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Bibliometric Analysis on Artificial Intelligence Research in Indonesia Vocational Education

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ABSTRACT

The purpose of this study is to determine the development of research on artificial intelligence in vocational education. The method used in this study uses a bibliometric approach based on computational mapping analysis assisted by VOSviewer, based on searches from the Google Scholar database, and article titles used as a guide in the search process obtained from the keywords "Artificial intelligence, vocational, and Indonesia". From the search results, 330 articles were obtained from the search results on Google Scholar using Publish or Perish that are relevant to artificial intelligence in vocational education from the last 5 years (2020-2024). The results show an increase in 2020-2021, from 61 to 66 publications until a significant increase occurred in 2024, namely up to 102 publications. In 2024, articles on artificial intelligence in vocational education decreased, namely only 14 publications. The conclusion of this study will be a new object for researchers in conducting research related to artificial intelligence in education with a more in-depth study, especially in vocational education.

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1. INTRODUCTION

Technological advances encourage the digitization of learning tools and media, such as the use of Artificial intelligence (AI) in the learning process. AI has had a significant impact on various industries, including vocational education. AI can automate tasks, improve decision-making processes, and increase efficiency (Kong *et al*., 2023). However, technology also has the potential to negatively impact behavior (Sofyan & Hidayat, 2022). Exploring the challenges faced by education related to technological advances, the acceptance of technological digitalization into vocational education needs to be accompanied by awareness, literacy, ability, and criticism.

Previous research that discusses Artificial intelligence in education includes a discussion of the importance of AI in learning English (Hou, 2021) a review of the progress of AI research in the hospitality and tourism industry (Kong *et al*., 2023). Kong *et al*. (2023) discussion of training modes on AI (Wu & He, 2014), discussion on the influence of learning interest in electrical engineering (Riani & Effendi, 2024) and artificial intelligence in prosthodontics which is more focused on the health field (Lerner *et al*., 2014). Based on several previous studies on Artificial intelligence, there has been no research that analyzes research trends on Artificial intelligence using a bibliometric analysis approach assisted by mapping visualization (Lerner *et al*., 2020).

Recently, the use of bibliometric analysis has become a popular method in recent studies to identify research trends (Chiu *et al*., 2019; Saputro *et al*., 2023; Syafitri *et al*., 2023). Therefore, this study aims to analyze research trends regarding Artificial intelligence research in vocational education by using bibliometric analysis methods assisted by mapping analysis. This research also analyzes the development of research and the development of the number of citations on research on Artificial intelligence in education. Visualization mapping is used to determine the keywords of discussion in research on statistical significance tests.

2. METHODS

This research uses a literature review method with a bibliographic analysis system. The data used in this study are international publication data from journals indexed in Google Scholar assisted by reference management software, namely Publish or Perish. Until now, this software can only analyze articles in English. The collection data used in this article uses the keywords 'Artificial Intelligence', 'vocational', 'education', and 'Indonesia' for the period 2020 to 2024. Article data is stored in format (*.csv) so that it can be analyzed using Microsoft Excel software, and in format (*.ris). Thus, it can be analyzed and visualized using the VOSviewer application to find out the development of international publications, then make 3 types of mapping from sources that have been processed, namely Network Visualization, Density Visualization, and Overlay Visualization.

3. RESULTS AND DISCUSSION

3.1. Development of Artificial Intelligence Research in Indonesia Vocational Education Publications 2020-2024

Based on the results of research conducted using the publish or perish application based on Google Scholar data, 330 articles with relevant themes and meeting the criteria were released from 2020 to 2024. Article data consists of the author's name, year of publication, journal name, publisher, number of citations, article link, and citation URL. **Table 1** shows the number of publications each year with a total of 330 publications. **Table 1** shows the development of research related to Artificial Intelligence in vocational education for the last

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5 years, namely from 2020 to 2024 found on Google Scholar. In 2020 there were 61 articles published. In 2021 there were 66 articles. In 2022 there were 87 articles. In 2023 there were 102 articles and until 2024 there were 14 articles. From this statement, it can be concluded that the development of articles on Artificial Intelligence in vocational education has increased until 2023 but is still relatively rare as illustrated in **Figure 1**.

Table 1. Annual report on "Artificial Intelligence in Vocational Education".

Year of Publication	Number of Publications
2020	61
2021	66
2022	87
2023	102
2024	14
Total	330

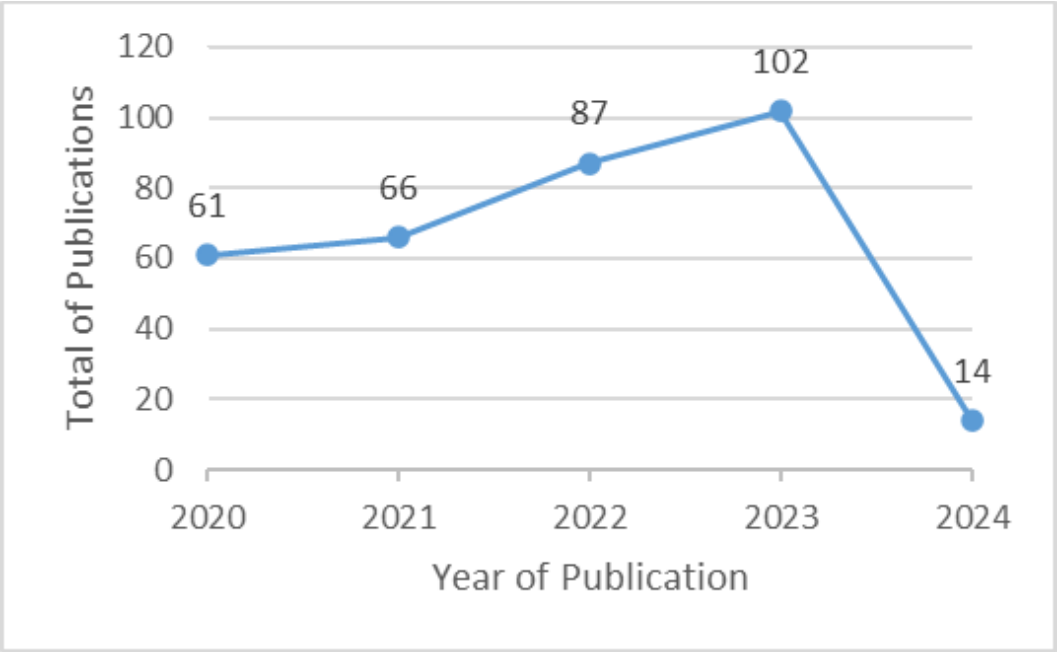

Figure 1: Research development level of "Artificial Intelligence in Vocational Education".

3.2. Trend of Statistical Artificial Intelligence Research in Indonesia Vocational Education Publications Citations 2020-2024

In the last 5 years, this study presents 20 articles with the highest citations. **Table 2** presents some metadata of the articles with the highest number of citations. It is known that the most citations are in the article with the title "EFL classes must go online! Teaching activities and challenges during the COVID-19 pandemic in Indonesia" written by Atmojo and Nugroho (2020) with a total of 820 citations. Based on **Table 2**, it is known that there are many articles with the publication year 2020 with the most citations, a total of 9 articles, in 2021 as many as 2 articles, in 2022 as many as 5 articles, and in 2023 as many as 4 articles.

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Table 2. Publication data of Artificial Intelligence in vocational education.

No.	Cites	Title	Year	Cites Per Year	Cites Per Author	Ref.
1	820	EFL classes must go online! Teaching activities and challenges during the COVID-19 pandemic in Indonesia	2020	205.00	410	(Atmojo & Nugroho, 2020)
2	268	The Influence of Training, Work Environment and Career Development on Work Motivation That Has an Impact on Employee Performance at PT. Suryamas	2022	134.00	268	(Sugiarti, 2022)
3	240	Adoption of artificial intelligence (AI) for talent acquisition in IT/ITeS organizations	2020	60.00	120	(Pillai & Sivathanu, 2020)
4	235	Antecedents of customers' acceptance of artificially intelligent robotic device use in hospitality services	2020	58.75	78	(Lin *et al.*, 2020)
5	155	Unlocking digital technologies for waste recycling in Industry 4.0 era: A transformation towards a digitalization-based circular economy in Indonesia	2022	77.50	39	(Kurniawan *et al.*, 2022)
6	147	The challenge of elementary school teachers to encounter superior generation in the 4.0 industrial revolution: Study literature	2020	36.75	37	(Rachmadtullah *et al.*, 2020)
7	126	Human resource management in the age of generative artificial intelligence: Perspectives and research directions on ChatGPT	2023	126.00	32	(Budhwar *et al.*, 2023)
8	121	The principal's strategy in preparing students ready to face the Industrial Revolution 4.0	2020	30.25	40	(Maryanti *et al.*, 2020)
9	120	The applications of artificial neural networks, support vector machines, and long-short term memory for stock market prediction	2022	60.00	40	(Chhajer *et al.*, 2022)
10	113	Artificial intelligence (AI) technology in OpenAI ChatGPT application: A review of ChatGPT in writing English essay	2023	113.00	113	(Fitria, 2023)

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Table 2 (continue). Publication data of Artificial Intelligence in vocational education.

No.	Cites	Title	Year	Cites Per Year	Cites Per Author	Ref.
11	112	The Identification of Online Strategy Learning Results While Students Learn from Home During the Disruption of the COVID-19 Pandemic in Indonesia	2021	37.33	56	(Sudarmo *et al.*, 2021)
12	109	The Role of Technology in Era 5.0 in the Development of Arabic Language in the World of Education.	2022	54.50	36	(Keshav *et al.*, 2022)
13	96	Trends in expert system development: A practicum content analysis in vocational education for over growing pandemic learning problems	2020	24.00	96	(Ana, 2020)
14	93	A review paper on artificial intelligence at the service of human resources management	2020	23.25	31	(Berhil *et al.*, 2020)
15	93	A study of artificial intelligence on employee performance and work engagement: the moderating role of change leadership	2022	46.50	23	(Wijayati *et al.*, 2022)
16	90	Text based personality prediction from multiple social media data sources using pre-trained language model and model averaging	2021	30.00	23	(Christian *et al.*, 2021)
17	86	The role of artificial intelligence (AI) in developing English language learner's communication skills	2023	86.00	17	(Rusmiyanto *et al.*, 2023)
18	76	Digital transformation in the Indonesian banking industry: Impact on employee engagement	2020	19.00	25	(Winasis *et al.*, 2020)
19	75	The effect of STEM-EDP in professional learning on automotive engineering competence in vocational high school	2020	18.75	25	(Nurtanto *et al.*, 2020)
20	68	Strengthening waste recycling industry in Malang (Indonesia): Lessons from waste management in the era of Industry 4.0	2023	68.00	17	(Kurniawan *et al.*, 2023)

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3.3. Visualization of Research Data Mapping of Statistical Artificial Intelligence Research in Indonesia Vocational Education

The results of network visualization regarding the development of vocational AI research in Indonesia are divided into 8 clusters with a total of 2932 links, resulting in. The network visualization shows that the terms generated from abstracts and keywords that are considered to match the keywords used during data collection are divided into 8 clusters as shown in **Figure 2**. Each item has different links, total link strength, and occurrence. Overall, based on the network visualization, the total items are 137, and the link strength is 6124. The following is a more detailed explanation of each cluster:

(i) Cluster 1 marked in red consists of 26 items, namely automation, career choice, competence, data, evidence, factor, field, growth, guidance, higher education, impact, Indonesia, industrial era, intelligence, life, pandemic, quality, republic, research, robotic, strategy, student, time, vocational, vocational training, worker.
(ii) Cluster 2 marked in green consists of 23 items, namely ability, adoption, bibliometric analysis, career development, compensation, effect, effort, empirical study, employee, employee performance, expertise, Indonesian student, influence, job satisfaction, lack, paper, performance, person, process, professional development, role, training, work.
(iii) Cluster 3 marked in red consists of 22, namely advantage, artificial intelligence, awareness, big data, career path, competency, development, experience, fact, focus, job, knowledge, machine, machine learning, management, perception, perspective, professional career, professional job, professional, organization.
(iv) Cluster 4 marked in blue consists of 19 items, namely analysis, artificial neural network, career guidance, country, course, example, implementation, internet, IoT, information, issue, job opportunity, part, problem, review, system, technology, thing, vocational education.
(v) Cluster 5 marked in purple consists of 14 items, namely challenge, education, engineering, era, exploration, industrial, revolution, institution, model, opportunity, professional educator, society, study, and teacher.
(vi) Cluster 6 marked in light blue consists of 12 items, namely advancement, career, change, ChatGPT, demand, digital transformation, human resource, human resource manage, implication, Indonesian, systematic literature rev, and tool.
(vii) Cluster 7 marked in orange consists of 12 items, namely advance, artificial intelligence techno, country, future, job loss, job market, lack, Malaysia, supercomputer, vocational high school, and vocational school.
(viii) Cluster 8 marked in brown consists of 9 items, namely application, case study, company, digital technology, importance, industry, job description, and level task.

The relationship of each item to the existing items is shown in the clusters listed. Each item in the cluster is given a circle with a different color in each cluster to facilitate the grouping of each cluster. The size of each item circle varies depending on the frequency of occurrence of the item. The size of the item circle shows a positive relationship with the occurrence of the term in the abstract and title. Therefore, it can be said that the more frequently the term is found, the larger the label size will be. The mapping visualization that has been analyzed in this study consists of several parts: network visualization (**Figure 2**), overlay visualization (**Figure 3**), and density visualization (**Figure 4**).

Density view is an item (label) that is marked the same as the visible item. Each item point has a color that depends on the density of the item at that time. This identifies that the color of a point on the map depends on the number of items associated with other items. This section is very useful to get an idea of the general structure of the bibliometric map by paying

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attention to the items that are considered important to analyze. Through this worksheet, we can interpret the most used keywords in a publication. Visualization of the co-word density map of research development of vocational AI research in Indonesia can be seen in **Figure 3**. **Figure 3** shows the density map which is the result of an analysis using all research development articles on vocational AI research both related and unrelated. The redder the denser, and the greener the sparser. In the figure, there will be 3 clusters when sorted by keywords.

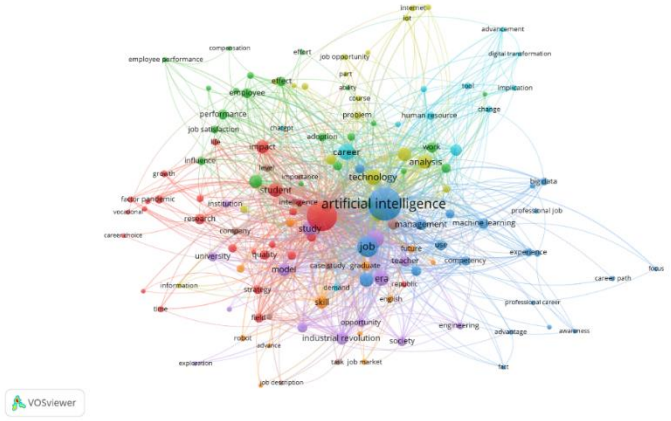

Figure 2. Network Visualization of the development of vocational AI research.

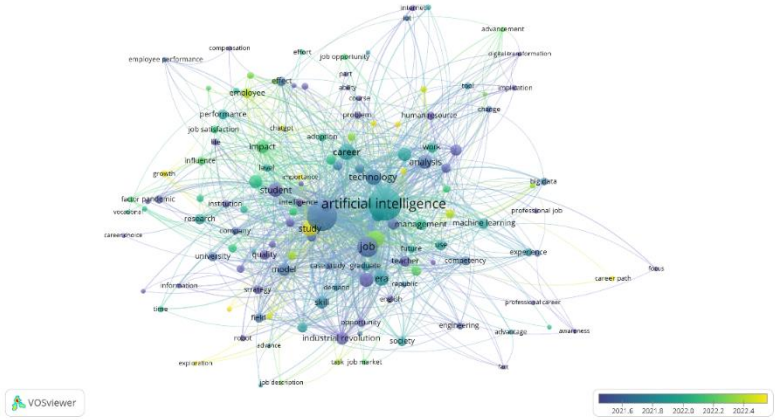

Figure 3. Overlay Visualization.

Density view is an item (label) that is marked the same as the visible item. Each item point has a color that depends on the density of the item at that time. This identifies that the color of a point on the map depends on the number of items associated with other items. This section is very useful to get an idea of the general structure of the bibliometric map by paying attention to the items that are considered important to analyze. Through this worksheet, we can interpret the most used keywords in a publication. Visualization of the co-word density map of research development of vocational AI research in Indonesia can be seen in **Figure 4**. **Figure 4** shows the density map which is the result of analysis using all research development articles on vocational AI research both related and unrelated. The more yellow or red the denser, and the greener the sparser.

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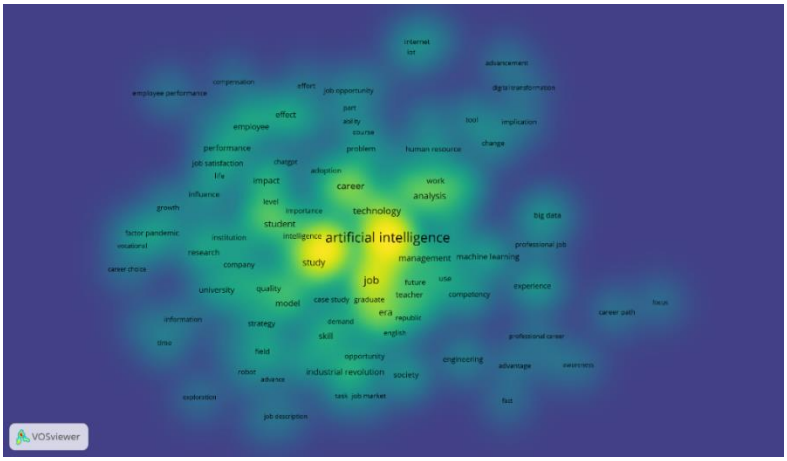

Figure 4. Density Visualization.

4. CONCLUSION

This article was created to analyze the bibliometric data mapping of research articles that have been conducted. The theme of this research is "AI in vocational education". The articles obtained are the results of the search. The search results used the Publish and Perish software application which was then processed with the help of Microsoft Excel software which then made a mapping analysis using the VOSViewer application. From the search results, there are 330 articles published from 2020 to 2024 that have titles relevant to the chosen theme. In 2020 there were 61 articles, in 2021 there were 66 articles, in 2022 there were 87 articles, in 2023 there were 102 articles, and in 2024 there were 14 articles. These results show that there are still many opportunities available to conduct research on AI in vocational education.

The terms used as keywords when used at the mapping stage using the VOSviewer application resulted in 137 items divided into 8 clusters marked with different colors. Each cluster has a different number of items, and each item has a different number of occurrences, links, and total link strength.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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