Determination of Artificial Intelligence usage tendency in primary education

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Abstract: *This study aims to determine the inclination of studies on the use of artificial intelligence in primary education. The studies published in the Scopus database were analyzed with the bibliometric analysis method and the "distribution by year, citation status over the years, document type, distribution by country, keywords preferred by authors, and the most frequently used keywords in the title and abstract sections" of the mentioned studies were determined. The study, which was carried out to guide researchers and provide them with resources, found that papers on the use of artificial intelligence in primary education were first published in 1988. It was determined that the top cited studies were published in 2021. It was seen that the highest number of studies were carried out in China and article was the most preferred document type by the researchers. The keywords mostly used by the researchers in their studies were determined as "artificial intelligence", "education" and "Chatgpt". It was found that the most popular keywords in the title and abstract sections of the studies were "art", "mathematics", "professional development", "artificial intelligence integration", "primary school students", "Chatgpt integration and potential", "Stem", "ability", "perspective" and "computational identity".*

Keywords: Primary School, Artificial Intelligence, AI, Scopus, Bibliometric Analysis, Student, Teacher.

1. Introduction

It is observed that the area of artificial intelligence is gradually developing in information societies where 21st century skills are gaining importance. In the literature, it is stated that artificial intelligence, which deals with complicated and developing areas, provides a systematic approach for analysis of huge amounts of information (Padovano & Cardamone, 2024). Artificial intelligence, which was designed in the mid-1950s as a method to determine the intelligence of machines, has begun to be applied in other areas over time (Oliver, 2018). Stating that the idea of creating intelligent machines and artificial intelligence dates back to the 14th century, Humble and Mozelius (2019) emphasize that the field of artificial intelligence in education has left a significant impact in the last 25 years. Walan (2024) argues that debates on artificial intelligence intensified in late 2022 and

affected various segments of society. Liang (2020) defines artificial intelligence as "a collection of information technologies based on machine learning" and states that its application in the field of education is making ground and will have a profound impact on education reform. Emphasizing that artificial intelligence has a high potential in the field of education, Hu et al. (2024) mention the benefits of artificial intelligence, including providing resources to teachers, improving the quality of teaching, encouraging personalized learning, and equipping students with efficient learning experiences. Similarly, Delgado de Frutos et al. (2024) underline that the most obvious benefit of artificial intelligence is streamlining teachers' work and providing access to resources. Dhara et al. (2022) explain that the integration of artificial intelligence into education provides advantages in education with features such as evaluating student performance, dividing students into groups according to their performance, improving performance, and facilitating class participation.

Artificial intelligence, which is considered extremely important for both students and teachers, was initially used at the university level. However, recent studies have drawn attention to the need to integrate artificial intelligence into primary education settings as well (Huang et al., 2024; Li, 2024; Yim, 2024; Ye et al., 2021). Similarly, interest in artificial intelligence education in primary schools is developing and studies are being carried out to design and develop effective artificial intelligence programs (Padovano & Cardamone, 2024; Gao et al., 2024). Artificial intelligence, which helps students cope with social, technological and environmental challenges (Chai et al., 2021) also provides support to teachers in fulfilling their duties in the education process, determining educational content and identifying educational needs (Alam, 2021). Considering the contributions of artificial intelligence technologies to the education process, it becomes clear that further research on this subject is required. The need for research on qualified research is developing on a daily basis, especially on the usage and development of artificial intelligence at primary education which has gained popularity in recent years. In this context, this study has aimed to determine the tendency for usage of artificial intelligence in primary education and to provide researchers with resources. Answers are sought to the following questions so as to realize the purpose of this study:

1. What is the distribution of studies by year?

2. What is the number of citations to studies by year?

3. What is the most preferred document type by researchers in their studies?

4. What is the distribution of studies by country?

5. What are the most widely used keywords by authors in their studies?

6. What are the most widely used keywords in the title and abstract sections of the studies?

2. Methodology

Scopus database was used to determine the trend towards the use of artificial intelligence in primary education. The research was based on a bibliometric analysis of data obtained from studies published in Scopus until 27.12.2024. The query was carried out using only the following keywords in the titles of the studies: "*(TITLE (artificial AND intelligence AND primary AND education) OR TITLE (artificial AND intelligence AND primary AND school) OR TITLE (artificial AND intelligence AND primary AND teacher) OR TITLE (artificial AND intelligence AND primary AND student) OR TITLE (ai AND primary AND education) OR TITLE (ai AND primary AND school) OR TITLE (ai AND primary AND teacher) OR TITLE (ai AND primary AND student) OR TITLE (chatgpt AND primary AND education) OR TITLE (chatgpt AND primary AND school) OR TITLE (chatgpt AND primary AND teacher) OR TITLE (chatgpt AND primary AND student) OR TITLE (google AND gemini AND primary AND education) OR TITLE (google AND gemini AND primary AND school) OR TITLE (google AND gemini AND primary AND teacher) OR TITLE (google AND gemini AND primary AND student)*".

As a result of this query, 80 studies indexed in Scopus database between 1988 and 27.12.2024 were reached, and the data were downloaded as "Comma Separated Values (.csv)" and "Research Information Systems (.ris)", which are formats supported for analysis by VOSviewer. "Microsoft Excel for Microsoft 365" software was used for the analysis of the obtained data for which graphics and maps were formed. In the study, donut chart and map visuals were created using Excel. In order to determine the keywords preferred by the authors and most commonly used in the title and abstract sections of the studies, VOSviewer bibliometric data analysis tool version 1.6.20 was employed (Van Eck & Waltman, 2010). https://www.vosviewer.com/download.

3. Findings

This section includes the findings obtained from the study.

3.1 Distribution of studies by year

Figure 1 gives the distribution of studies on the employment of artificial intelligence in primary education by year. According to Scopus data, the first study on artificial intelligence in primary education was conducted by Barnard ve Sandberg (1988) in 1988. This study discussed the results of CAI program usage in elementary school open sentence mathematics problems. However, no study was found between 1988 and 2018 on artificial intelligence in primary education. Only 1 study was conducted in 2018 on artificial intelligence in primary education, 2 studies in 2019, and 3 studies in 2020. 10 studies were carried out on the use of artificial intelligence at the primary education level in 2021, and the number of

studies increased to 13 in 2022. It is believed that Covid 19 pandemic played an effective role in the increase of number of studies on artificial intelligence after 2019. With the outbreak of Covid-19 pandemic, distance education applications gained popularity in the field of education and there has been a trend towards the use of digital tools. It is thought that this tendency directed resources to the field of artificial intelligence. 20 studies were carried out in 2023 whereas the number significantly increased to 30 in 2024.
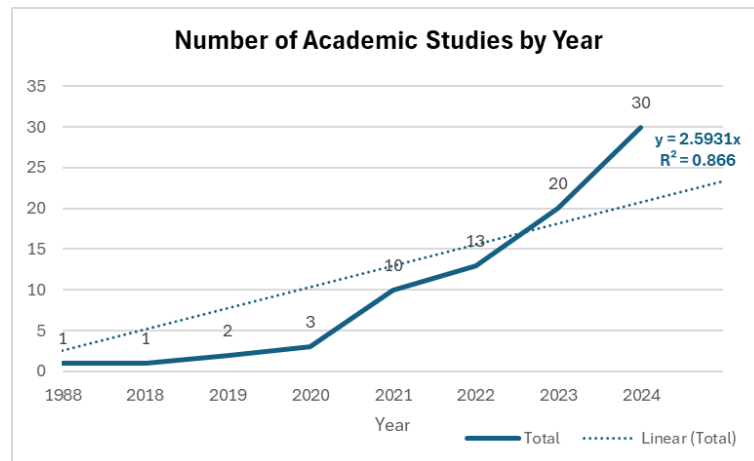
Figure 1. Distribution of studies on the use of artificial intelligence in primary education by year

3.2 Number of citations received by studies by year

Figure 2 gives the data obtained as a result of analysis conducted with the purpose of determining the number of citations made to studies by year.
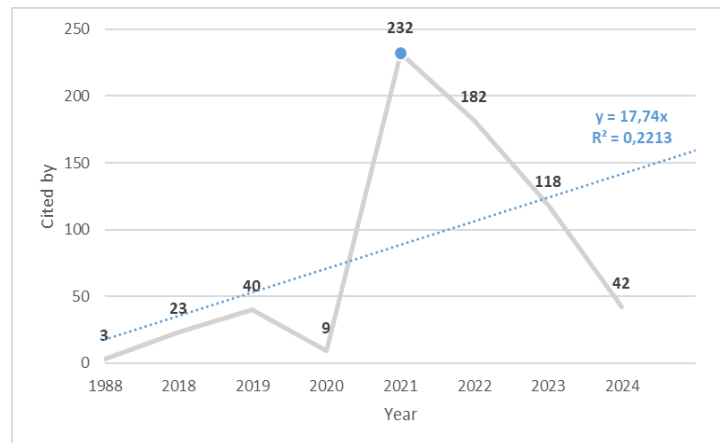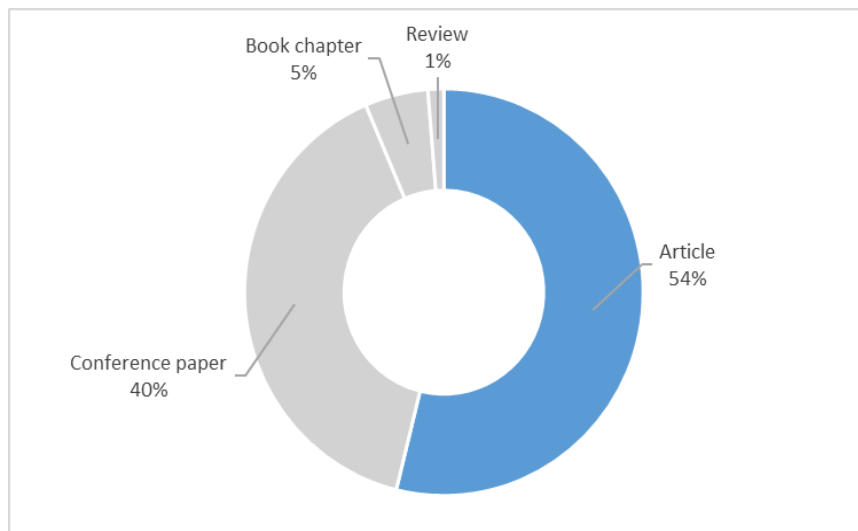

Figure 2. Distribution of citations by year

An examination of the studies conducted on the use of artificial intelligence in primary education shows that the highest number of citations are made to 2021 dated papers. Distribution of most cited studies by years reveals that the number of citations to studies conducted in 2021, 2022 and 2023 are 232, 182, and 118, respectively. The obtained findings show that the top cited paper is the study conducted by Chai et al. in 2021 with 124 citations, which examined the perception and behavioral intentions of primary school students towards learning artificial intelligence. It was determined that the second top cited study, with 85 citations, was conducted with the purpose of developing artificial intelligence literacy among primary school students and using digital stories by Ng et al. in 2022. The study by Lin et al. in 2021, which examined students' motivation to learn artificial intelligence, ranked third with 74 citations.

3.3 Distribution of studies by type of document

Examining the distribution of studies according to document type reveals that 54% of researchers prefer the article as document type in their studies (f=43) whereas 40% of researchers (f=32) prefer conference papers, 5% (f=4) prefer book chapters, and only 1% (f=1) prefer reviews. The distribution of studies according to document type is presented in Figure 3.
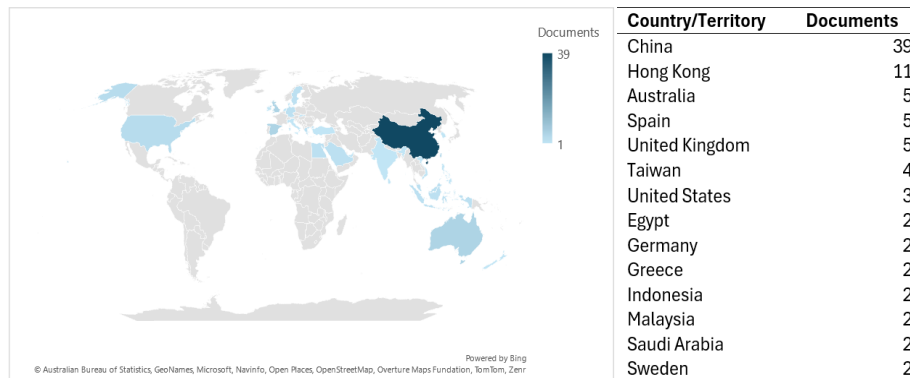

Figure 3. Distribution by document type

3.4 Distribution of studies by country

An examination of the distribution of studies conducted on the usage of artificial intelligence in primary education by country and region shows that China ranks first in terms of the number of studies (n=39). Hong Kong ranks second with 11 studies, while Australia, Spain and the United Kingdom each hosted 5 studies.

Taiwan contributed to the field with 4 studies, while 3 studies were conducted in the United States. A total of 29 countries were found to have conducted research on the use of artificial intelligence in primary education, and it was determined that only 1 or at most 2 studies were performed on this subject in most countries.

| Country/Territory	Documents
China	39
Hong Kong	11
Australia	5
Spain	5
United Kingdom	5
Taiwan	4
United States	3
Egypt	2
Germany	2
Greece	2
Indonesia	2
Malaysia	2
Saudi Arabia	2
Sweden	2

Figure 4. Distribution by countries

3.5 The most frequently used keywords by authors in their studies

In order to determine the most preferred keywords in the studies, the full counting method was used with VOSviewer to make calculations. In the study, the criterion was determined as "each keyword being used at least twice". As a result of the analysis, it was seen that the keywords were collected in 7 groups. It was determined that the most preferred keyword by the authors (f=32) was "artificial intelligence" with the connection strength of 36.

The second most preferred keyword in the studies (f=6) was found as "education" with a connection strength of 8. "Chatgpt" was the 3rd most frequently used keyword (f=5) and its connection strength was 7.
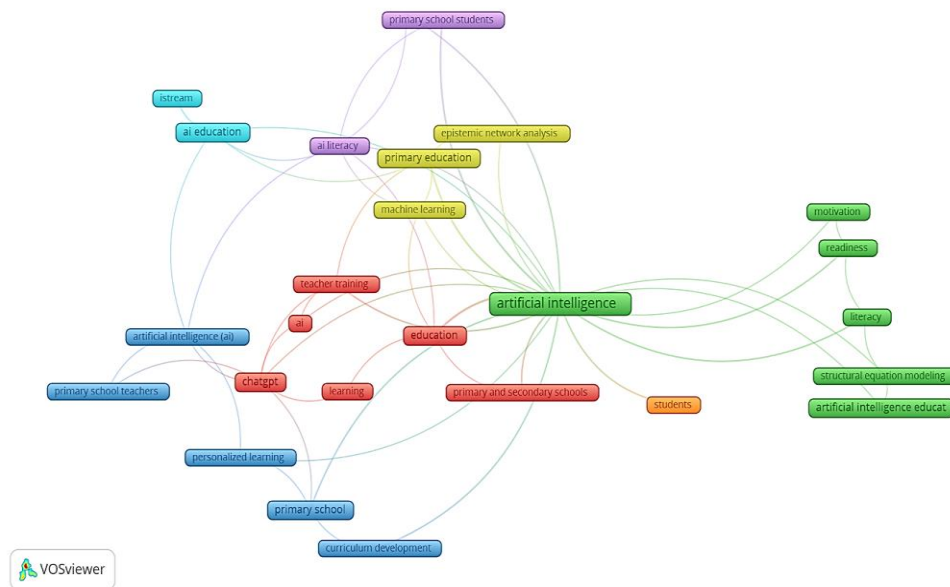
Figure 5. The most frequently used keywords by authors in their studies

When the clusters in Figure 5 are examined, it is seen that the green cluster reveals that the use of artificial intelligence focuses on variables such as motivation, readiness and literacy, and structural equation modeling was preferred as a method in examining these variables. As regards the red cluster, it is observed that the focal point is education and that the studies are conducted on the training of artificial intelligence. When the blue cluster is examined, it is seen that artificial intelligence studies focus on primary school teachers, curriculum development and personalized learning. Studies in the purple cluster were found to focus on artificial intelligence literacy in primary school students, and studies in the yellow cluster were found to focus on machine learning and epistemic network analysis in primary school.

3.6 The most frequently used keywords in the title and abstract sections of studies

In order to determine the most frequently used keywords in the abstract and keywords sections of studies, the use of a keyword for at least 5 times was preferred as a criterion. The calculation performed using full counting with VOSviewer method resulted in the grouping of keywords in 7 clusters. The obtained findings are given in Figure 6.
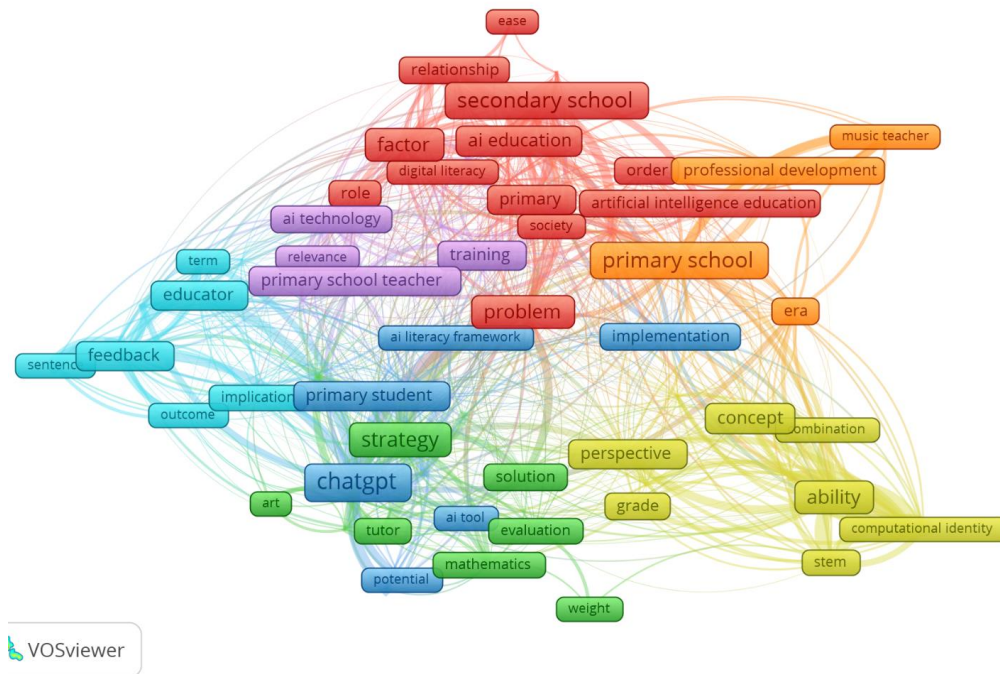
Figure 6. Most used keywords in the title and abstract section

The green cluster refers to problem solving and evaluation in education of arts and mathematics, whereas the orange cluster focuses on music teachers and professional development. It was found out that artificial intelligence is handled at elementary and secondary education levels together in red cluster, which examines the role of artificial intelligence in education, problem and digital literacy factors. The turquoise cluster includes studies examining feedback and outputs from instructors regarding AI integration. The blue cluster includes studies on primary school students, which also examine the integration and potential of Chatgpt as an AI tool. The findings reveal that the keywords in the yellow cluster include stem, perspective, ability, grade, and computational identity concepts.

4. Discussion and conclusions

This study determined the bibliometric analysis of studies on the usage of artificial intelligence in elementary education which are indexed in the Scopus database. Eighty studies published between 1988 and 2024 were examined, and it was found out that the highest number of studies were conducted in 2024. When the distribution of citations by year are examined, it was determined that 2021 was the year with the highest number of citations to these studies. Among the results obtained is that China is the country where the highest number of studies on the use of artificial intelligence in primary education are conducted. It was determined that the article document type was mostly preferred in the studies, and the keywords

"artificial intelligence", "education", and "Chatgpt" were frequently used by the authors. It was also found out that the keywords "art", "mathematics", "professional development", "artificial intelligence integration", "primary school students", "Chatgpt integration and potential", "Stem", "ability", "perspective" and "computational identity" were used in the title and abstract sections of the studies.

It is recommended that researchers who will conduct studies on the usage of artificial intelligence in primary education should take the results of this study into consideration.

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