International Summit on Science Technology and Humanity
ISETH 2023
ISSN: 2807-7245 (online)

Bibliometric Analysis of Improfing Academic Performance in the Era of Industry 4.0: A Scopus-based Mapping (1969-2023)

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Abstract

This research aims to map improving academic performance in publications indexed by the Scopus database from 1969 – 2023. 1969 was chosen as the starting year based on findings in the Scopus database that in that year the first publication on improving academic performance was found. The analysis method used is bibliometrics to collect data from the Scopus database from 1969 to 2023 using the Boolean search engine. Data was analyzed using Excel and R/R-Studio. while VOSviewer is used to perform a visual analysis of the simultaneous occurrence of keywords and document quotes. The author found 1,612 publications that matched the specified function, subject, and criteria. The results of this research show an annual growth rate of 9.26%, indicating increasing interest in the topic & quot; Improving Academic Performance & quot; along with the development of the Revolution 4.0 era. The peak publication occurred in 2021. The United States (US) was the country that contributed the most with 560 documents, followed by China with 127 documents, and the UK with 117 documents. The most prolific writer was Bradshaw, CP. Perry, R.P. Skinner, C.H. leading with the number of publications of 4 documents. The authors recommend further research considering other national and international databases. This research provides a brief overview of the literature that can be accessed by researchers interested in "improving academic performance" in the Industrial Revolution 4.0 era and provides recommendations for future research.
Keywords: *Academic Achievement, Controlled Study, Curriculum, Learning System, Teaching*

Introduction

The Industrial Revolutionbecame a real manifestation of technological progress (Liu et al., 2020). general, the Industrial Revolution was a striking technological advance accompanied by important changes in social (Al-Rahmi et al., 2015) and economic aspects (Teixeira, 2016). The Revolution 4.0 terminology was first introduced by Hannover Messe Germany in 2011 by establishing intelligent manufacturing facilities to realize the concept of perfect manufacturing (Seresinhe et al., 2019). This era is a challenge for every human being to prepare themselves to face competitive global competition (Mamun-ur-Rashid & Rhman, 2017). The challenge of providing quality education (Masino & Niño-Zarazúa, 2016). considering the positive impact of the 4.0 revolution, helping wider job opportunities, and making human work easier, in this era is increasingly receiving attention both in the industrial and academic (Jiang et al., 2023; Salas-Morera et al., 2016).

Technological developments in the Industrial Revolution had a major impact on the fields of information and education (Alturki et al., 2021). The rapid development of the internet and computer technology has encouraged the modernization of information networks (Gao, 2021). Apart from the field of information networks, technology has an important role in helping create intelligent and competitive individuals in facing the challenges of globalization (Varouchas et al., 2018). Technological developments in education have changed it from conventional to modern (Ojetunde & Ramnarain, 2023). One way that can be done to improve the field of education in terms of technology is to change learning methods (D & D, 2022; Wang, 2021). Optimizing the use of technology as an educational tool is one solution to forming a creative, innovative, and competitive generation in the era of revolution. Utilizing technology in the learning process (Abirami et al., 2022) makes students more adept at using relevant devices and applications in the future, meaning that their readiness in the digital industrial world can be mastered easily.

Teachers and lecturers have become important figures in welcoming the era of the industrial revolution in education (Yustisia et al., 2021). Apart from preparing students who are competent in facing the era of revolution 4.0, the role of teachers and lecturers as the front guard in the world of education is required to be able to master the digital world (Poy & García, 2019) and be competent in their field Educators have a crucial role in ensuring the achievement of learning goals (Banda & Nzabahimana, 2023) by indicators that have been formulated according to students' needs, such as intellectual competence, motor skills, and emotional aspects. The quality of technology implementation pedagogy is determined by the teacher's knowledge and skills. Considering that students are the millennial generation who are no familiar about the

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world of industrial technology. Student academic achievement (Meng & Zhang, 2023; Schiller et al., 2018; Wilton et al., 2021) has an important role in producing competent graduates for countries to advance national development. Achievement indicates that, if teachers work in a conducive environment, student achievement will also increase. Maintaining the enthusiasm of teachers and employees to achieve school goals at a high level throughout their careers is a very significant aspect.

Teachers have a big challenge in educating students (Abushandi, 2021) in the millennial generation. Millennial students are synonymous with the gadgets in their hands. Therefore, educators are expected to have the ability to encourage students to use gadgets to achieve student competency (Gearhart et al., 2012). However, it cannot be denied that the digital divide includes differences between individuals who have access to technology and those who do not, both in urban and rural areas.

The main problem is the absence of bibliometric mapping of educational databases (Apriantoro et al., 2022, 2023). Therefore, this research aims to map improving academic performance in publications indexed by the Scopus database from 1969 - 2023. 1969 was chosen as the starting year based on findings in the Scopus database that in that year the first publication on improving academic performance was found. The research procedure can be seen in the diagram in Figure 1.

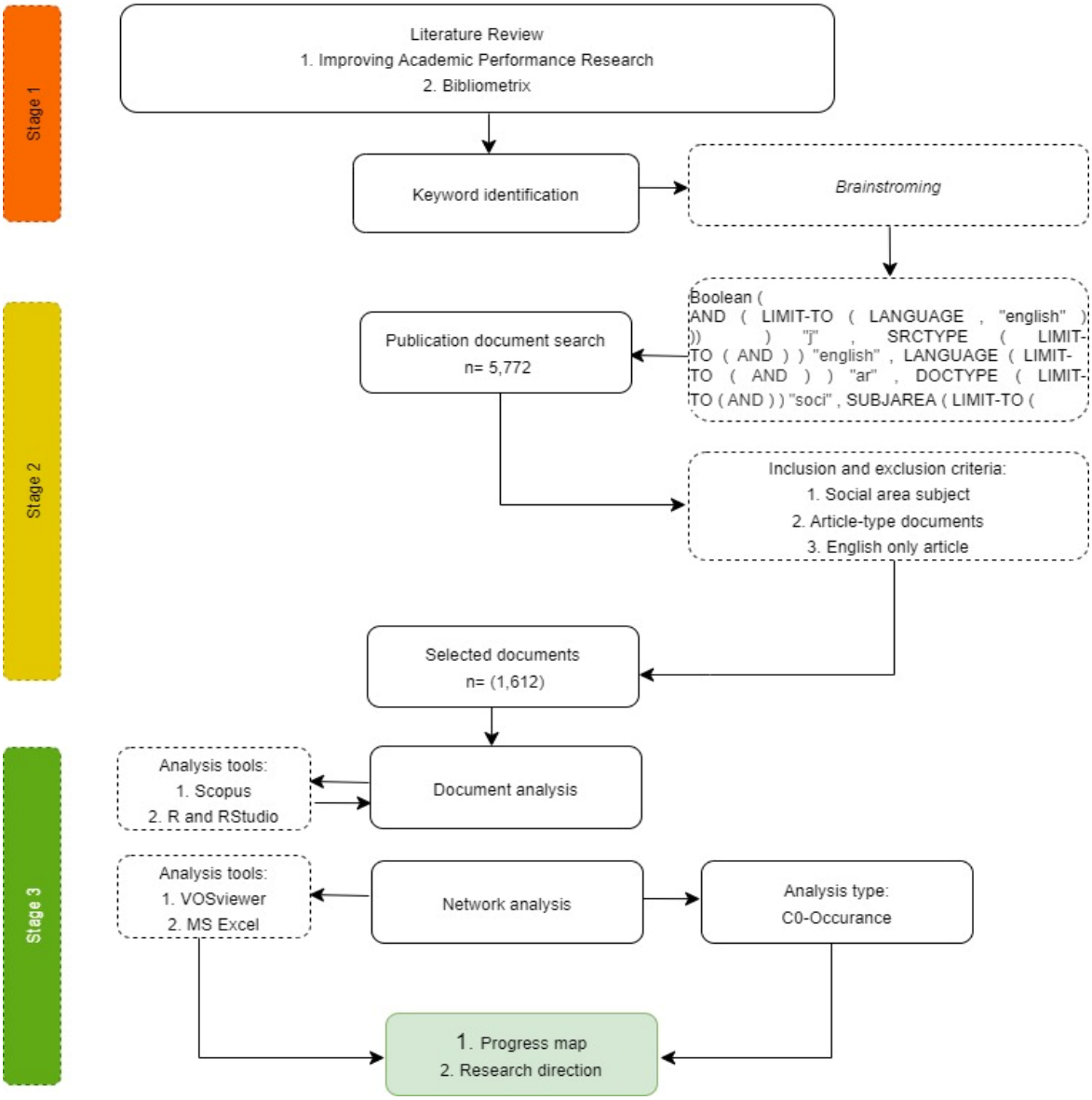

Figure 1. Research procedures

Result and Discussion

Document Analysis

The results and discussion in this section contain the results of document analysis. The researcher completes this analysis with pictures, tables, and bibliometric analysis. The research carried out analyzed documents spanning the period 1969 – 2023. To make it easier, the researchers described them in Table 1.

Table 1. Research Period Documents

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1969 : 2023
Sources (Journals, Books, etc)	749
Documents	1612
Annual Growth Rate %	9,89
Document Average Age	7,41
Average citations per doc	16,58
References	70357
DOCUMENT CONTENTS	
Keywords Plus (ID)	2902
Author's Keywords (DE)	4429
AUTHORS	
Authors	4904
Authors of single-authored docs	255
AUTHORS COLLABORATION	
Single-authored docs	255
Co-Authors per Doc	3,23
International co-authorships %	14,21
DOCUMENT TYPES	
Article	1612

Table 1 shows research documents covering the period from 1969 to 2023. The documents analyzed in this dataset were published or relevant in that period. There were 749 sources used in this research, including journals, books, and other sources. This indicates the diversity in the reference sources used by the authors in the research. In this research, there were 1,612 documents. Includes a variety of papers, reports, or other scientific works that may have different topics, methods, or objectives.

The annual growth rate of 9.89% indicates that the number of research documents in this data has increased significantly over the period from 1969 to 2023. The average age of documents in this data is 7.41 years. This shows these documents have been in existence for an average of 7.41 years since their publication. This age can reflect the relevance or actuality of the research in the dataset. Meanwhile, an average of 16.58 citations per document shows the extent to which these documents have been cited in other scientific literature. The higher the average citations, the more influential the research.

References in this dataset total 70,357, this shows the extent to which authors refer to other sources in their research documents. There are also 2,902 additional keywords (keywords Plus) and 4,429 author keywords (Author's keywords) in the dataset. These keywords can provide insight into relevant research topics in these documents. There were a total of 4,904 authors involved in writing the documents in the dataset, indicating collaboration and contributions from various authors. A total of 255 documents are single documents written by one author without collaboration.

An average of 3.23 collaborators per document indicates significant collaboration in the research presented in this dataset. The percentage of 14.21% indicates that the majority of author collaborations in the dataset are international collaborations, reflecting the global nature of this research. All documents in this dataset are research articles. This indicates that the documents are scientific works containing the results of research and analysis in various fields.

Document by Year

Every year scientific publications increase, but several years fluctuate. This increase was driven by technological developments in the education sector. To make the explanation easier, the researcher has included it in Figure 2.

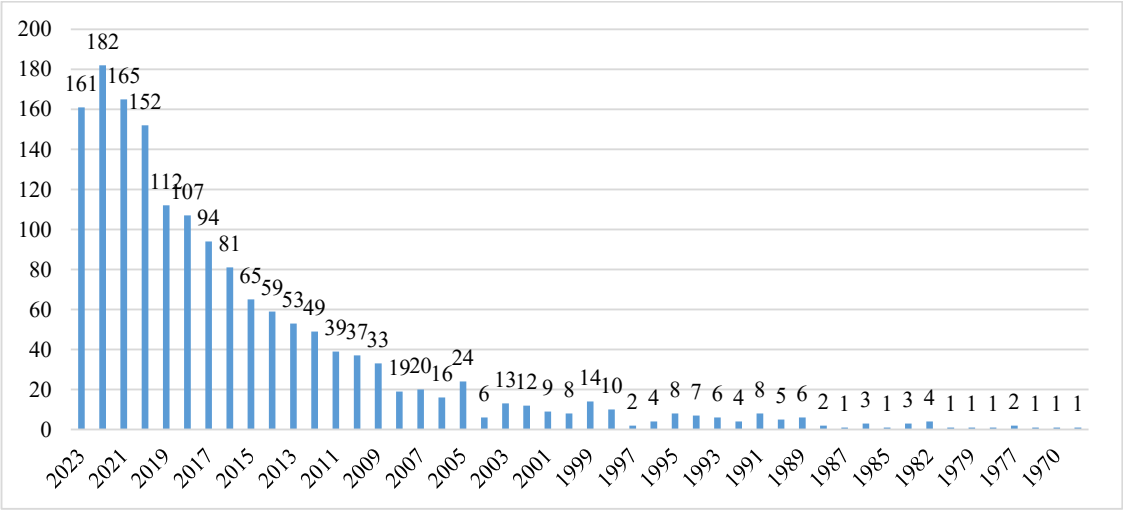

Figure 2. Development of Publication by Year

Figure 2 shows the development of publications on the theme of Improving academic performance. Based on this graph, in 1969 "improving academic performance" first appeared in this year's research. Meanwhile, between 1970 and 1981, there was a period of stagnation in publications on this theme with a relatively low number of publications. In 2022 there will be a big spike in publications about "improving academic performance" which will reach its peak in that year.

This graph reflects the fluctuation pattern in research interest in the topic of "improving academic performance" over time. This research may depend on factors such as educational trends, government policies, or changes in societal needs that influence research interest and focus in a particular period.

Most Relevant Authors

Authors have a relevant role and are often cited in research. The more citations there are, the more citations from each author will increase. The 10 most influential authors analyzed by researchers in publications on Improving academic performance. You can see Figure 3.

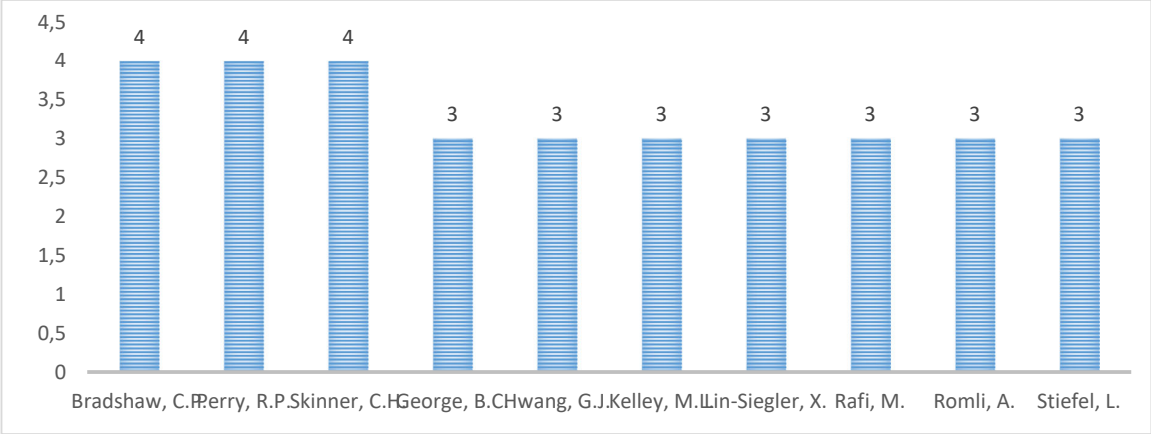

Figure 3. Most Relevant Authors in Publication

Figure 3 shows the ten most influential authors in publications on Improving academic performance. Bradshaw, CP, Perry, R.P, and Skinner, CH are the most influential authors in research on "improving academic performance" with four documents each. They may have made a significant contribution to the development of literature in this area. Apart from these three authors, seven other authors also contributed quite significantly to this research, namely George, Hwang, Kelley, Lin-Siegler, Rafi, and Romli with 3 documents each. This shows that several researchers are active in exploring this topic. In some cases, authors may have the opportunity to collaborate further in their research because they have worked on the same or related topics. This can strengthen research and generate a diversity of thought.

Document by Affiliation

Documents based on influential affiliations will be presented by the researcher in the form of Figure 4. This figure shows the ten most influential affiliates in publications about "improving academic performance", from this figure it can be seen that the two leading affiliates in the number of publications for each University of Granada are leading with 15

documents, followed by The University of North which has contributed 14 documents. This shows that these two institutions have made a significant contribution to the development of literature on "improving academic performance". Meanwhile, the University of Toronto, Columbia University, University of California, Irvine, Arizona State University, and New York University are also affiliate groups that are very active in this research with a fairly high number of publications. See Figure 4.

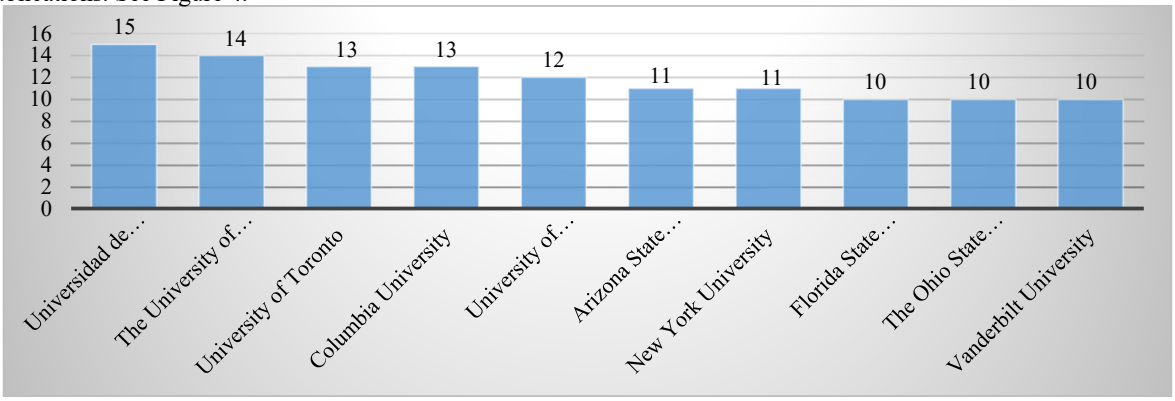

Figure 4. Affiliation Influences Publications

Document by Country

Researchers will present documents based on countries in the form of images that provide information related to academic publications based on countries with the theme "Improving Academic Performance". From this figure it is clear that the United States leads in publications with 560 documents, showing a significant contribution to research related to "Improving Academic Performance". China (Asia) is in second place with 127 documents, showing a significant contribution to research related to this theme and the United Kingdom is in third place with 117 documents, also making significant contributions to research related to the theme "Improving Academic Performance."

Spain contributed 102 documents, showing its role in the development of this topic in Europe. Followed by Australia with 84 documents, showing contributions from the Oceania region on this topic. Meanwhile, India has contributed 56 documents, showing contributions from Asia in developing topics related to "Improving Academic Performance." Canada produced 46 documents, also making important contributions. Malaysia produced 45 documents, demonstrating its role in further understanding this theme in Asia. Followed by Taiwan with 44 documents, showing its contribution in developing this topic in Asia and South Africa providing 38 documents, showing contributions from Africa in research related to "Improving Academic Performance."

It is important to note that countries on the Asian continent have made a significant contribution to the development of this topic, with 4 of them making important contributions. This indicates that research with the theme "Improving Academic Performance. Tends to be popular and is mostly done by countries on the Asian continent. Therefore, researchers include it in Figure 5.

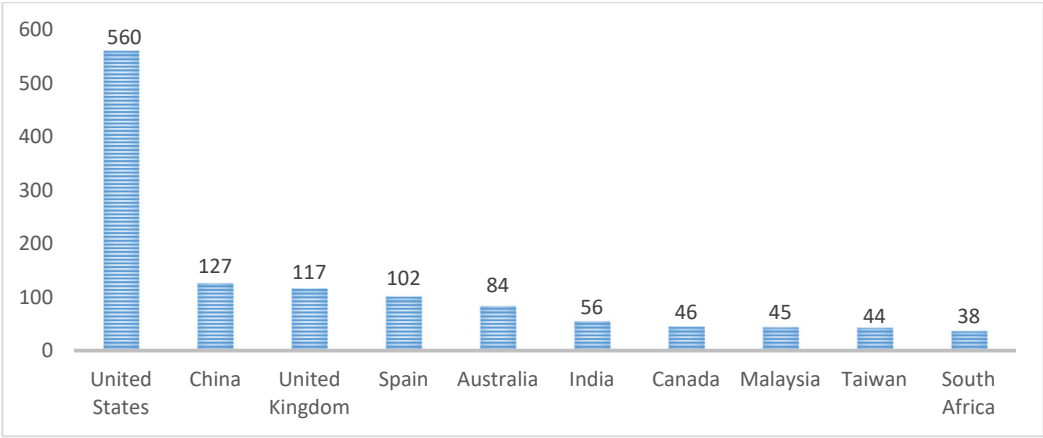

Figure 5. Academy Publications by Country

Three-Field Plot

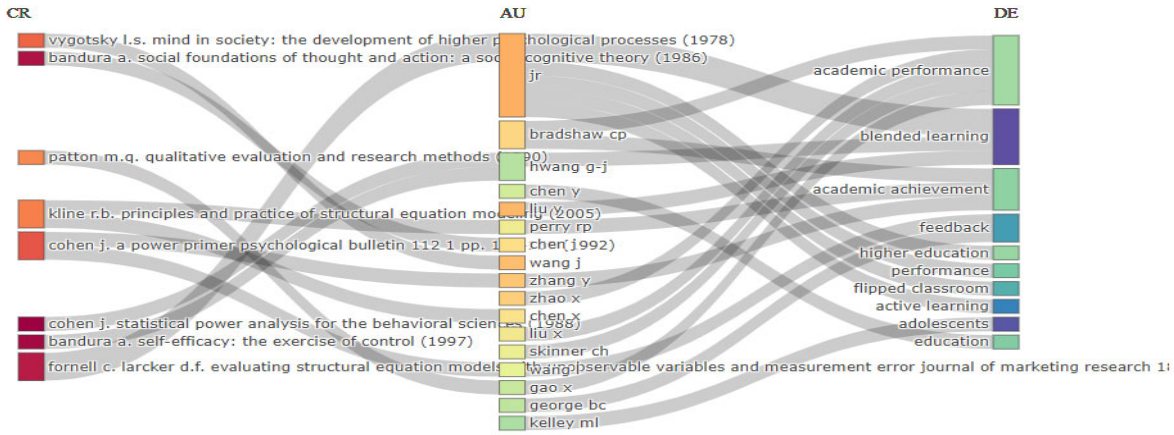

Figure 6. Relationship between Journal Publication Name, Author and Research Theme

Figure 6 visualizes the relationship between the name of the journal publication, the author, and keywords related to the research topic "Improving Academic Performance". The journal that publishes the most research with the theme "Improving Academic Performance" is "Computer and Education", marked in dark red in the image. There are 17 authors related to this theme. The authors who most often contribute to articles on the theme "Improving Academic Performance" are Jr, Bradshaw CP, and Hwang g-j, as shown by the larger size of the bar chart. In the third element, each research topic is connected to an author who has written extensively on the topic of "Improving Academic Performance". From the results of the analysis, there are 10 keywords. "Academic performance", "Blended learning" and "Academic achievement" occupy the top positions, showing a close connection with research in the context of "Improving Academic Performance".

Correponding Author's Countries

The countries with the largest number of Senior Corresponding Authors (SCP) are the USA (United States), China, and Spain (Spain). The high number of SCPs from these countries indicates that they had a major contribution in the role of lead author or author who had a senior role in the research. Meanwhile, the countries with the largest number of Main Corresponding Authors (MCP) are the USA (United States), China, and the UK (England). The high number of MCPs from these countries indicates that they had a major contribution as lead authors or authors who had a major role in the research. The USA and China are the two countries that dominate in the role of main author or senior author in research based on both SCP and MCP, with Spain and the UK also having significant contributions, especially in the role of SCP and MCP. This shows that these countries have an important role in scientific contributions related to the themes or topics discussed in the data. You can see Figure 7.

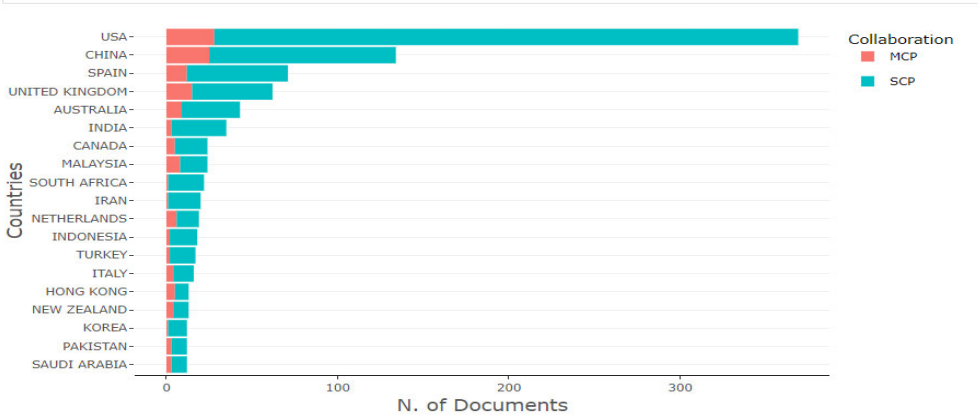

Figure 7. Countries by SCP and MCP

Most Global Cited Document

Through data analysis, the paper with the most citations is "HANUS MD, 2015, COMPUT EDUC" with a total of 956 citations. This shows that this paper has had a significant influence on the scientific literature, measured by the number of citations it has received. Even though "HANUS MD, 2015, COMPUT EDUC" has a high total citation, this paper has the highest TC per year (number of citations per year) with a value of 106.22. This shows the high frequency of citations received each year, reflecting the sustainability and popularity of this paper over a certain period.

The analysis of the data obtained, it shows that there is no clear relationship between the year the paper was published and the total citations received. Even though "HANUS MD, 2015, COMPUT EDUC" has a very high total citation, several papers with older publication years also have quite significant citations. This shows that factors other than the year of publication also influence the number of citations obtained by a paper. Meanwhile, Normalized TC takes into account the number of citations per year and provides a more even picture of the impact of publications in a certain period. Some papers have high Normalized TC "HANUS MD, 2015, COMPUT EDUC" and "LONGONI A, 2018, J BUS ETHICS", indicating a significant influence in these publications over time. For example as seen in Table 2.

Table 2. Scientific Publication and Citation

Paper	Total Citations	TC per Year	Normalized TC
HANUS MD, 2015, COMPUT EDUC	956	106,22	29,44
CARLO MS, 2004, READ RES Q	411	20,55	3,74
CLAESSENS A, 2009, ECON EDUC REV	288	19,20	9,68
QIAN DD, 1999, CAN MOD LANG REV	263	10,52	7,45
ZIV A, 2005, MED TEACH	213	11,21	4,17
KING G, 2001, WORLD POLIT	199	8,65	4,66
ADAMS KS, 2000, J SCH PSYCHOL	198	8,25	3,22
LONGONI A, 2018, J BUS ETHICS	185	30,83	10,79
WILSON TD, 1982, J PERS SOC PSYCHOL	177	4,21	2,12
HSIEH P-H, 2007, J ADV ACAD	174	10,24	3,33

Network Analysis

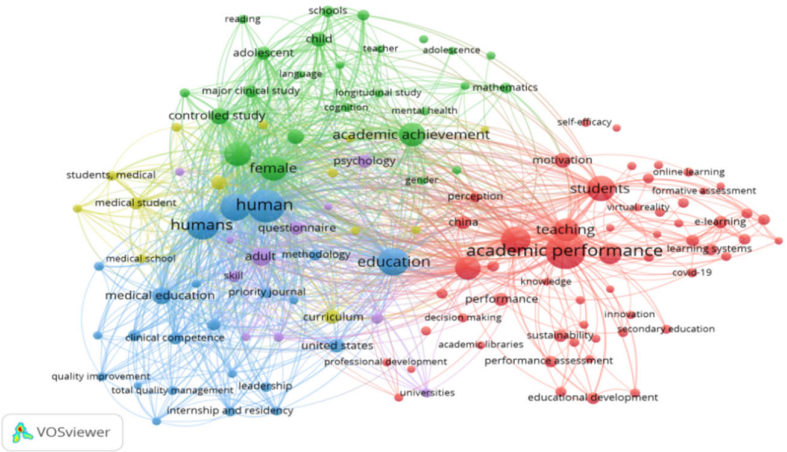

Figure 8. Network Occurrence Analysis

Network analysis in Figure 8, which is an occurrence analysis of research on improving academic performance, identifies 5 main clusters with a minimum cluster size of 13. Cluster 1 consists of 57 items related to the research topic, cluster 2 consists of 25 items, cluster 3 consists of 23 items, cluster 4 consists of 14 items, and cluster 5 consists of 11 items. The keyword "academic performance" is the dominant keyword with a total link strength of 1089. This shows that the topic "academic performance" is the main focus of this research.

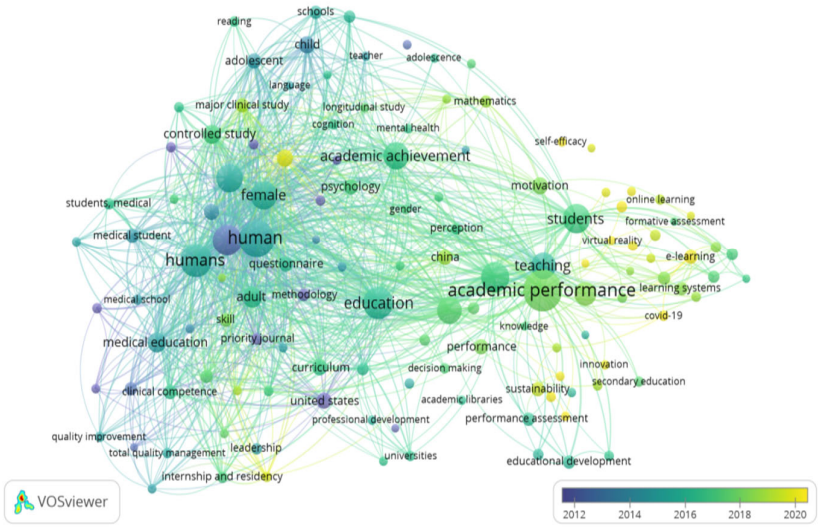

Figure 9. Keyword Network Analysis based on Overlay

Figure 9 shows the keyword network analysis based on overlay. It can be seen that the keyword "Human experiment" is a popular keyword in 2020. This indicates an increase in interest or research related to the topic "improving academic performance" in that year. Meanwhile, the keywords "methodology", "achievement", and "psychological aspect" are keywords that have been used for a relatively long time since 2012. Apart from Figure 9, the researcher also includes them in Figure 10 as follows.

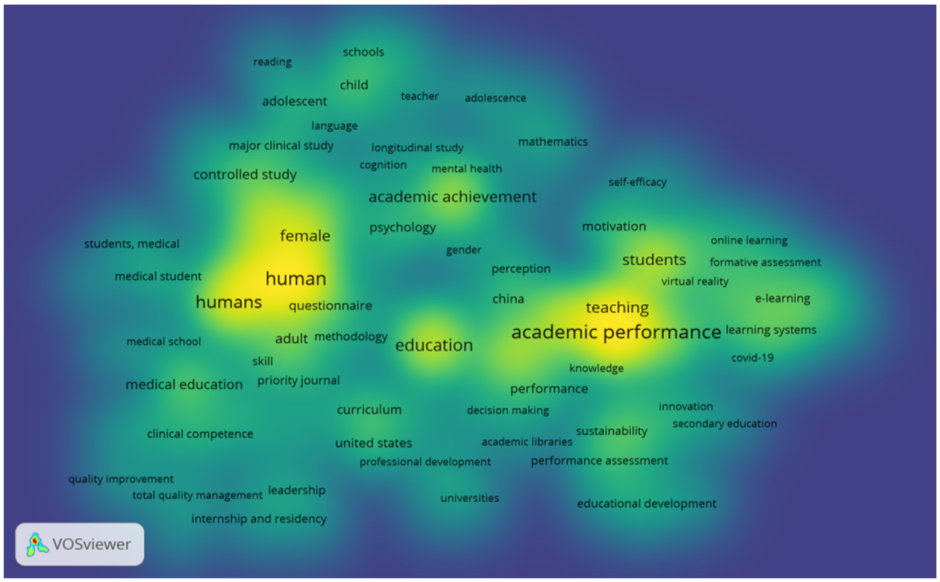

Figure 10. Research Density Analysis

Figure 10 shows a research density analysis describing the frequency distribution pattern of keyword use in the literature. From this image, several keywords such as "academic performance", "teaching", and "human" show a significant level of occurrence. Meanwhile, keywords displayed in the image with a blurry appearance, such as "quality improvement", "internship and residency", and "educational development" have a lower frequency of appearance, indicating that this topic may still be rarely researched and does not have a significant frequency. You can see Table 3.

Table 3. Keywords in The Main Cluster

Keyword	Occurrences	Cluster
1. Academic performance	279	1
2. Teaching	112	
3. Student	141	
4. Learning	111	
5. Educational development	50	
1. Academic achievement	122	2
2. Controlled study	58	
3. Schools	29	
4. Educational status	18	
5. Reading	17	
1. Human	233	3
2.Education	169	
3.Medical Education	67	
4.Medical school	18	
5.Quality improvement	18	
1. Curriculum	43	4
2. Medical student	34	
3. Student, Medical	22	
4. Educational	18	
5. Medical school	18	
1. Psychology 39	39	5
2. Questionnaire 37	37	
3. Skill	28	
4. Survey and questionnaires	16	
5. Young adult	20	

Table 3 shows the occurrence in each cluster which represents the main themes in research in the field of improving academic performance. Several keywords such as "academic performance", "teaching", and "human" have a significant level of occurrence, indicating a strong research focus on these topics. On the other hand, the keywords "quality improvement", "internship and residency", and "educational development" have a lower frequency of appearance, indicating that this topic may still be rarely researched and does not have a significant frequency.

From the table above, it can be seen that keywords are divided into 5 main clusters, each of which has a main theme related to research in the field of "improving academic performance". The theme in the first cluster is Improving teaching and learning has an impact on educational development. The theme in the second cluster is competent medical personnel and an effective health system. The theme in the third cluster is improving the quality of medical education. The theme in the fourth cluster is the medical school curriculum. The themes in the fifth cluster are individual development, research, and a more holistic understanding of young adult life stages.

This analysis provides insight into the research focus on the topic of "improving academic performance" in the academic community, including the level of keyword density that indicates different levels of interest and research in this sub-topic. This can help researchers or practitioners to understand trends and research areas in depth to develop better understanding and practice in improving academic performance.

Conclusion

Publications with the theme "improving academic performance" claim to peak in 2022, indicating increasing interest in this topic. This reflects increasing awareness and attention to improving academic performance among researchers and practitioners. Meanwhile, the most relevant author on this theme is Bradshaw, CP. Perry, R.P. Skinner, C.H. became the most relevant author with a total of 4 publications each. Their contribution shows an important role in advancing research on "improving academic performance".

The United States (US), China, and England are the countries with the largest author contributions (MCP) to the theme "improving academic performance". This indicates the leading role of these countries in producing quality research in this field. The document most cited globally is Hanus MD, 2015, Computeduc with a total of 956 citations. The keyword "academic performance" is the dominant keyword with a total link strength of 1089. This shows that aspects of academic performance are the main focus of the literature analyzed. This research has limitations, including limited exploration of datasets that are only indexed in Scopus, as well as limitations on analysis of English language documents. In addition, this study does not consider other global indexations, languages other than English, and document types other than journal articles.

Topic Keywords “Improving Academic Performance” is an important and growing research subject, with interest increasing in recent years. Major contributions date from prominent authors and affiliated institutions primarily in the United States, China, and the United Kingdom. However, it is important to remember that these data are representative of a limited dataset and there is potential for further research involving broader coverage.

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