Key Research Ideas of Artificial Intelligence in Higher Education: Bibliometric Analysis and Information Mapping

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This research aims to describe and map information and research ideas that can be developed in the application of artificial intelligence in higher education. The method applied in this research is Preferred Reporting Items For Systematic Reviews And Meta-Analyses (PRISMA) which uses scientific articles or proceedings sourced from the Scopus database which are analyzed using Vos Viewer and Publish Or Perish as well as Google Trends and Dimensions. The research results reveal that artificial intelligence research covers three aspects that can be applied in higher education: development of AI tools, application of AI in learning, and digitalization of higher education.

Keywords: artificial intelligence, higher education, research ideas

INTRODUCTION

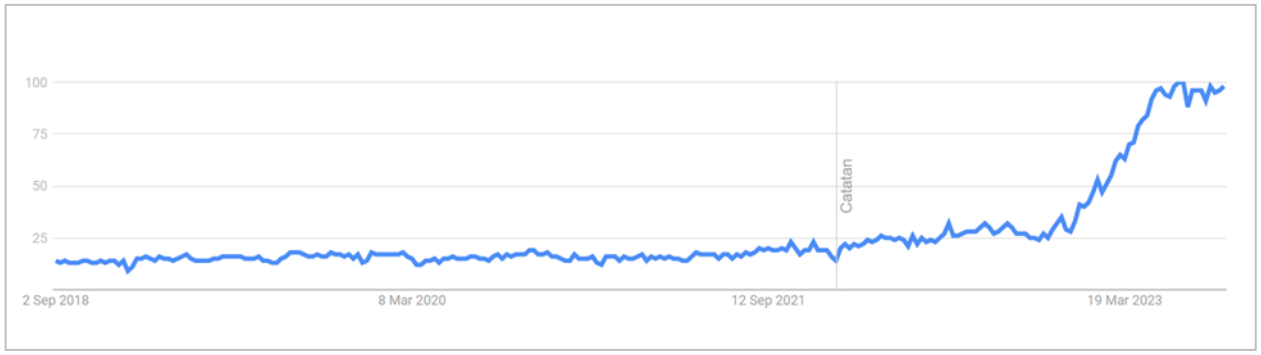
The development of educational software using artificial intelligence is useful for helping novice students in the learning process (Rusmiyanto et al., 2023). This shows that artificial intelligence in education has begun to be implemented (Jing et al., 2019). Initially, artificial intelligence was used to facilitate human work. For example, artificial intelligence is applied in the legal and judicial system (Alzou'bi et al., 2014). Besides that, artificial intelligence is also applied in the industrial world (Belk et al., 2023) and health (Sunarti et al., 2021).

The application of artificial intelligence in education was carried out by Gao, (2020), reviewing the application of AI in increasing teacher innovation in learning. Chamekh & Hammami (2020) researched the application of AI in strengthening E-Learning. Zhao & Fu, (2022) developed a public health education system to strengthen human resources. Artificial intelligence research in the field of higher education has

great potential to be carried out in recent years (Crompton & Song, 2021) and developed in developed countries, including Singapore, America and England Zahra & Nurmandi, (2021)

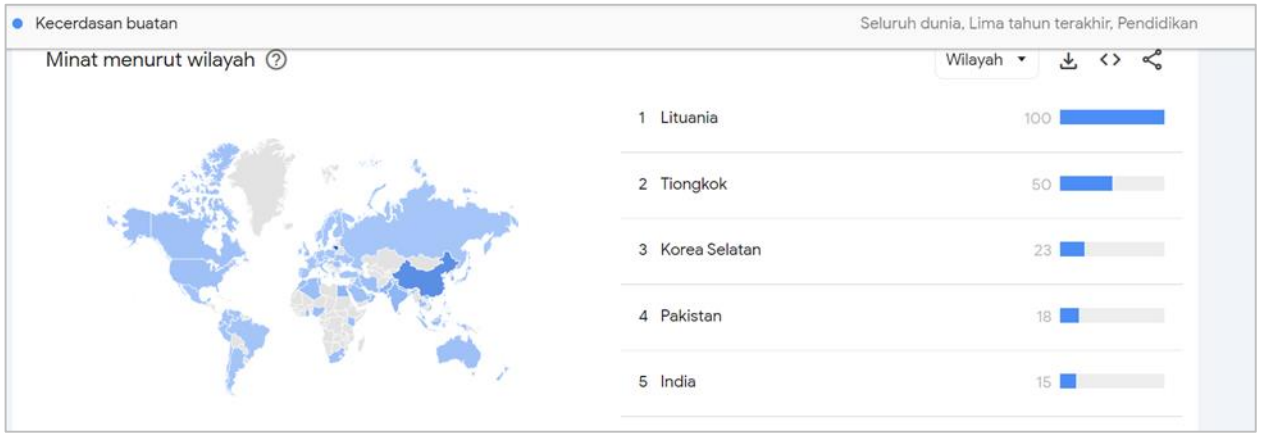
Meanwhile, research interest over the last five years on the topic of artificial intelligence throughout the world in the field of education based on Google Trends is presented in Figure 1

FIGURE 1
INTEREST OVER TIME THE LAST FIVE YEAR IN THE TOPIC AI IN EDUCATION



There is a significant increase from 2021 to 2023 regarding artificial intelligence research in education. Meanwhile, interest by region over the last five years in the topic of artificial intelligence in education around the world (the five most countries) is presented in Figure 2.

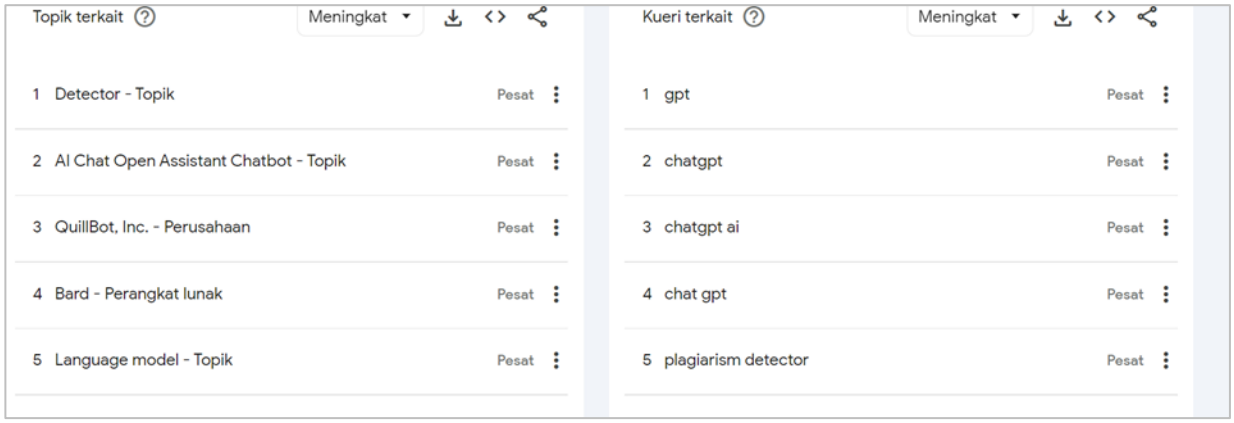
FIGURE 2
HISTOGRAM OF INTEREST BY COUNTRIES IN THE TOPIC OF AI IN EDUCATION



Lithuania is ranked first in the world, followed by China, South Korea, Pakistan and India for countries interested in artificial intelligence research and education based on Google Trends data.

Meanwhile, frequently searched topics and information requests submitted to the system related to artificial intelligence throughout the world in the field of education (top five topics) are presented in Figure 3.

FIGURE 3
TOP FREQUENTLY SEARCHED TOPICS ABOUT AI WORLDWIDE IN EDUCATION



Five topics can be developed in artificial intelligence research in education including Detector, AI Chat Open Assistant Chatbot, QuillBot, Bard and Language Model as well as the top five queries, namely gpt, chatgpt, chatgpt ai, gpt chat, and plagiarism detector, namely several intelligence development applications products that can be used in education.

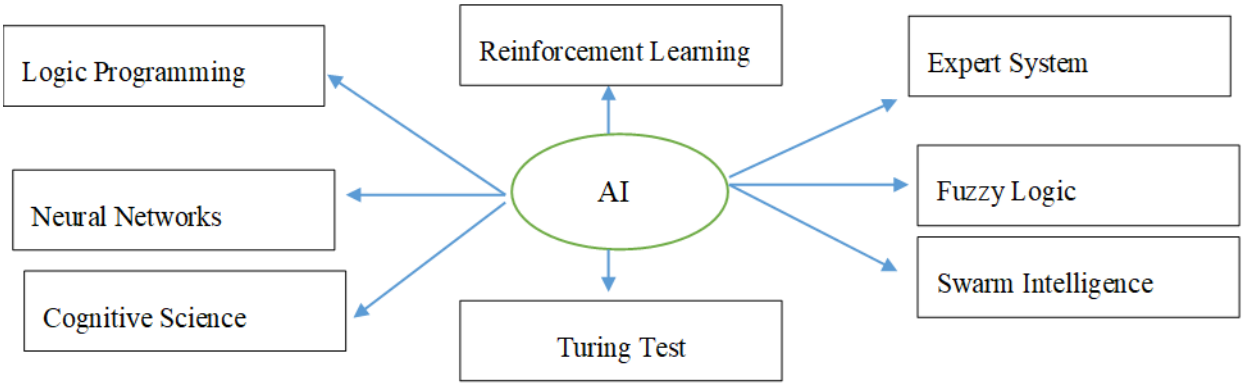
In research, researchers need information related to trends and novelties for the use of artificial intelligence in higher education. This is a problem that often arises among researchers. However, bibliometric analysis with publications on the use of artificial intelligence in higher education does not yet exist. The questions that will be answered in this research are how many publications and citations, journal publications, authors, and information mapping based on Vos Viewer and Open Knowledge Maps on the topic of using artificial intelligence in education.

This research aims to find out the latest research ideas on the topic of artificial intelligence in the field of higher education. The writing systematics in this research are structured as follows. The first part describes the background, problems and research objectives. The second part explains the methods used, data collection and data analysis. The third section presents the research results followed by discussion. The fourth section provides conclusions, limitations and recommendations.

LITERATURE REVIEW

Artificial intelligence comes from two words, namely intelligence and artificial, intelligence is the ability to reason and produce new ideas and artificial has an unreal meaning, thus artificial intelligence is a field of computer science that focuses on creating intelligence that works like a machine and can provide different reactions. just like humans (Verma, 2018). There are several scopes in artificial intelligence which are illustrated in Figure 4.

FIGURE 4
SCOPE OF ARTIFICIAL INTELLIGENCE

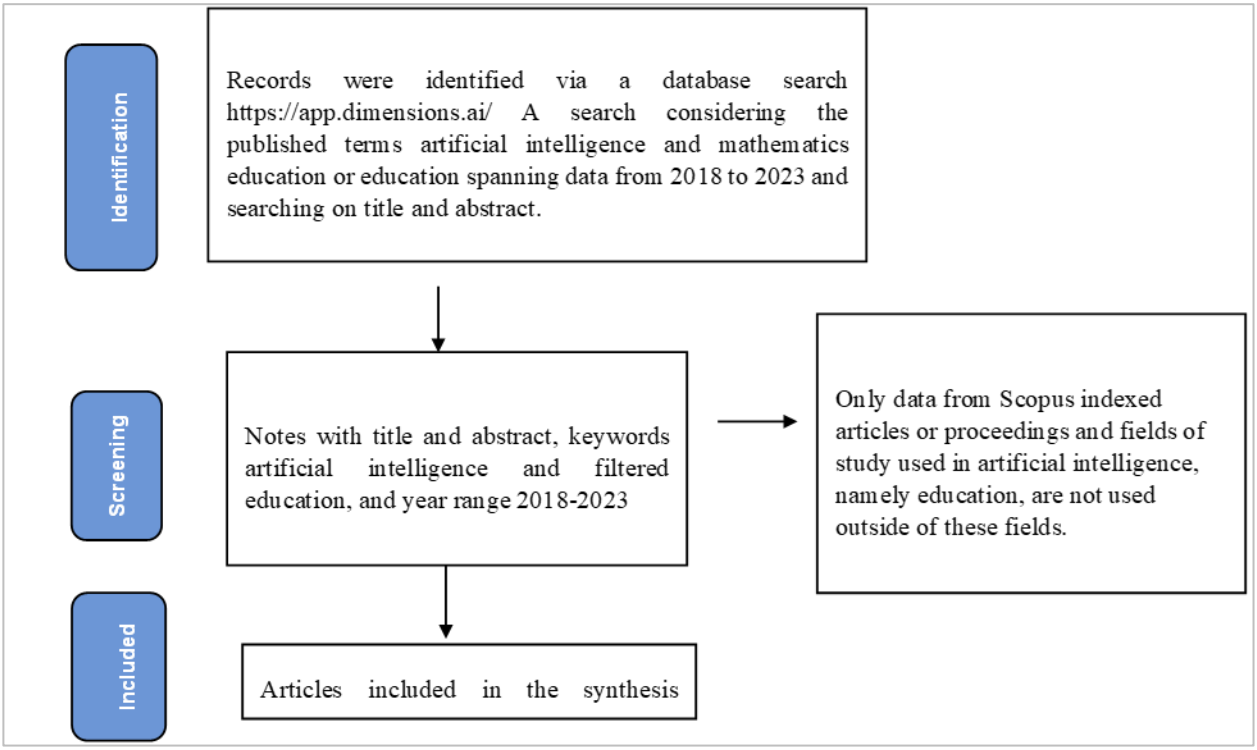


METHOD

The method used in this research is a literature study with bibliometric analysis, which is expected to provide important references for future research (Machmuda et al., 2022), (Thanuskodi, 2010) relating to the topic of artificial intelligence in higher education. Researchers maximized the Scopus Elsevier Data Base obtained from Publish Or Perish, then analyzed it with Vos Viewer over a period of the last five years and data from Open Knowledge Maps using two keywords, namely artificial intelligence and education and supported by data from Google Trends in Indonesia and Dimensions. In scientific research, it is very important to obtain a broader perspective of the research that has been conducted in relation to relevant content and a bibliometric analysis profile regarding research trajectories and dynamics of research activities throughout the world (Suprapto et al., 2021).

Artificial intelligence and education are used as filters to search for titles, abstracts and keywords from 2018 to 2023; then the data is analyzed, then the data is investigated starting from the development of artificial intelligence research topics, countries or regions that make the most use of artificial intelligence topics in the field education and artificial intelligence sub-topics, including additional investigations, namely including the number of publications, citations, fields of artificial intelligence research, journals, and authors. Vos Viewer and Open Knowledge Map are used to discover research trends on artificial intelligence in education. In principle, this research method uses the PRISMA (Preferred Reporting Items For Systematic Reviews And Meta-Analyses) flow diagram (Effendi et al., 2021), which is presented in Figure 5.

FIGURE 5
SCOPE OF ARTIFICIAL INTELLIGENCE



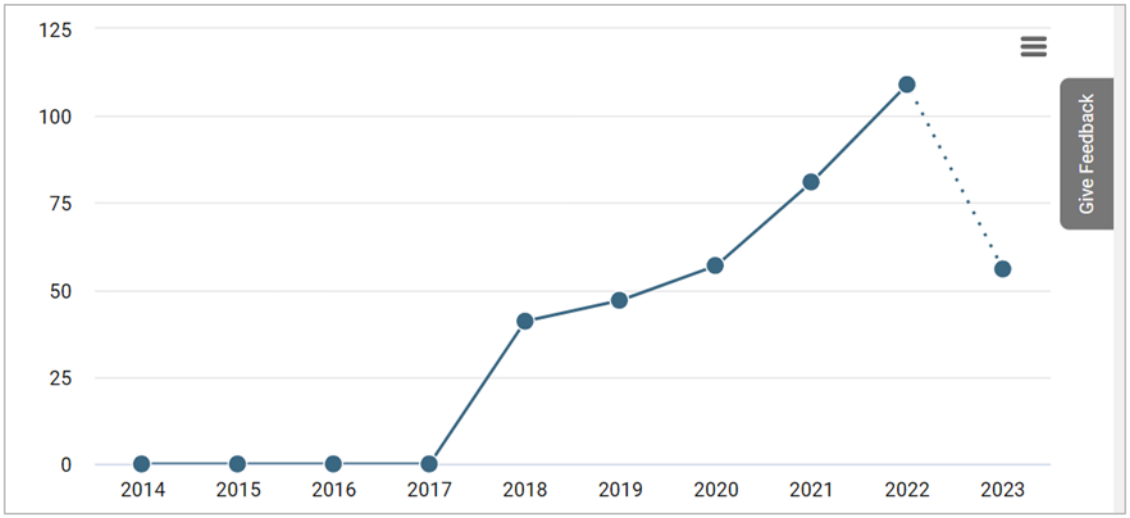
RESULTS

This section explains some data taken from Dimension, Vos Viewer and Open Knowledge Map regarding information on artificial intelligence research in education.

Number of Publications Per Year

Data searches from 2018 to 2023 produced 391 publications of 374 articles, 11 edited books, 5 monographs and 1 preprint. The number of publications per year on the topic of artificial intelligence in the field of education is presented in Figure 6.

FIGURE 6
NUMBER OF PUBLICATION ABOUT ARTIFICIAL INTELLIGENCE IN EDUCATION

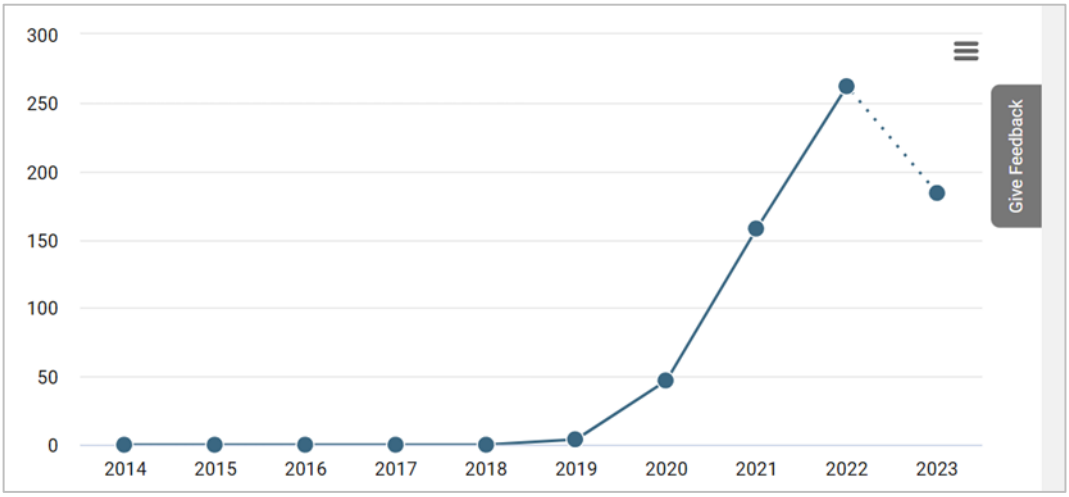


(https://app.dimensions.ai/)

Number of Citations Per Year

The number of citations for artificial intelligence in education from 2018 to 2023 is 655. The number of citations per year is presented in Figure 7.

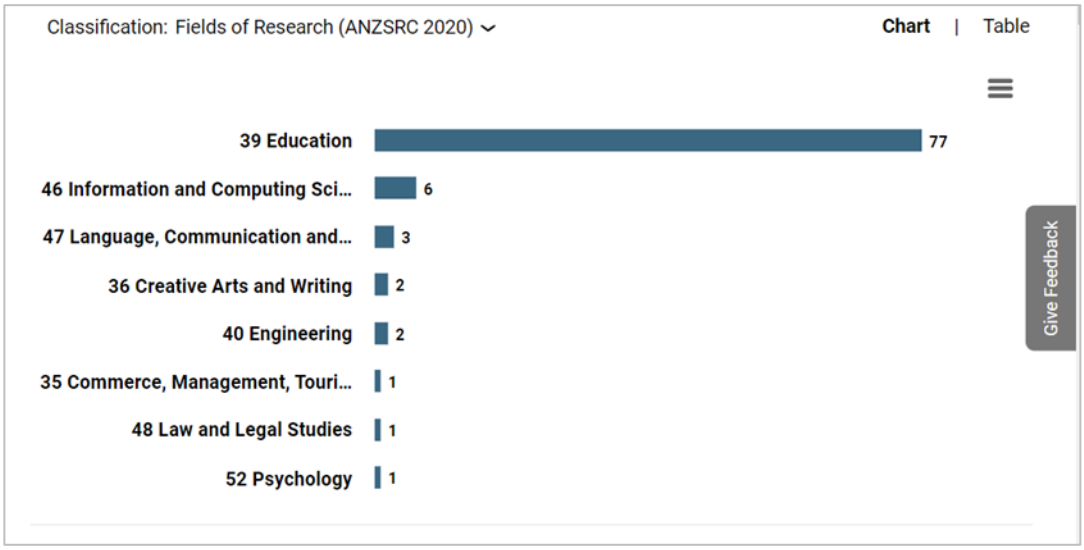
FIGURE 7
THE NUMBER OF CITATIONS



(https://app.dimensions.ai/)

A search for data from 2018 to 2023 yields 93. Based on research fields, publications can be grouped. The number of publications in terms of research fields (the 8 most fields) is presented in Figure 8.

FIGURE 8
THE NUMBER OF PUBLICATIONS IN TERMS OF RESEARCH FIELDS



(https://app.dimensions.ai/)

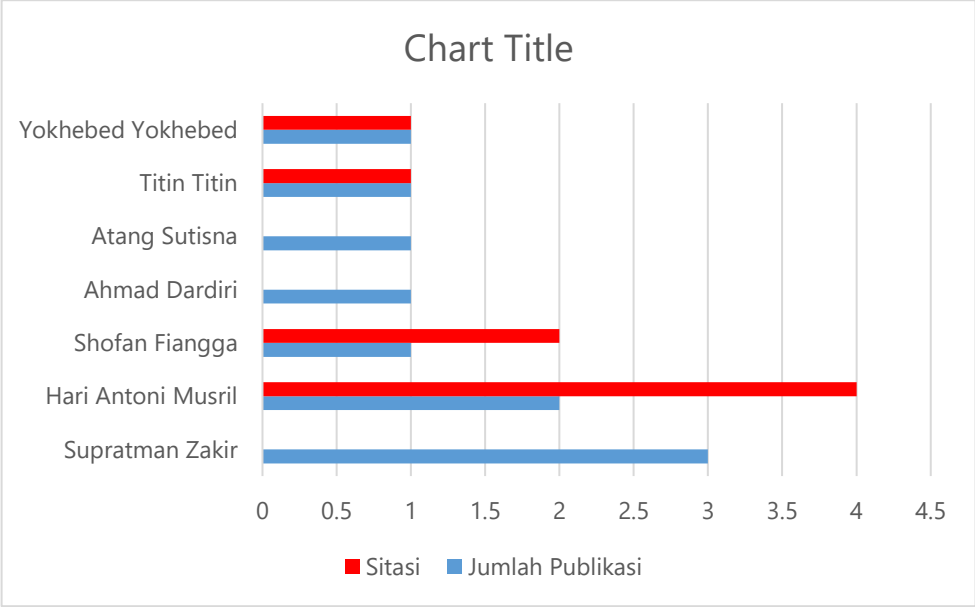
Searching for data from 2018 to 2023 resulted in several findings published in several journals. The number of publications reviewed from the seven journals that appear in the AI dimensions is presented in Figure 9.

FIGURE 9
THE NUMBER OF PUBLICATIONS REVIEWED FROM JOURNALS

(https://app.dimensions.ai/)

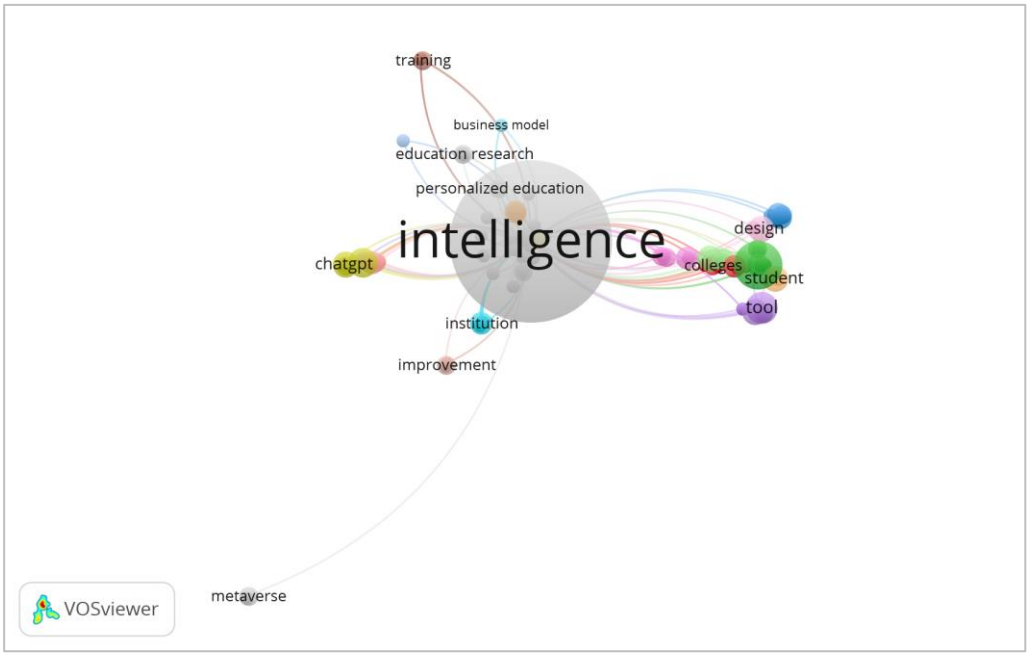
Searching for data from 2018 to 2023 resulted in several authors in Indonesia studying artificial intelligence in education. The number of publications in terms of researchers is the top seven people who study artificial intelligence in mathematics education, presented in Figure 10.

FIGURE 10
THE NUMBER OF PUBLICATIONS IN TERMS OF RESEARCHERS



VOSviewer provides a network visualization map for co-occurrence. Network visualization of these 173 terms is presented in Figure 11.

FIGURE 11
NETWORK VISUALIZATION FOR CO-OCCURANCE



(Vos Viewer and Publish or Perish)

FIGURE 12
OVERLAY VISUALIZATION FOR CO-OCCURANCE

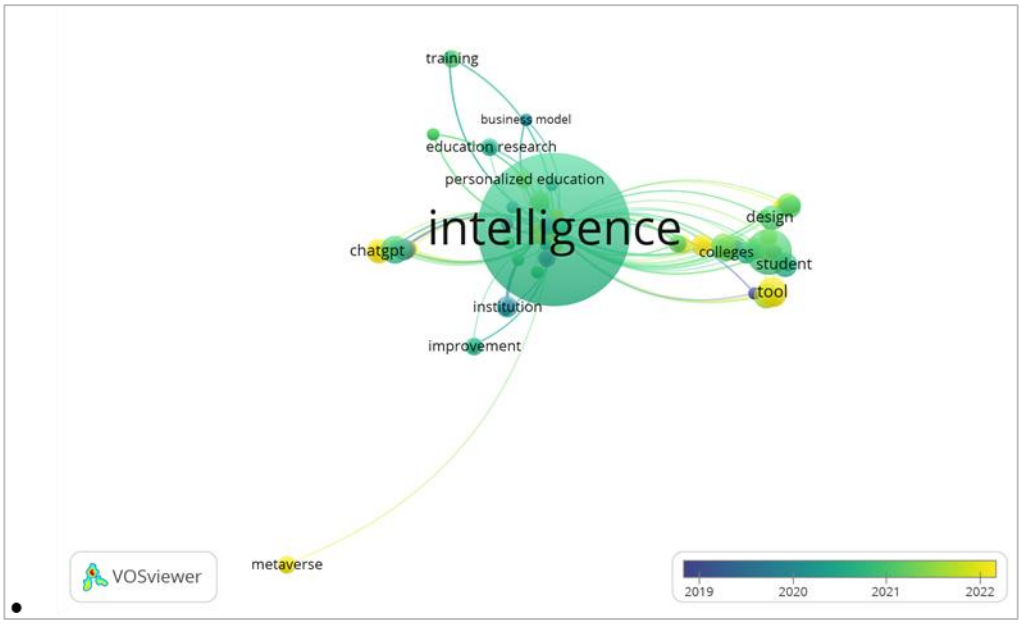


FIGURE 13
DENSITY VISUALIZATION FOR CO-OCCURANCE

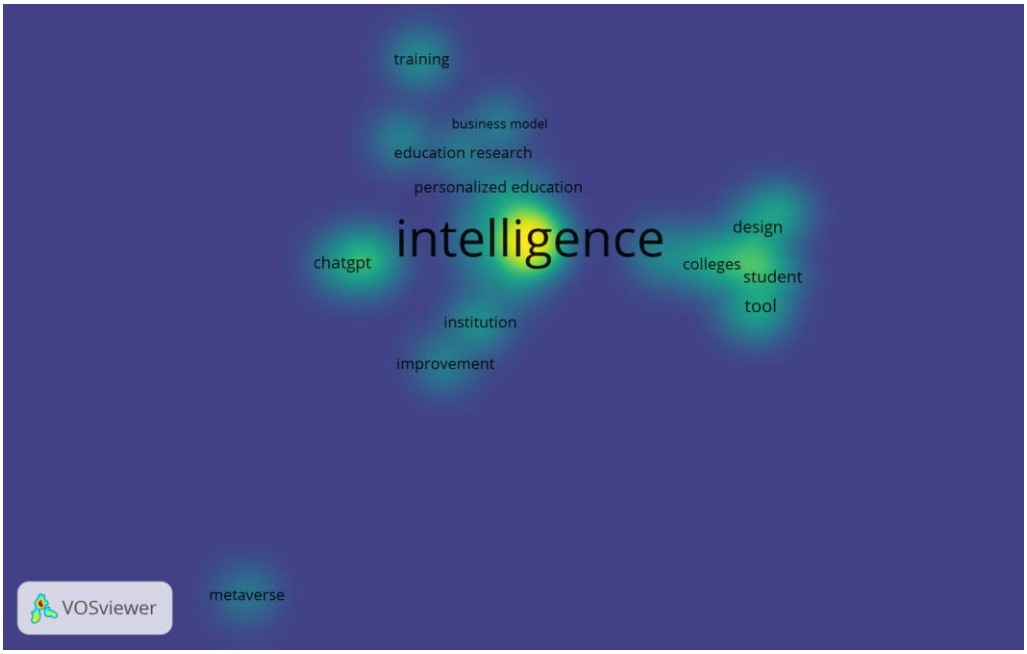
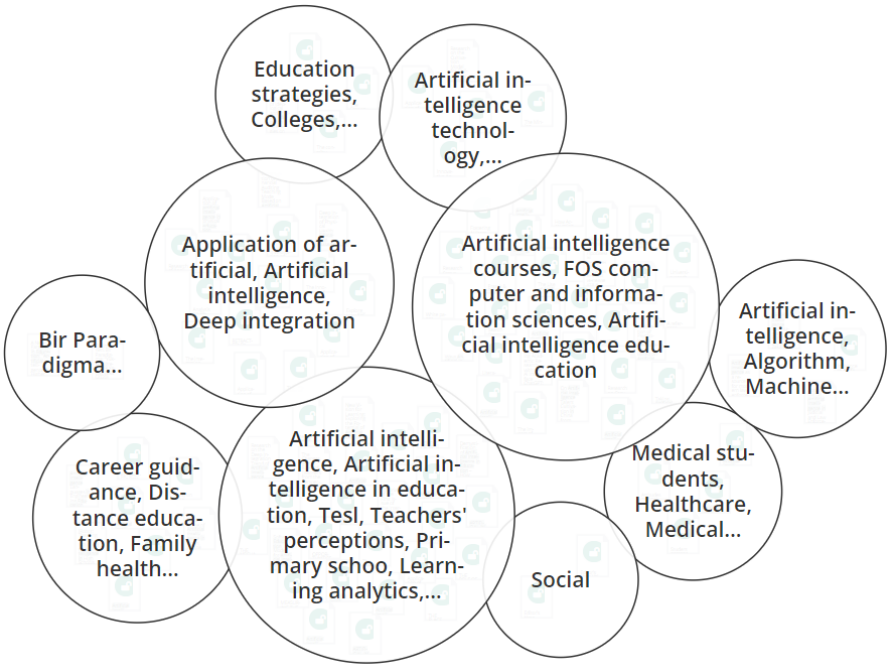


FIGURE 14
SPREAD OF ARTIFICIAL INTELLIGENCE TOPICS WITH EDUCATION SECTOR



(https://openknowledgemaps.org/)

DISCUSSION

Figure 1.6 shows that publications in the Scopus Journal on the topic of artificial intelligence in the field of education from 2018 to 2023 have increased every year. This shows that many research opportunities can be generated using other variables in the topic of artificial intelligence in the field of education. The increasing development of technology in recent years has encouraged researchers to study the use of artificial intelligence in depth, one of which is in the learning process. There is a positive impact of using artificial intelligence in online learning (Crompton & Song, 2021). This has encouraged several studies on artificial intelligence in the field of education to increase along with technological developments. There are new evolutions, research schemes and future studies that explain a lot about artificial intelligence, one of which is in the field of education (Dwivedi et al., 2023)

Figure 1.7 shows the increasing number of citations on artificial intelligence in the field of education, so that there is research that supports each other and a comprehensive and impactful scientific work is produced. With the large number of artificial intelligence research studies in the field of education, several researchers have cited previous research articles that support the research that has been carried out, because most of the research on artificial intelligence is advanced research from what has already been researched and many aspects of artificial intelligence research have been revealed and some still require more in-depth study, namely the vision and challenges of using artificial intelligence in the field of education(Hwang et al., 2020). Data from Google Trend regarding artificial intelligence research in Indonesia, with the largest number of regions and communities in Southeast Asia, significantly contributes to artificial intelligence educational research in education. Shifting to South Asia Artificial intelligence and Big Data are becoming quite important aspects in the region (Arfanuzzaman, 2021).

Figure 1.8 based on Dimensions data, in Indonesia the topic of intelligence research in the education sector occupies the top position, followed by information and computing science, language and communication, creative arts and writing, as well as engineering and several other fields which are not as

numerous as the education sector. This shows that artificial intelligence research is very important in the field of education, especially in Indonesia, which is in fourth place in the world with the largest number of citizens. With the largest population with active use of technology, it opens up research opportunities in the field of higher education or universities in the development of device or software-based artificial intelligence that can be used in a learning capacity (Crompton & Burke, 2023). Considering that universities are an effective place in developing and applying artificial intelligence technology that can connect product makers and users directly (Bali et al., 2022)

Figure 1.9 based on Dimensions data in Indonesia shows that the Indonesian Research Journal In Education is ranked first, followed by AKSIOMA, Scholaria Jurnal Pendidikan and International Journal of Research, each of which has the same number of places for scientific publications and is followed by several other journals with topic coverage. artificial intelligence in education. The large amount of research on artificial intelligence encourages scientific journals to accept the best manuscripts that can be published as a form of mapping information about the extent of research on artificial intelligence in the field of education. These journals can be used as reference sources for developing research ideas and relevant publication venues in publishing research on artificial intelligence. Several studies have examined the sub-topic of artificial intelligence in secondary school education (Triansyah et al., 2023) which can be published in indexed journals.

Figure 1.10 based on Dimensions data in Indonesia Supratman Zakir, Hari Antoni Musril, Shofan Fiangga ranked third in the number of publications and citations on the topic of artificial intelligence in the field of mathematics education. Apart from researchers in Indonesia, several researchers abroad have competencies related to the field of artificial intelligence studies who collaborate with each other by involving several countries and fields of expertise. In principle, collaborative artificial intelligence research in education can maximize findings and make the content in manuscripts higher quality and more impactful. Yilmaz & Karaoglan Yilmaz, (2023) who are experts in designing artificial intelligence tools in computational thinking can collaborate with Seo et al., (2021) in online learning.

Figure 1.11 using VosViewer for Network Visualization it shows that the interest in artificial intelligence research is quite high concerning several other fields, namely tools, education, students and campuses or colleges. In Network Visualization, artificial intelligence research opportunities are associated with educational and tertiary research and there are still not many students who do research, because the circles connected with artificial intelligence are still small compared to circles that study artificial intelligence. This situation shows that research opportunities are still very broad and need to be disclosed regarding the development of artificial intelligence in the field of education and higher education, including in the development of AI tools that are in accordance with practice and can be implemented in universities. Several artificial intelligence tools have been developed in universities to facilitate human performance (Schepart et al., 2023). Another tool that is also being developed is the digitalization of writing assistants developed in universities (Nazari et al., 2021).

Figure 1.12 using VosViewer for Overlay Visualization in recent years the main topic of artificial intelligence research has been very high especially associated with universities, gpt chat and devices. These three aspects are still the main topics of research that can be related to artificial intelligence and open wide opportunities for further research. This research topic is still ongoing with device specifications for more specific uses. One of them is the development of marketing applications (Haleem et al., 2022), which can be used for scientific development for business and management students.

Figure 1.13 using VosViewer the Density Visualization aspect for artificial intelligence has a high enough color brightness so that research on artificial intelligence is still an interesting issue and several other fields related to education can still be studied, namely educational research, chat gpt, universities (campuses).), students and tools. There are still many of these five aspects related to the field of education that need to be studied in depth when linked to the main topic of artificial intelligence. There are broad opportunities and new research ideas that can be developed in artificial intelligence in the development of devices and their applications for future research (Haleem et al., 2022), because in the last 10 years and the next few years the world is entering an era of digitalization, so that the development of artificial intelligence in higher education is increasing (Boiko et al., 2023).

Figure 1.14 using Open Knowledge Maps with high metadata quality criteria shows that there are still many research topics in educational artificial intelligence that can be researched and have an impact. Within the big circle which includes the Artificial Intelligence Course, FOS Computer And Information Science, Artificial Intelligence Education has links with other educational fields that are in a different big circle, for example Teacher's Perception, Primary School, Learning Analytics. Besides that, Artificial Intelligence Education is also related to educational topics in a smaller circle, namely Artificial Intelligence Technology. This aspect can be linked with educational topics in the next circle, namely Education Strategies and Colleges. Based on the level of education, research on artificial intelligence can be studied at primary school through Teacher's Perception and Learning Analitys and at the College level, research on artificial intelligence can be deepened by developing Artificial Intelligence Technology. In Malaysia, the era of artificial intelligence research in higher education has entered into a study in the Mixed Reality Learning System (Ahmad & Wan Abdul Ghapar, 2019). Virtual learning with artificial intelligence in higher education needs to be studied more deeply to maximize blended learning (Lone et al., 2023).

CONCLUSION

This research reveals several research ideas that can be developed from the topic of artificial intelligence in higher education, namely the development of AI devices, AI applications in learning, and the digitalization of higher education. Although this research has contributed to providing a state-of-the-art understanding of the development of artificial intelligence in the field of education from 2018 to 2023 through Google Trends, Dimensions, Publish or Perish, Vos Viewer and Open Knowledge Maps using the Scopus database, this research If you have the limitation of not using the Web Of Science database, for further research you can add the Web Of Science Base data.

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