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Chatbots in Education: A Bibliometric Analysis of Publications from 2013-2023

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Abstract

This study aims to analyze the development trend of researching articles related to chatbots in education. The method used in this study was bibliometric analysis with the help of the VOSViewer application. Publication data was collected using the Publish or Perish application to obtain article data in Google Scholar-indexed journals. This study analyzed publications from 2013 to 2023. An initial search found a total of 606 articles. The data was then processed and double-checked using the Microsoft Excel application. After double-checking, several articles were found that were the same, so the total number of articles collected was 598. The research development trend has increased yearly related to chatbots in education, except in 2023 because this research was conducted in june 2023. Topics often discussed recently besides the keywords used in searches were covid, higher education, natural language process, context, English performance, text, online learning, AI chatbot, and language learning. Most often used keywords were chatbot, analysis, learning, student, application, study, deep learning, system, machine learning, and machine. However, some topics should be discussed more, such as fields (fields of study in subjects) and analysis (analysis). It is expected that this study can be a starting point for other researchers to develop research on these topics.

Keywords: Chatbots; Education; Learning; Bibliometric Analysis.

Abstrak

Penelitian ini bertujuan untuk menganalisa tren perkembangan publikasi artikel penelitian terkait dengan chatbot dalam dunia pendidikan. Metode yang digunakan dalam penelitian ini adalah analisis bibliometrik dengan berbantuan aplikasi VOSViewer. Data publikasi dihimpun dengan menggunakan aplikasi Publish or Perish untuk memperoleh data artikel pada jurnal-jurnal yang terindeks Google Scholar. Penelitian ini menganalisa publikasi dari tahun 2013 sampai dengan 2023. Pencarian awal menemukan sebanyak 606 artikel. Data tersebut kemudian diolah dan dicek ulang dengan menggunakan aplikasi Microsoft Excel. Setelah pengecekan ulang ditemukan beberapa artikel yang sama sehingga total artikel yang dihimpun adalah 598. Tren perkembangan penelitian mengalami peningkatan setiap tahunnya terkait dengan chatbot dalam pendidikan, kecuali pada tahun 2023 karena

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penelitian ini dilakukan pada pertengahan tahun 2023. Topik yang sering dibahas baru-baru ini selain kata kunci yang digunakan dalam pencarian adalah covid, higher education, natural language process,context, english performance, text, online learning, AI chatbot, dan language learning. Kata kunci yang sering muncul adalah chatbot, analysis, learning, student, application, study, deep learning, system, machine learning, dan machine. Namun terdapat beberapa topik yang jarang dibahas seperti field (bidang kajian pada mata pelajaran) dan analysis (analisis). Sehingga dapat menjadi bahan eksplorasi bagi peneliti lain untuk mengembangkan penelitian pada topik-topik tersebut.
Kata Kunci: *Chatbots; Education; Learning; Analisis Bibliometrik.*

INTRODUCTION

Digital technology is rapidly developing, affecting various life aspects (Ismail, 2022). This era is referred to as the 5.0 era, where artificial intelligence, big data, the Internet of Things, and technological developments change the way people think and interact. One of the aspects affected by technological developments is the aspect of education. This led to a significant transformation in the world of education. Transformation in the educational aspect includes ways of learning, teaching, and future career preparation (Rafi & Putra, 2023). This transformation in the world of education allows educators and students to be more creative by utilizing existing technology.

The technology that is currently developing is Artificial Intelligence (AI). Artificial Intelligence (AI) is a computer system/program capable of performing tasks that usually require human intelligence by using data and analysis in making decisions and processing data. (Sobron et al., 2021). AI is widely used in sharing things to help humans. One of the AI that can support this educational transformation is a chatbot. According to the Lexico dictionary, chatbot is a computer program designed to simulate conversations with users, primarily via the Internet (Adamopoulou & Moussiades, 2020).

Chatbots are often used as virtual assistants with various purposes depending on the user, one of which is in the world of education. Currently, a lot of research is developing chatbots in the world of education, both as educational media, administrative systems, and others. Many studies have been found discussing chatbots in various journals, one of which is an analysis of the use of chatbots in education (Colace et al., 2018; Herfian & Adriansyah, 2021). Many of the studies focused on discussing how chatbots were created and then tested (Belda-Medina & Calvo-Ferrer, 2022; Fauziah et al., 2022; Wijaya et al., 2018; Zulkarnain

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et al., 2020). In the other words, the literature shows that research on chatbots in education is growing. Therefore, it is essential to investigate the development of research on chatbots in education.

Bibliometric analysis is one of the techniques that can be used in carrying out the analysis. Among various studies, there is still no bibliometric analysis on the development of publications related to chatbots in education. Therefore, this study aims to conduct a bibliometric analysis of articles about chatbots in education in journals indexed by Google Scholar using VOSViewer software to help visualize data mapping from articles that have been collected. It is hoped that this research will later become a reference for other researchers in determining research topics related to chatbots in education.

METHODS

Bibliometric analysis is an analytical technique used in this study. Bibliometric analysis is a meta-data analysis technique to help researchers understand the bibliography and analyze excerpts of an article published in a journal or other scientific work (Al Husaeni & Nandiyanto, 2022). In this study, bibliometric analysis was used to identify research trends, concepts, and keywords in bibliometric mapping for reviewing related publications (Busro et al., 2021). This research used VOSViewer for mapping data and presenting specific information about the research being conducted (Al Husaeni & Nandiyanto, 2022). Data was collected using Publish or Perish from the Google Scholar database. The use of Google Scholar as a database source is because the indexing engine is open source (Nuryadin et al., 2023). In this analysis, researchers refer to the four stages described by Al Husaeni and Nandiyanto (2022).

The first stage was the collection of publication data. This study collected publication data using the Harzing's Publish or Perish application with a database source, namely Google Scholar. The keywords used were "chatbot AND (learning OR education)" by limiting the year of publication from 2013-2023. It is also limited to the maximum column for the number of publication data search results, namely 1000 data, then the data were stored be stored as .ris files and .csv files.

The second stage was bibliometric data processing. Data collected using the Publish or Perish application in .csv format were then processed using Excel. The .csv file obtained from the Publish or Perish application was processed using Microsoft Excel. After that, the data were processed as needed.

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The third stage was bibliometric mapping which was done using the VOSViewer application. The data obtained from the Publish or Perish application in a .ris file format was imported to the VOSViewer application for computational mapping. In VOSViewer, there are three mapping forms: Network Visualization, Overlay Visualization, and Density Visualization.

The fourth stage was a computational analysis of the bibliometric mapping results. Analysis was carried out to retrieve important information related to chatbots in the world of education.

RESULTS

Publication Data of Chatbots in Education

The authors found 606 articles related to the keywords sought in that search. When checking again, 1 article was found that did not meet the criteria because the year of publication was not known after a manual search was carried out. Even in the checking stage, the author found several similar articles and deleted them. Thus, there were 598 articles that the author analyzed using VOSViewer. In this data, information can be seen in the form of the author's name, title, year, article, journal name, publisher, number of citations, article link, and related URLs. The number of citations from all articles collected in this study was 5118. The number of citations for each year was 511, 80, and the number for each article was 8.52. All articles' average h-index and g-index were 34 and 60, respectively.

The author then saved the data in the form of a .csv file, which were processed using Microsoft Excel later. Data processing was done by sorting each article collected by year. Sorting was done by sorting the articles based on the lowest and highest year, namely the lowest in 2013 and the highest year, namely in 2023.

Research Development of Chatbot in Education.

The research development in the publication of articles in Google Scholar-indexed journals is shown in Table 1. Table 1 shows publications for each year; namely, in 2013, there was only 1 number of publication; in 2014, there were some publications; in 2015, there were no publications; in 2016, there were five publications; in 2017, there were 16 publications; in 2018 there were 44 publications, in 2019 there were 73 publications, in 2020 there were 94 publications, in 2021 there were 135, in 2022 there were 160 publications, and

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in 2023 there were 68 publications. So, the total number of publications regarding Chatbot in education from 2013 to 2016 was 598, with an average of 54 publication per year.

Table 1. Distribution of chatbot in education publication per year

Year of Publication	Number of Publications
2013	1
2014	2
2015	0
2016	5
2017	16
2018	44
2019	73
2020	94
2021	135
2022	160
2023	68
Total	598

In the diagram presented, every year the research trend regarding chatbot in education continues to increase. This is related to the industrial revolution, which resulted in the development and many new inventions in the field of technology from time to time (Fernando & Fahruddin, 2023). The number of publication in 2023 is expected to be higher because this research was carried out in june 2023.

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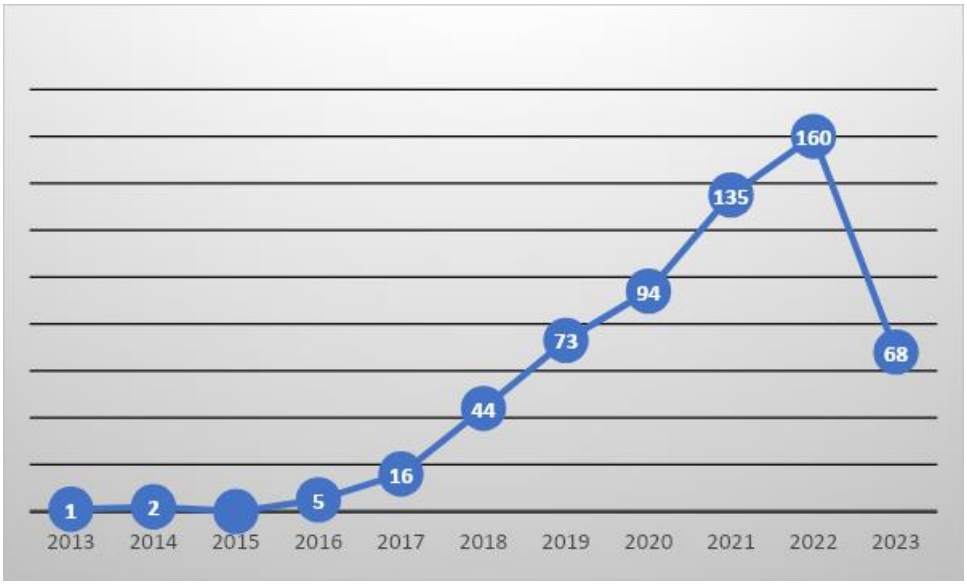

Graph 1. Distribution of chatbots in education publication per year.

Visualizations of Topic Areas of Chatbot in Education.

In the mapping results from the VOSViewer application, it can be seen that the relationship between each item is shown in each of the clusters. Each item is marked with a colored circle. The circle size for each item varies depending on the frequency of occurrence of each item. The mapping is based on the frequency with which an item/term appears in the title and abstract. So the more terms/items appear, the bigger the circle (Al Husaeni & Nandiyanto, 2022; Purwanto et al., 2023; Sukyadi et al., 2022). In this study, the mapping used three types of visualization: Network Visualization, Overlay Visualization, and Density Visualization.

Network Visualization

This network mapping shows the relationship between items/terms in research on chatbots in education. Figure 2 shows clusters of related items by showing the relationship between items. The mapping results found 61 words related to chatbots in education that are connected by lines. The items were divided into 7 clusters. Each cluster has different colour facilitate information mapping. The most frequently occuring keywords: chatbot, analysis, learning, student, application, study, deep learning, system, machine learning, and machine.

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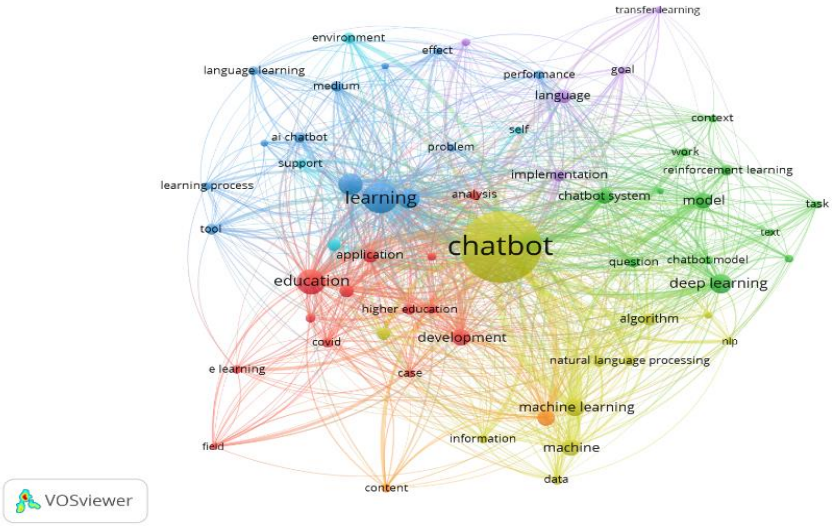

Figure 1. The network visualization map of co-occurrence of keywords.

Table 2. Distribution of keyword per cluster

VOSVIEWER DATA				
Number of cluster	**Items**	**Links**	**Total Link Strength**	**Occurences**
1	Analysis	63	1066	207
	Application	60	593	88
	Case	40	243	43
	Chatbot Application	43	215	32
	Chatbot Technology	27	160	25
	Covid	37	149	27
	Development	31	121	26
	E-Learning	31	121	18
	Education	23	108	19
	Field	27	104	18
	Higher Education	24	97	14
	Technology	32	92	20
	Use	23	86	16
2	System	50	411	75
	Deep learning	49	389	85
	Model	43	291	52
	Chatbot System	44	278	51
	Question	38	167	25
	Reinforcement Learning	26	101	25
	Work	29	101	19
	Task	2	86	14
	Context	26	82	16
	Chatbot Model	22	65	18
	Text	20	65	11
	Case Study	23	55	9
	Deep Learning Model	15	51	13

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3	Learning	60	1019	207
	Study	56	571	88
	Student	52	560	103
	Medium	26	156	25
	Tool	34	146	27
	AI Chatbot	27	114	26
	Language Learning	22	107	19
	Performance	27	104	18
	Effect	23	95	14
	Learning Process	23	86	16
	Problem	20	68	15
	Online Learning	20	66	10
	Effectivenes	21	60	12
4	Chatbot	60	4176	1113
	Machine Learning	41	391	65
	Machine	36	338	61
	Artificial Intelligence	40	209	31
	Algorithm	38	199	31
	Technique	34	164	23
	Natural Language Proces	34	153	25
	Data	30	134	23
	Information	32	109	18
	NLP	19	76	11
	Intelligent Chatbot	18	48	10
5	Language	41	238	45
	Implementation	39	191	32
	Goal	24	78	14
	English	23	63	13
	Transfer Learning	14	52	11
6	Platform	34	212	32
	Environment	26	141	25
	Support	28	118	18
	Self	20	63	13
7	User	43	302	53
	Content	15	89	17

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Overlay Visualization

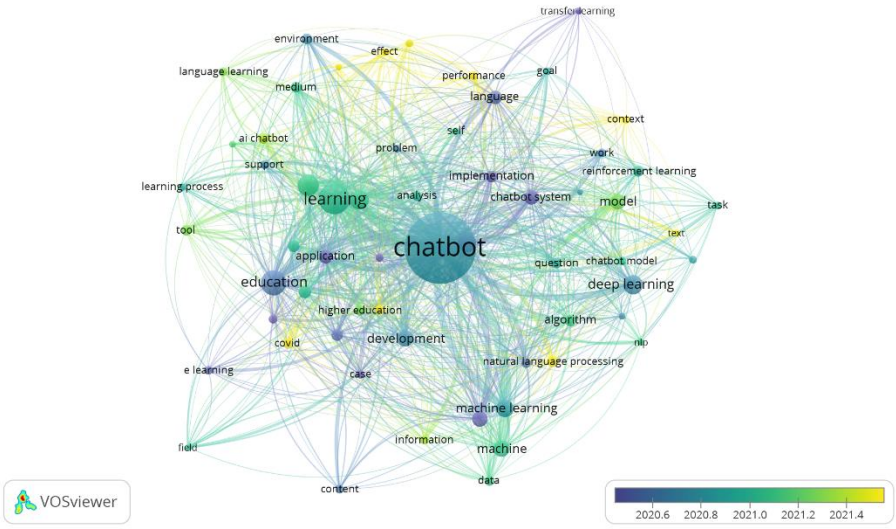

Figure 2. The overlay visualization map of keywords based on recent research.

Overlay visualization can show research updates from data entered into VOSViewer. The brighter the color, the more recent the research is (Sukyadi et al., 2022). In the meta-data of this research, issues regarding chatbots are still a trending topic but the amount of research that has been done is still limited. Keywords related to chatbots appeared the most between 2020-2022. The colour of yellow in the figure 3 was indicated the most often used keywords. Several keywords that have been frequently used lately are covid, higher education, natural language process, context, English performance, text, online learning, AI chatbot, and language learning.

Density Visualization

Density Visualization shows the density of keywords in yellow; the more yellow an item, the more research has been conducted related to it. It can be seen that the chatbot item becomes the yellowest word concerning the topic being researched. The other keywords/items with the most density are learning and education. Contrary to these words, several items/keywords have a less bright yellow color, such as the word “field”. This can be interpreted that research related to Chatbot and fields in the scope of education still needs to

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be improved. The words with the highest density are chatbot, learning, education, student, and deep learning.

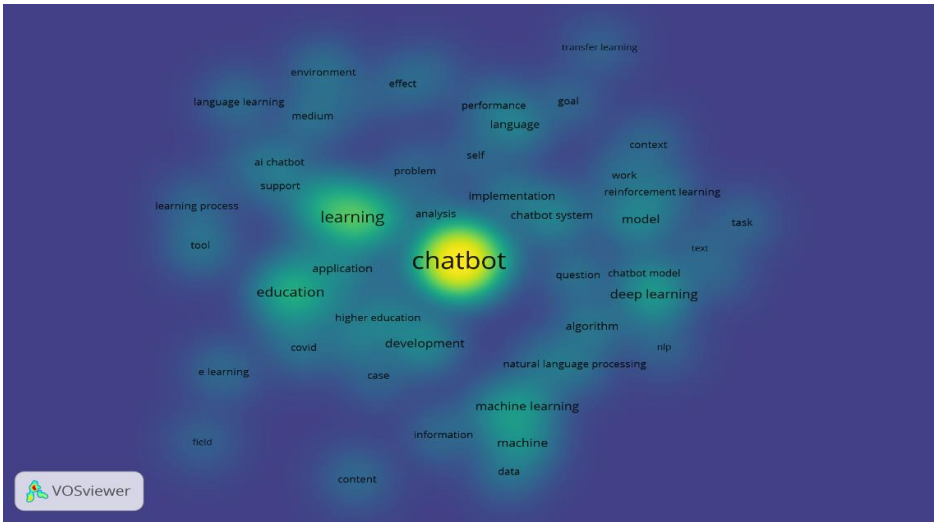

Figure 3. The density visualization map of keywords based on recent research.

DISCUSSION

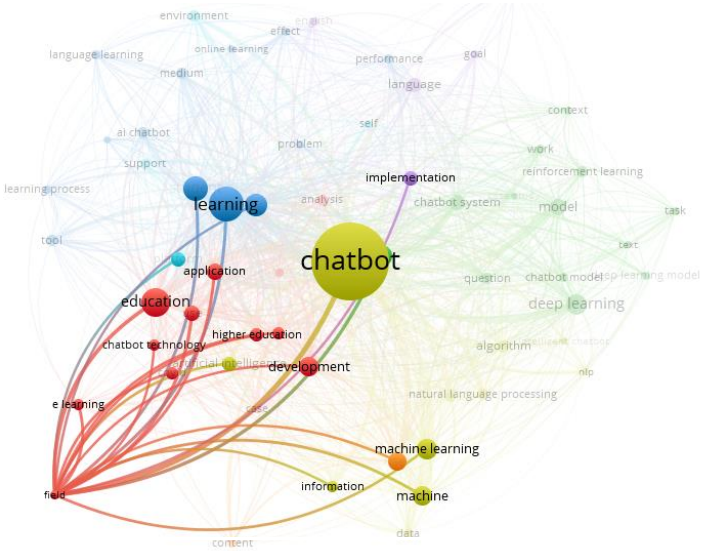

Figure 4. The connection of "field" with other keywords.

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Chatbot, fields, education, and learning are related to each other. This linkage keeps chatbot research open in the educational sphere. The openness of this research can indicate that the development of chatbots research in education can still be widely open for research. There still needs to be more research when viewed from the density visualization of the keyword "field". A field can be interpreted as a field or area rarely researched, so it can be an excellent opportunity to research various fields, especially in education.

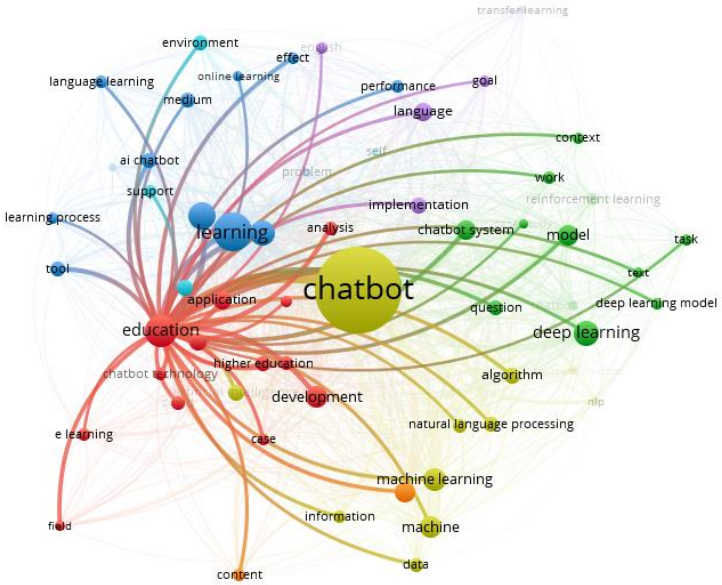

Figure 5. The word "education" connection with other keywords.

However, as can be seen here, there is one keyword related to Chatbot, education, and learning, namely language learning. It is indicated that language learning has been widely researched, one of which is research by Chen and Lin (2023) which discusses how to use Chatbot in learning english tense and testing it. The research found that AI Chatbot can help improve student learning outcomes in learning english tense and reduce their anxiety in learning the topic. There is also research related to language learning, namely research from Huang et al., (2022) who examined the use of Chatbot in language learning. This study explains that after conducting research, language learning using Chatbot encouraged students through effective, open, and coherent communication. Apart from learning, the other related words are e-learning, student, artificial intelligence, and development. One of the related

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studies is research from Febrilian Zulrahman and Syahputra (2023) which discusses how researchers develop Chatbot for E-Education in Islamic education. Another article is from Dewi et al., (2022) which explains chatbot training for teachers for educational transformation after the pandemic, indicating that many people are starting to become aware of using Chatbot to improve the quality of education.

One of the keywords/items that are often used lately is covid. There are several studies related to covid and Chatbot, one of which is research conducted by Qasem et al., (2023) who researched the use of Chatbot in learning English for specific purposes during the Covid-19 period. The study's results found that using Chatbot in ESP learning plays a significant role in improving and improving students' vocabulary. It was proven by the test results of the experimental class that outperformed the control class.

In the keywords found, there is the word NLP (Natural Language Processing). NLP is a computer program that can analyze the words the user gives and display answers that are appropriate and related to the words given (Bhattacharyya, 2019). NLP is often used for developing Chatbot as described by Adarsh et al., (2023) who stated *Chatbot* is a computer program that conducts conversations with users using Artificial Intelligence with NLP programs. NLP and chatbot have become something that is related to each other; there is much research related to these keywords, such as research from Hikmah et al., (2023) who developed Chatbot by applying Natural Language Processing. Moreover, there is also research from Aprilinda et al., (2022) which discusses making Chatbot for learning English using Natural Language Processing.

Most of the research on Chatbot that are related to learning of eductaion focused on English learning. For example, a study conducted by Fauziah et al., (2022) who developed a chatbot for mathematics in data presentation material for fourth grade elementary school children. In addition, there is also research that develops Chatbot for learning physics in elementary school (Anwarulloh & Dwi Agustia, 2019).

CONCLUSION

This research examines the trend of publishing articles that discuss Chatbot in education. The search for article meta data was done by using Publis or Perish to find articles published in Google Scholar-indexed journals, which is open source. The data obtain was then processed using Microsoft Excel and analyzed computationally with the help of the VOSViewer application. VOSViewer helps in visualizing the data into three types of visulizations:

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Network Visualization, Density Visualization, and Overlay Visualization. The initial search resulted in 606 articles. After double checking, several articles were eliminated, resulted in 598 that analyzed further. Then the data was processed by dividing the articles according to the year of publication in Microsoft Excel. It was found that research trends related to Chatbot in education are increasing every year. This increase can prove that over the years, the interest in Chatbot in education is increasing. This research presents these developments in the last ten years, namely 2013-2023, so research related to Chatbot in education is still in demand today. In mapping, it was found that topics frequently discussed recently besides the keywords used in the search process were covid, higher education, natural language processes, context, English performance, text, online learning, AI Chatbot, and language learning. The most frequently occurred keyword were chatbot, analysis, learning, student, application, study, deep learning, system, machine learning, and machine. There are many Chatbot that are used in language learning, especially English. Only a few studies discuss Chatbot in another fields. Therefore, research that cover other fields are crucially needed to create more learning innovations.

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