A Bibliometric Analysis of Generative Artificial intelligence Chatbots in Higher Education: A case study of African countries collaborating with developing nations

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ABSTRACT

The emerging generative artificial intelligence (AI) chatbots, such as Chat Generative Pre-Trained Transformer (ChatGPT), have recently taken different disciplines by surprise. Very few scholarly papers show the collaborative effort by researchers on the impact of generative AI in higher education (HE) and its implication on HE disciplines and activities. This paper uses citation network analysis by deep searching the different research articles using Scopus databases. A bibliographic analysis tool is used to reveal patterns of application of generative AI chatbots in HE, collaboration of generative AI research, and generative AI in HE among different countries of the world. Furthermore, it investigates the thematic topics that generative AI in HE researchers are studying. Research papers from Scopus databases were sampled. The sampling timeframe is from January 2022 to September 2023. This paper presents the preliminary findings of the work that was conducted for a doctoral thesis in computer science and information technology. The preliminary findings show that Spain, the United States of America (USA), and Australia are countries that collaborate more often on the development of generative AI chatbots. In the study, generative AI chatbots were most likely to cover plagiarism and essay inclusion, but very few covered research for postgraduate enterprises. The study concludes that Chatbots are an important part of teaching technology that should be embraced by higher education.

Keywords: *generative AI; educational chatbots; Education 4.0; bibliometric analysis*

INTRODUCTION

Artificial intelligence (AI) chatbots like Chat Generative Pre-Trained Transformer (ChatGPT) have recently taken over several websites, apps, and even the mobile phone (Memarian & Doleck, 2023). As it is increasingly used in a variety of industries, such as private companies, government, finance, and education, it promotes innovation and increases productivity (Chapina-Heras & Díaz-Sanchez, 2023). In higher education, AI chatbots such as ChatGPT can have unintended consequences, ethical dilemmas, challenges, and risks (Hurajova et al., 2023). There are indications that the number of jobs and tasks that can be automated with AI may be a replacement option for crucial staff, faculty, and administrative roles (Chapina-Heras & Díaz-Sanchez, 2023).

A chatbot can simulate human communication through text or voice and can be used to answer questions, provide study tools (Southworth et al., 2023), provide feedback, or even provide personalized data analysis, facilitate skill development, and enable personalized coaching sessions. Furthermore, this technology can be used to enhance online learning and teaching, automate routine tasks for instructors, and facilitate adaptive assessment (Menon & Shilpa, 2023). However, the impact of generative AI in HE and its implications on HE disciplines and activities cannot be ignored, and it is important to ask whether African countries are making great efforts to integrate and collaborate to further implement AI in higher education to benefit African students.

In this study, possible collaborative opportunities between African countries and other countries is proposed. The African institutions in HE are examined to see whether they are collaborating in AI

to address the issue of a lack of collaboration between the African continent and the other six continents. The study also examined the challenges faced by the African continent when using AI chatbots like ChatGPT.

Related work

There has been a growing number of scholarly papers on chatbots powered by artificial intelligence (AI) in higher education as a cutting-edge technology (Margaret et al., 2023) There is no doubt that collaboration between African countries and developing nations in education and research is of critical importance. The education sector within Africa has the potential to influence collaboration from African institutions to increase collaboration with developing nations, given that academia is a knowledge-based field for both students and academics and researchers (Haase & Hanel, 2023). For the developing countries to recognize unity in Africa, African countries must develop programs that will expand friendships and increase system flexibility (Amara & Qiao, 2023). As a growing trend in HE, AI is used to improve student learning, research, and experiences (Lampos et al., 2021; Ade-Ibijola & Okonkwo 2023). Chatbots and ChatGPT are challenging to use in HE and come with unintended consequences (Lampos et al., 2021).

Teachers instructing autistic students found that using an artificial intelligence classifier to identify applicable communication strategies was effective. This technology can also be adopted by higher education institutions and added to their programs to encourage collaboration with other countries that do not use it (Ade-Ibijola & Okonkwo 2023). Most chatbots are primarily implemented in developing countries, and African countries are among the last to adopt this technology (Manson et al., 2023). There are some emerging challenges in Africa, such as the lack of necessary infrastructure and resources to adopt artificial intelligence, preventing Africans from adopting these technologies, which may negatively influence African economic development and collaborations (Hurajov et al., 2023). Some chatbots are providing healthcare services to people without them having to see a doctor, proving that artificial intelligence penetrates the world's social system in many ways, and if Africa adopts this technology, there are chances to increase collaborations (Manson et al., 2023).

The literature suggests that HE should take advantage of chatbots as a teaching tool worldwide because they have a lot of benefits, such as reducing human error, reducing risk, and having 24x7 availability of student assistance or support. However, as much as there are benefits, there is also disruption by AI and the risk that students and teachers will become too dependent on AI-driven technologies, according to some educators (Hurajova et al., 2023). AI technologies like chatbots can also be used to enhance student engagement, which increases information retention (Hurajova et al., 2023). Furthermore, using artificial intelligence to generate syllabus-related answers can enhance students' self-esteem and excitement about learning, bring them closer together through collaboration and discussion tools, and enhance society (Ajayia & Laseindeb, 2023). The Fourth Industrial Revolution (4IR), powered by AI, can improve various aspects of socio-economic development all over the world and enhance HE collaboration in Africa. Solaimani & Swaak (2023) specified that it is imperative that policymakers, universities, large corporations, and multi-stakeholders collaborate to accelerate the adoption of artificial intelligence in Africa.

Several aspects of our society and everyday life are being disrupted by AI technologies, which have become a central concern of academic and public discourse (Southworth et al., 2023). As far as AI in HE development and deployment are concerned, there is a huge gap between developed and developing countries (Rafsanjani & Nabizadeh, 2023), a lack of research data from Africa, and the potential impact of AI, which, if not closed, will lead to more inequalities between African and Western students. African universities are therefore responsible for developing national AI

strategies to ensure AI in HE is driving technological change in businesses, economies, education, agriculture, and infrastructure (Adams & Pente, 2023).

Research Design

Step 1: Data Collection:

The first step was to access the Scopus database and export the dataset.

Data was collected using the Scopus database on September 18, 2023, to cover two years of progress in artificial intelligence chatbots in HE. Text mining was conducted by inserting the keyword "artificial intelligence chatbots in higher education" and 2,799 research documents were found with 375 authors cited. The average citation per document was 3.838 (see Figure 2).

A descriptive query string was used for searching: TITLE ('Artificial intelligence chatbots in higher education'). The result were filtered according to year, source, author, affiliation, country or territory, subject areas, and document types. A standard review article, which contained terms such as progress, review, overview, updates, and bibliometrics, was excluded from the latest search string. The authors used Biblioshiny, a C++ software package based on RStudio. They saved the final search string and the list of documents for later use.

Figure 1 below illustrates the five analysis processes proposed by this study in order to achieve the objective.
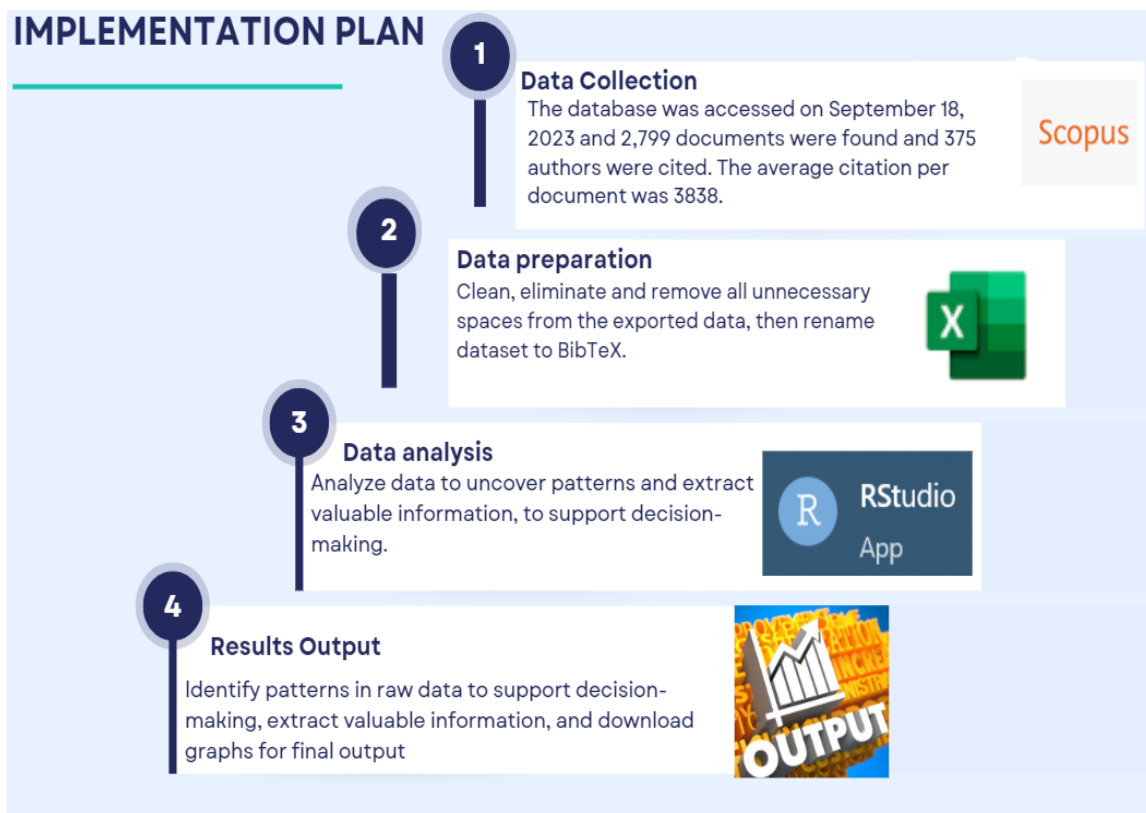

Figure 1: Implementation plan

Step 2: Data Preparation:

To prepare the data, Excel was used to clean, eliminate, and remove all unnecessary spaces from the exported data. The dataset was then renamed to BibTeX.
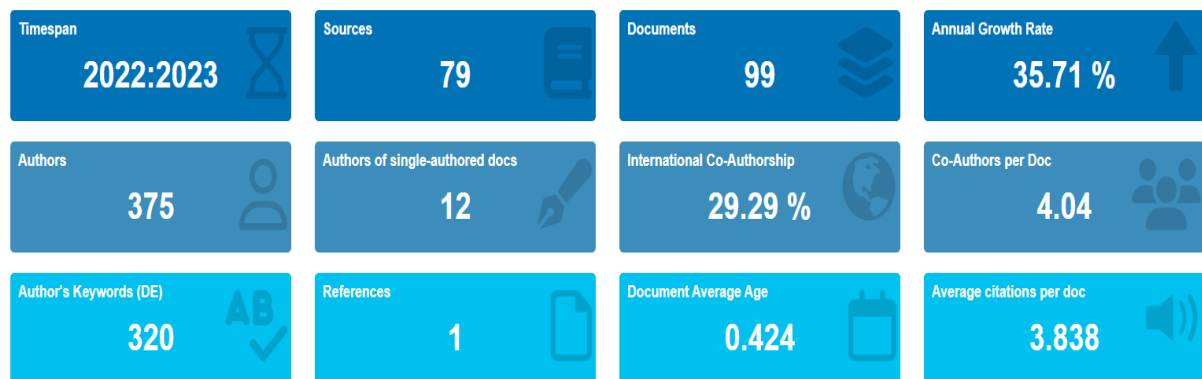
Step 3: Data analysis:

Data were uploaded and analysed in this step, with the goal of uncovering patterns and extracting valuable information as part of the decision-making process.

Step 4: Results Output:

In this step, we identified patterns in raw data to support decision-making, extract valuable information, and download graphs for final output.

Results

In Figure 2 below, 375 authors are cited because of a search query for "'Artificial intelligence chatbots in higher education' that found 35.71% of an annual increase in research articles on AI chatbots in HE between 2022 and 2023. There were 12 authors of single-authored research in the SCOPUS database.

Timespan	Sources	Documents	Annual Growth Rate
2022:2023	79	99	35.71 %

Authors	Authors of single-authored docs	International Co-Authorship	Co-Authors per Doc
375	12	29.29 %	4.04

Author's Keywords (DE)	References	Document Average Age	Average citations per doc
320	1	0.424	3.838

Figure 2: Artificial intelligence chatbots in higher education

Generative AI research collaboration between countries

As shown in Figure 3 below, the USA is the country most cited by AI chatbots in higher education, with over 112 articles, followed by Spain with 42 articles cited. In Africa, Zimbabwe ranked first with 12 articles cited, followed by South Africa, which ranked second with 4 articles cited.
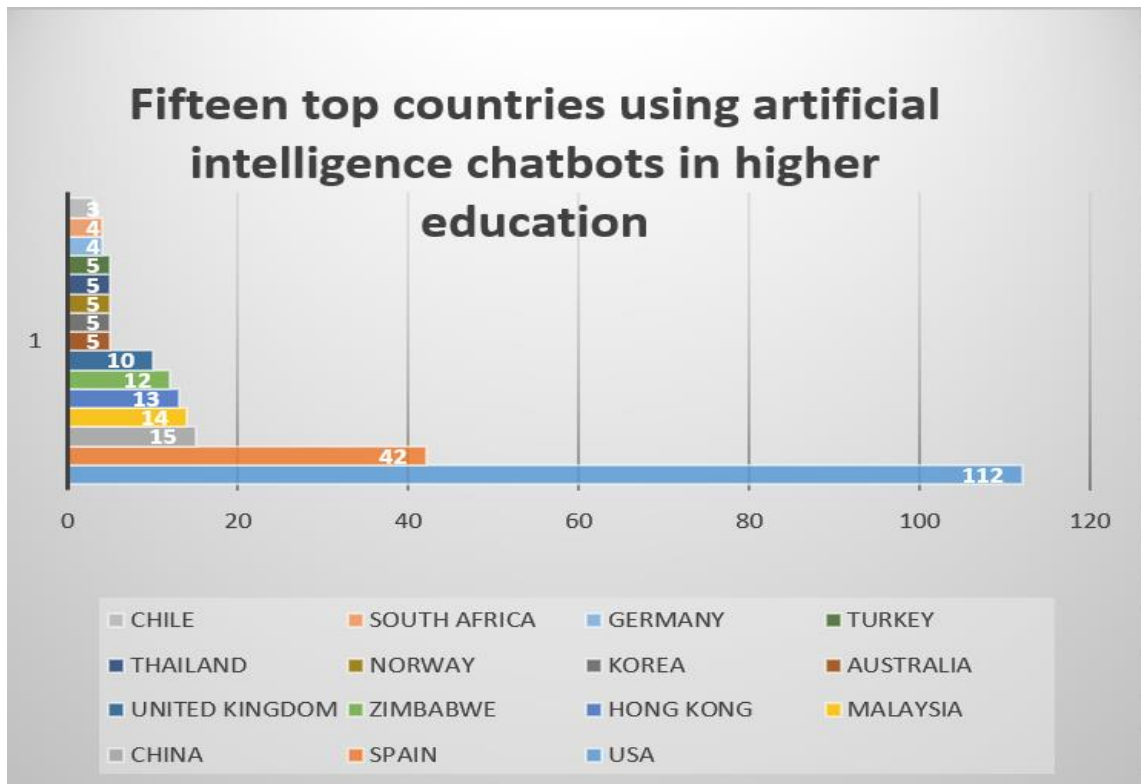
Figure 3: Generative AI research collaboration between countries

As shown in Figure 4 below, the USA is the country most collaborating with other countries on AI chatbots in HE between 2022 and 2023. The following authors were highly cited in the USA: Gill (2023) and Minxian (2023), Zimbabwe has collaborated often with African countries, and the following authors are most frequently cited: Nyagadza (2023) and Zhou (2023).
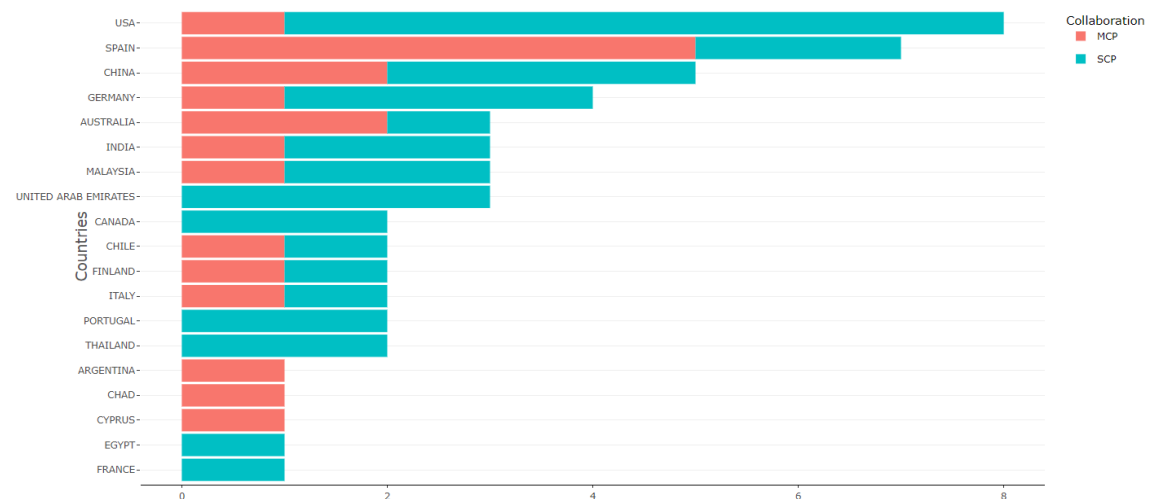

Figure 4: Generative AI research collaboration between countries

As shown in Figure 5 below, Spain is the country most collaborating on research with other countries on AI chatbots in HE, with more than 65% of the collaborations. Between 2022 and 2023, the following authors were highly cited in Spain: Altmäe (2023), Sola-Leyva (2023). Australia was the country with the next highest collaborations at 35%, and the following authors are most frequently cited: Chang (2023) and Jun-Hwa (2023).
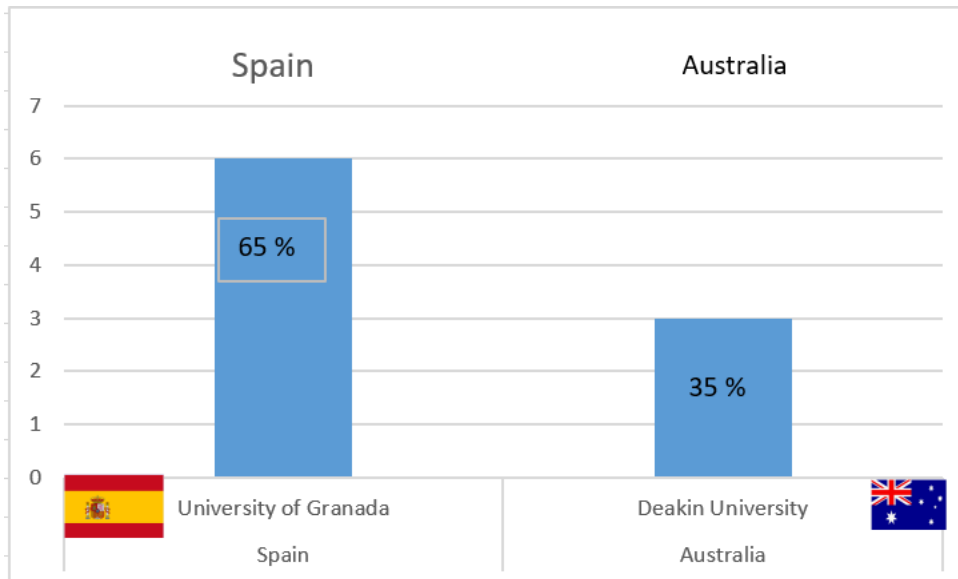

Figure 5: Research affiliations for generative AI

As shown in Figure 6, the University of South Africa leads with 43% of AI chatbots in HE in South Africa. The following authors were highly cited: Umenne (2023), Msila (2023), and Chaka (2023), followed by the University of the Witwatersrand with 29%, Hazelhurst (2023), and Myezwa (2023), and the University of Johannesburg with 28%: Robertson (2023), and Phoobane (2023).
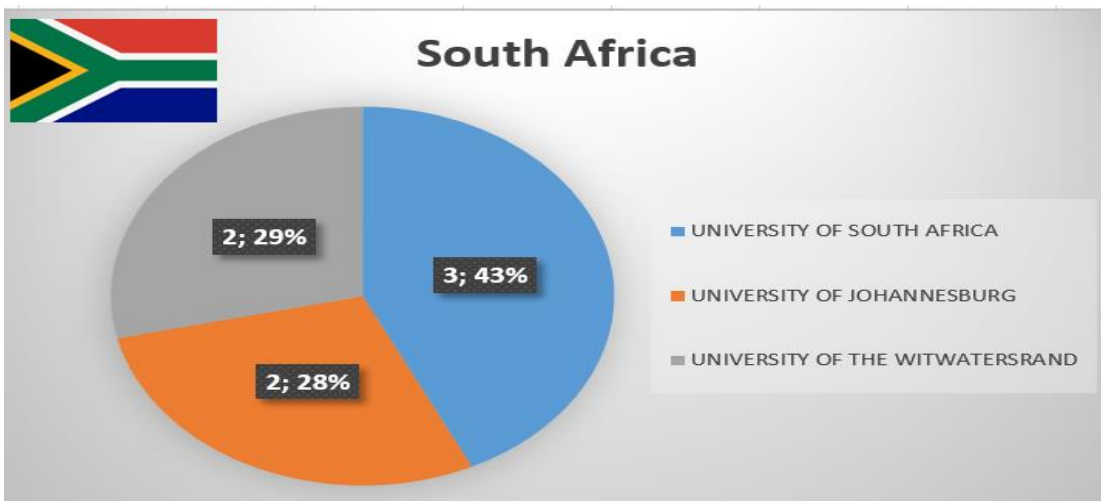

Figure 6: Research affiliations for generative AI in South Africa

The data in Figure 7 below indicates that in the USA, the University of Maryland School of Public Health ranks first with 38%; the highly cited author is Lushniak (2023), followed by the Institute for Education's Future with 37%, Haleem (2023), and San Jose State University with 25%. The highly cited author is Apiletti (2023).
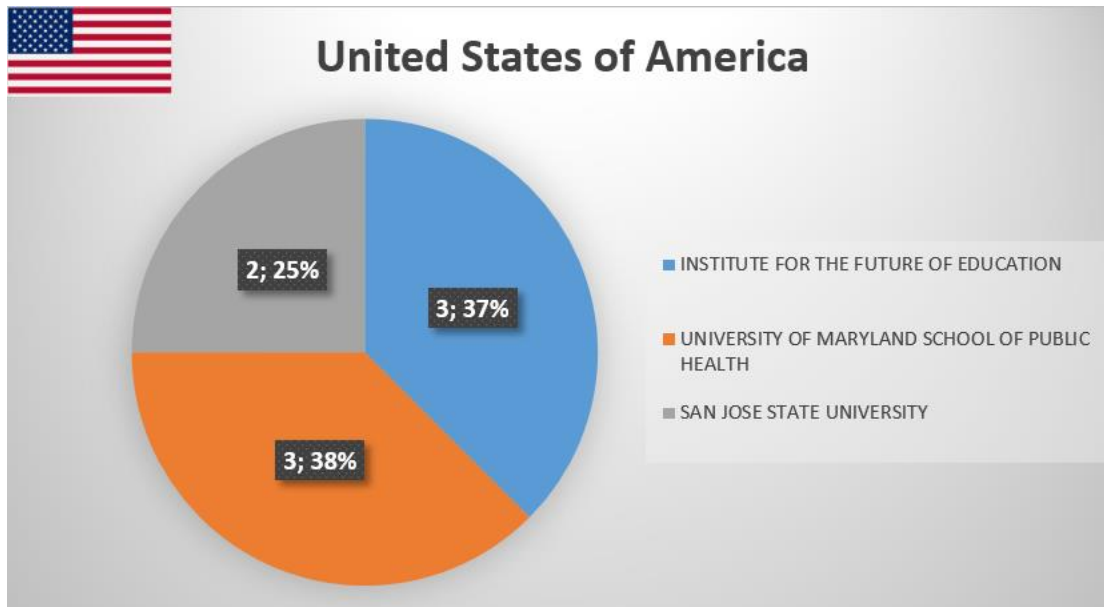

Figure 7: Research affiliations for generative AI in United States of America

An analysis of generative AI chatbots in higher education has shown that the most cited words are as shown in Figure 8 below.
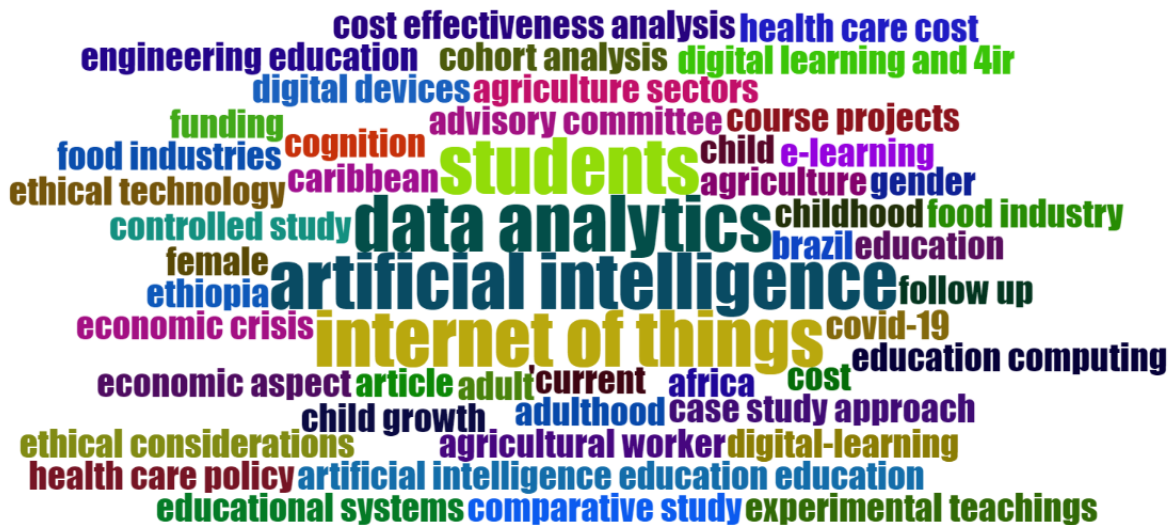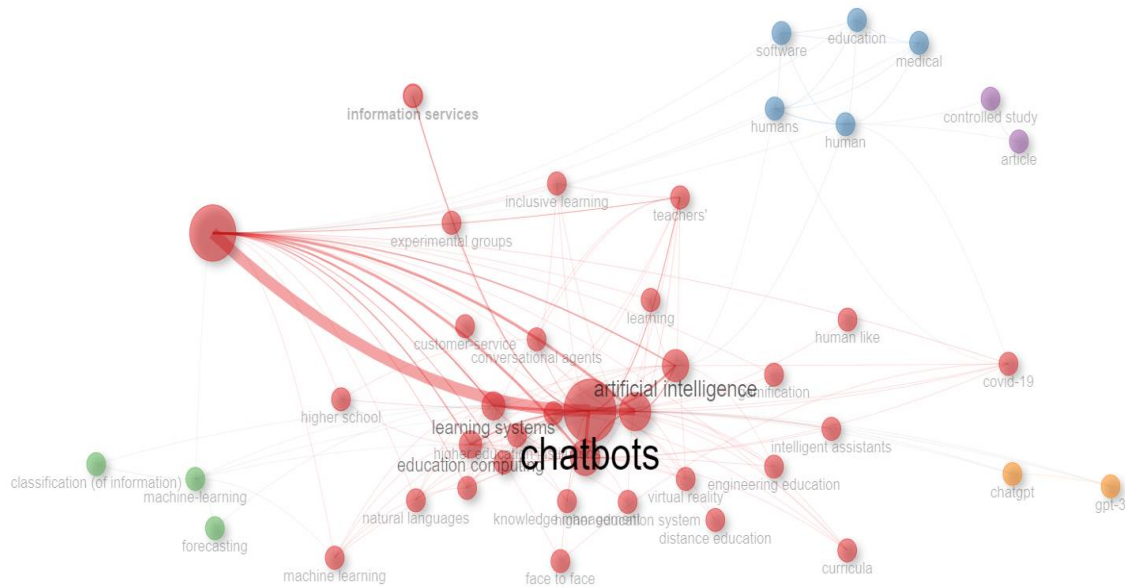

Figure 8: Scopus databases of most cited or used words in generative AI between 2022 and 2023

An AI collaboration network, in which the thickness of the line indicates the strength of the connections is shown in Figure 9 above.

Figure 9: Collaboration network analysis of generative AI chatbots

Recommendation and future studies

In the study, it is revealed that there is a vast gap between developed and developing countries when it comes to AI in higher education development and deployment. It is essential that African countries discuss collaboration and awareness, and the institutes of higher education or educational institutions could facilitate this discussion easily. Educating students in HE about generative artificial intelligence (AI) chatbots should be a priority. Therefore, it is critical to consider the limitations of bibliometric analysis when interpreting the results. Despite the study using Scopus as the database, Web of Science, PubMed, and Google Scholar were not included, which may have led to the loss of influential publications. Researchers should combine databases in the future. Scopus may not index Web of Science publications. Future researchers can also use bibliometric software like Bibexcel and VOSviewer to analyze the data. In the future, a comprehensive search that includes all articles will be required to increase the number of studies reviewed on Artificial Intelligence (AI) Chatbots in HE.

CONCLUSION

A few scholarly papers show the collaborative effort by researchers on the impact of generative AI in higher education (HE) and its implication on HE and activities. This paper examined research data from the Scopus database. The database was accessed on September 18, 2023, and contained 2,799 documents and 375 citations. The average citation per document was 3.838. The paper focused on the latest records from 2022 to 2023. The University of Granada is the most cited in Spain with more than 65% compared to other universities, and the European universities are leading with AI research data from the university point of view, whereas on the African continent, the University of South Africa is leading with AI research data in African universities with 43%. From the AI chatbots collaboration network, the United States of America (USA) is the country most cited

on artificial intelligence chatbots in HE with over 112 articles cited, and North America outperforms Europe, whereas in Africa, Zimbabwe ranked first with 12 articles cited, which only indicate 10% of collaboration with other developing countries. As far as AI in higher education development and deployment is concerned, there is a huge gap between developed and developing countries, which, if not closed, will lead to more inequalities between African and developing countries.

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