked about in networks, nor about its application in certain sectors, giving importance to how it should be used in a tool such as GPT Chat. Feelings are neutral, which also indicates that there is still a long way to go scientifically so that society can give its opinion in networks and awaken emotions and feelings.

The study has several limitations, the main one being that it was carried out on dates when

there was beginning to be talk of the use of some of the AI tools in specific fields of the university, such as the development of the so-called Final Degree Projects, or including in the conduct of tests and examinations, which started to generate a debate on the need to change teaching methodologies again. Possibly in the near future, lines of research stemming from the IAC will focus on this, ignoring the misuse that can be made by students and the excessive control to be performed by teachers to ensure that this does not happen.

On the other hand, we have not carried out a quantitative analysis, but a bibliometric analysis.

The WOS database and another analysis based on social listening, but despite these limitations, this study will allow a discussion on the EAI and, above all, how it is scientific studies need to advance in terms of AI tools applicable to university studies so that society can also have a say on it.

In short, the balance is going to point to more benefits in terms of AI use than disadvantages, but scientific studies are needed to demonstrate this for the whole of the university community to start using AI tools regularly in their academic teaching processes,

as has been the case years ago with other types of progress technology, which has subsequently become true allies of teachers, such as the m-learning, which was able to take advantage of Internet content through devices mobile electronic devices and has incorporated them as a new educational strategy.

Recent research suggests that AI will be the breakthrough in education and training, the teaching-learning process, as well as the driving force behind what is now being called the "learning process".

Education 4.0 (Fidalgo-Blanco et al., 2022; Ramírez-Montoya et al., 2022). Will this be the case and will we be able to talk about Education 4.0 in a few years?

Author's Contribution

Conceptualisation: S.M.-G. and A.B.-M.; Data curation: S.M.-G.; Formal analysis: S.M.-G.; Research: A.B.-M.; Methodology: S.M.-G.; Project management: A.B.-M.; Resources: A.B.-M.; Software: S.M.-G. and A.B.-M.; supervision: S.M.-G. and A.B.-M.; validation: S.M.-G.; visualisation: A.B.-M.; editing - original draft: S.M.-M.G.; proofreading and editing: S.M.-G. and A.B.-M.

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