BIBLIOMETRIC ANALYSIS OF RESEARCH TRENDS IN THE IMPLEMENTATION OF PROJECT-BASED LEARNING MODELS IN MATHEMATICS LEARNING

Ahmad Nurul Huda[1], Sariyah Damayanti[2], Ahmad Al Khafidz Razak M [3]
Nurul Husnah Mustika Sari, M.Pd [4].
K.H. Abdurrahman Wahid State Islamic University
Email: ahmadnurulhuda160403@gmail.com, sariyahdamayanti005@gmail.com, alkhafidzahmad5@gmail.com, nurul.husnah.ms@uingusdur.ac.id

ABSTRAK

Pendidikan merupakan upaya sadar untuk mempersiapkan siswa menghadapi masa depan. Oleh karena itu, banyak upaya yang telah dilakukan dalam mengebangkannya guna mempersiapkan generasi penerus bangsa yang lebih baik. *Projec- Based Learning* merupakan model pembelajaran yang saat ini banyak diimplementasikan diberbagai instansi pendidikan. Model pembelajaran ini mendorong siswa agar lebih aktif, mandiri dan kreatif dalam memecahkan suatu masalah. Ini menyajikan analisis bibliometrik terkait model pembelajaran *Project-Based Learning* dalam pembelajaran Matematika meliputi tampilan yang banyak di rujuk, keyword dan yang sering merujuk dengan menggunakan database Scopus dan dibatasi untuk artikel. Studi ini mengkaji artikel-artikel penelitian yang membahas *Project-based Learning* pada pembelajaran Matematika. Analisis ini menunjukan artikel dalam rentang waktu 2019-2023 kemudian di olah menggunkan *softwere* Vosviewer. Setelah dianalisis terdapat peningkatan penerbitan artikel pada tahun 2019 sampai 2020 setelah itu disusul pada tahun 2022 sampai 2023 dengan keyword yang paling banyak dirujuk yaitu "Project Based Learning".
Kata kunci: *Project-Based Learning*, Mathematics Learning, *Bibliometrict*

ABSTRACT

Education is a conscious effort to prepare students to face the future. Therefore, many efforts have been made to develop it in order to prepare a better future generation for the nation. Project-Based Learning is a learning model that is currently being implemented in various educational institutions. This learning model encourages students to be more active, independent and creative in solving problems. This presents a bibliometric analysis related to the Project-Based Learning model in Mathematics learning including views that are frequently referred to, keywords and those that are frequently referred to using the Scopus database and is limited to articles. This study examines research articles that discuss Project-based Learning in Mathematics learning. This analysis shows articles in the 2019-2023 time period which were then processed using Vosviewer software. After analysis, there was an increase in the publication of articles in 2019 to 2020, followed by 2022 to 2023 with the most frequently referred keyword, namely "Project Based Learning".
***Keywords** : Project-Based Learning, Mathematics Learning , Bibliometrict*

INTRODUCTION

Education according to KBBI is the process of changing the attitudes and behavior of a person or group of people in an effort to mature humans through teaching and assessment efforts (Apriadi et al. 2022). Education is a means of developing students' interests so that students are expected to become knowledgeable, knowledgeable, creative and inovative people. In simple terms, education is often defined as a person's effort to develop their personality in accordance with the values of society and culture. The concept of education or pedagogy refers to the guidance or assistance provided to a group of people so that they become more mature in their development (Anto and Anita 2019). Apart from that, education is defined as the effort of a person or group of other people to become adults or achieve a higher standard of living.

Education, learning media communication is one of the key factors in the development of a nation. Responding to the increasing development of technology and communication, the aim of education is also to improve the quality of human resources to produce individuals who are intelligent, skilled, independent and of character. One of the supporting factors to help, improve education and learning media is contained in the 2013 curriculum. The 2013 curriculum aims to increase curiosity, trigger creative and active learning in mathematics, the 2013 curriculum is implemented in Indonesia because it is suitable for the aspect of training students to be independent and to emphasize character education (Sukarmin, Putri, and ... 2023). In this curriculum, the educational unit carries out planning, implementation and evaluation of the learning process using models and approaches used to develop classroom learning.

According to Thomas JW in Uum Murfiah (2017*), Project-Based Learning* is a learning model that emphasizes student-centeredness in a project. This allows students to work independently to build their own learning and will culminate in a realistic result, such as work produced by the students themselves (Khamdanah, Wijaya, and Sabila Anjani 2022). One learning model that is prioritized in implementing the 2013 curriculum is the use of project-based basic learning or problem *project-based learning* (Pjbl), *project-based learningis* an

innovative learning model that encourages students to explore, collaborate and create projects. The aim of *project-based learning* is to apply knowledge to discover new things, master technology, and solve problems. It is hoped that in real problems to be solved, these problems can stimulate students' creative thinking or in other words allow them to find and solve problems and communicate ideas. ideas in new and appropriate ways. *Project-based learning* (Pjbl) is a learning model that is student-centered by first presenting the problem. Students will be grouped to discuss solving the problems given. Then the results of the discussion will be presented in front of the class (Erna, 2008).

The rationale for this research is to analyze the application of the *Project-Based Learning* (Pjbl) model in mathematics learning in terms of bibliometric distribution mapping using the Scopus database using VOS Viewer software. The benefit of this research is to provide knowledge regarding research developments related to the Project-Based Learning learning model in mathematics learning, on this basis this research was carried out.

Studies and research related to bibliometrics have also been studied by several previous researchers, such as Yusnaili Budianti et al, researching Merdeka Belajar in a bibliometric approach and producing five main clusters in research related to "freedom to learn". And the interesting thing found in this research is that in the fourth cluster elementary schools began to frequently discuss the independent learning program (Budianti, Nursalimah, and Ritonga 2023).

Sukarmin et al also researched the Bibliometric Analysis of Research Trends in the Implementation of the *Project-Based Learning* (Pjbl) – STEM Model in Physics Learning in 2011-2021 which resulted in the relevance of implementing the *Project-Based Learning* (Pjbl) – STEM model in the context of physics learning dominated by learning tools. and skills. The physics material taught is related to alternative energy (Sukarmin et al. 2023).

Apart from that, Selamat Triono Ahmad et al also researched Project-based Learning in Vocational Education: A Bibliometric Approach. The results of this research provide insight into the state of *Project-Based Learning* (Pjbl)

in vocational education and highlight the potential of educational computing to improve student learning outcomes. And review the use of technology, such as based learning computers, can increase the effectiveness of *Project-Based Learning* (Pjbl) in vocational education (Ahmad et al. 2023).

This research uses bibliometric analysis methods to assist in measuring patterns of all forms of recorded information and procedures. Bibliometrics has wide applications in the fields of library science and information science, especially those related to studying trends and subjects (Rahayu and Sulisnaeni 2021). The sources used in this research come from the Scopus database and are more focused on article publications. Scopus was chosen because it provides a comprehensive picture of world research results. Scopus also features features that can track, analyze and visualize research.

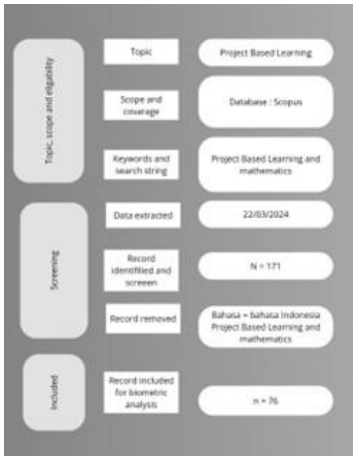

Figure 1. Bibliometric stages

wide applications in the fields of library science and information science, especially those related to studying trends and subjects (Rahayu and Sulisnaeni 2021). The sources used in this research come from the Scopus database and are more focused on article publications. Scopus was chosen because it provides a comprehensive picture of world research results. Scopus also features features that can track, analyze and visualize research. Data collection was carried out on March 22 2024 at 13.22 via the official Scopus website with keywords from the title and abstract ("project-based learning" and "mathematics) from 2019 to 2023. Next, the search results were formed as a data sample and downloaded in .csv format . The data that has been taken is then processed using VOSViewer software.

Based on the search results, 171 articles were obtained which were then screened to become 77 articles. This screening process is to determine the suitability of what will be studied in this research. then analyzed using VOS Viewer with network visualization and density visualization. Then, based on the results of the processed data, descriptive analysis is carried out. Descriptive analysis was carried out to describe the visualization results from VOS Viewer and to draw conclusions.

DISCUSSION

The number of publications obtained from Scopus data on (date, month, year) with keywords from the abstract title "Project-based learning and mathematics" publication data from 2019 - 2023 is obtained by database analysis in Figure 2.

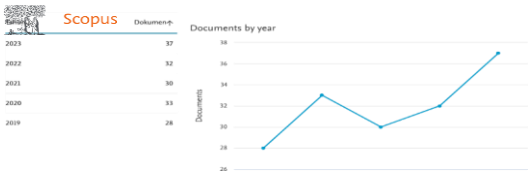

Figure 2. Data results from Scopus

From date-based research analysis from Scopus, the number of publications on the topic of Project-based learning and mathematics learning (mathematics) over the last 5 years, the most publications in 2023 were 37 articles and the least in 2019 was 28. The number of discussions on *Project-based learning* in 2019 there was a significant increase, from 2019 to 2020 there was an increase of 7 articles, followed by 2022 to 2023 there was an increase of 5 articles. This cannot be separated from the model *Project-based learning* in mathematics learning is more widely discussed and implemented.

Researcher Productivity

The analysis results from VOS Viewer show that there are 10 authors who actively contribute to research on the topic of *Project Based Learning* in mathematics learning, which is divided into 2 clusters. Arliani, Elly, Hamid, Harris, Jailani, Mahmudi, Ali, Prayitno, Harun Joko, Rafi, Ibnu, Zulnaedi, and Hutkemri are in the first cluster. Meanwhile, Retnawati, Heri, Setyaningrum,

Wahyu, Wawan are in the second cluster. These two clusters can be seen in Figure 3.

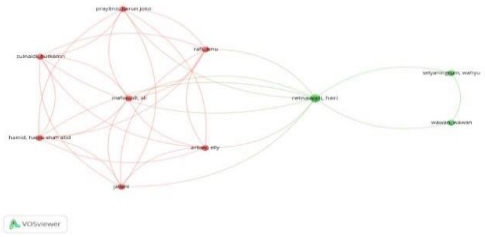

Figure 3. Researcher Productivity

Based on Figure 3, we can analyze that of the 2 clusters, the author who contributed the most to researching topics related to *Project-based learning* (Pjbl) was Retnawati. Retnawati's research results are also widely used as references by all researchers in cluster 1.Apart from that, we can conclude that all researchers are related to each other and develop the results of previous research related to *Project-based learning* (Pjbl).

Countries and Institutions Owning Scopus Indexed Publications

The country with the largest number of research contributors related to *Project Based Learning* (Pjbl) in mathematics indexed by Scopus is Indonesia, followed by Malaysia. Apart from these countries, there are also other countries which can be seen in Figure 4.

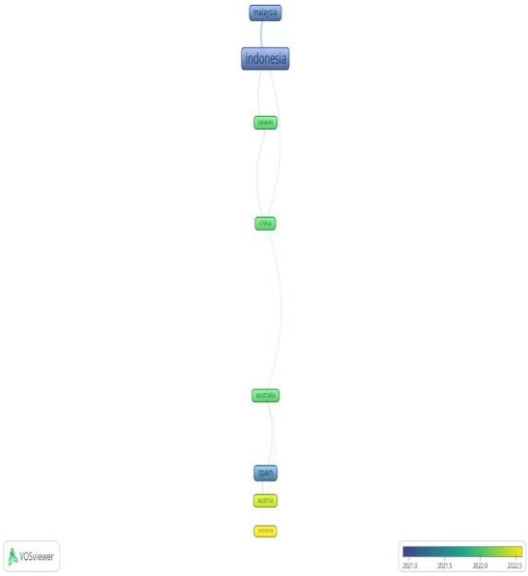

Figure 4. Country and Institution Owning the Publication

Based on Figure 4, it can be concluded that the thicker the text, the more it contributes to *project-based learning*(Pjbl) in mathematics learning. In the picture, it can be seen that there are 3 clusters with the third cluster that contributed the most to this research, namely Indonesia and Malaysia. The second cluster is China, Taiwan and the United Kingdom. And finally the first cluster is Australia, Austria, Spain. This analysis can also be seen in Figure 5, with the increasing red color indicating that there are more publications

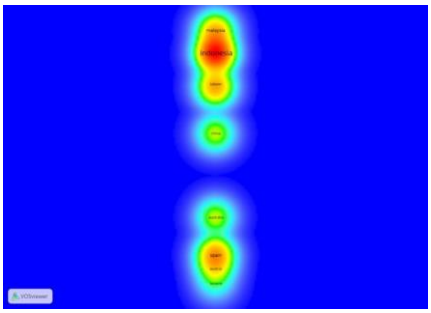

Figure 5. Country and Institution Owning the Publication

Apart from that, there are 149 institutes that contribute to research publications related to *Project-based learning* (Pjbl) in mathematics learning. Agencies that contribute more are found in clusters 2 of them are Ahmad Dahlan University Indonesia, Muhamadiyah University Semarang Indonesia, and Sultan Idris Education University Malaysia. The first cluster is the Ternate Indonesia State Institute of Religion, Indonesia Khairun University and the Department of Mathematics education. Among the two clusters, the one that has contributed the most is Ahmad Dahlan University Indonesia, however, of the 149 institutions, there is still little collaboration. We can see this analysis in the image below.

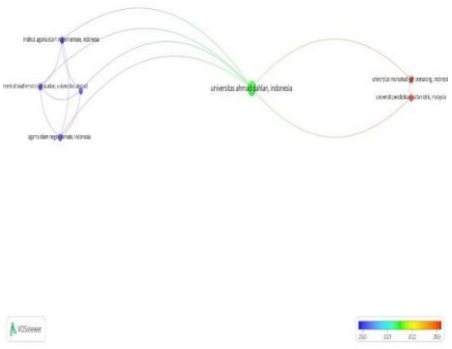

Figure 6. Country and Institution Owning the Publication

From this picture, we can also conclude that between 2022 and 2023, article publications experienced a fairly high spike in the publication year graph.

Frequently Appearing Keywords

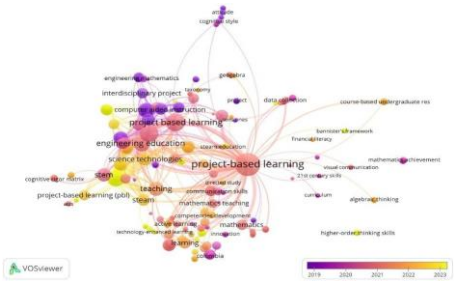

Figure 7. Keyword

Figure 7 shows the network display of the appearance of keywords and there are 346 items and they are divided into 33 clusters. Of all the items, *Project-Based Learning* is in first place which often appears as a keyword. We can analyze this through images with the largest points in the image. In the image above there are also several colors that indicate clusters with keywords that are often associated with one another. The first cluster or largest cluster is the pink one.

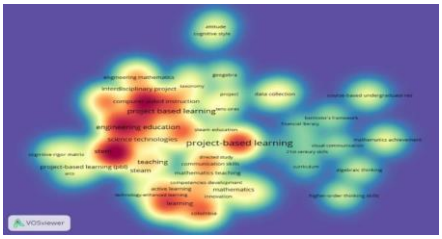

Figure 8. Keywords

Based on Figure 8, we can analyze that the appearance of the red brick color shows the current trend of *Project Based Learning* (PjBL) research in mathematics. Meanwhile, the appearance of dim yellow and almost green indicates that the topic can be used as an opportunity for further research, such as the Goegebra keyword, many of which are not associated with Project-based learning

CONCLUSION

Based on the results and discussion, it can be concluded that the development of Project-Learning mathematics research from 2019 to 2023 was indexed highest by Scopus in 2019 to 2020. The implementation of *Project Based Learning* in mathematics learning has a wide correlation. This is proven by the results of bibliometric analysis using VosViewer software which shows that there are many networks including *Project Based Learning*, Mathematics Education, STEM Education, Student, Engineering Education, STEM, and Mathematics. Meanwhile, the most productive is retnawati, while the country and agency that contributes most to research is Indonesia.

REFERENCES

Ahmad, Selamat Triono, Ronal Watrianthos, Agariadne Dwinggo Samala, Mukhlidi Muskhir, and Gimba Dogara. 2023. "Project Based Learning in Vocational Education: A BibliometricApproach."*International Journal of Modern Education and Computer Science*15(4):43– 56.

Alapján-, Vizsgálatok. 2016. "Unveiling the Evolution: A Bibliometric Analysis of Physics Learning Website Trends in the Past 5 Years." 2(1):1–23.

Anto, Puji, and Tri Anita. 2019. "Tembang Macapat as a Support for Character Education." Deixis 11(01):77.

Apriadi, Dodi, Nurul Hidayat, Nizhamuddin AB, Ahmatang, and Sudarto. 2022. "Real Work Lectures: Community Service Through Educational Assistance Activities." Paguntaka Community Service Journal 1(1):25–30.

Baharuddin, Muhammad Rusli, and Jumarniati Jumarniati. 2018. "Mathematics Learning Interaction Patterns for Students with Low Initial AbilityProject Based Learning." Al-Khwarizmi: Journal of Mathematics and Natural Sciences Education 6(2):149–56.

Budianti, Yusnaili, Nursalimah Nursalimah, and Maisaroh Ritonga. 2023."Freedom to Learn in a Bibliometric Approach: Issue Trends and Research Maps in 2022." Basicedu Journal 7(3):1627–36.

Dal, Elif, and Neşe Kutlu Abu. 2023. "The Trend of Differentiated Instruction Research: Bibliometric and Content Analysis." Eurasian Journal of Teacher Education 4(2):157–85.

Effendy, Femmy, Vanessa Gaffar, Ratih Hurriyati, and Heny Hendrayati. 2021. "Bibliometric Analysis of Research Developments in the Use of Mobile Payments with Vosviewer." Intercom Journal: Journal of Scientific Publications in the Field of Information and Communication Technology 16(1):10–17.

Gao, Ya, Long Ge, Shuzhen Shi, Yue Sun, Ming Liu, Bo Wang, Yi Shang, Jiarui Wu, and Jinhui Tian. 2019. “Global Trends and Future Prospects of E-Waste Research: A Bibliometric Analysis.” Environmental Science and Pollution Research 26(17):17809–20.

Al Husaeni, Dwi Fitria, and Asep Bayu Dani Nandiyanto. 2022. “Bibliometric Computational Mapping Analysis of Publications on Mechanical Engineering Education Using Vosviewer.” Journal Engineering Science and Technology 17(2):1135–49.

Kamid, Kamid, Sri Yuliya, and Muhaimin Muhaimin. 2020. “DEVELOPMENT OF A MATHEMATICS TEACHER GUIDE MODULE IN DESIGNING CULTURE-BASED PjBL LEARNING JAMBI.” AKSIOMA: Journal of the Mathematics Education Study Program 9(2):424.

Khamdanah, Laili, Indah Wijaya, and Atini Sabila Anjani. 2022. "The Effect of HOTS-Based Learning on Improving Mathematical Critical Thinking Abilities." Santika Proceedings 3 371–83.

Rahayu, Rochani Nani, and Sulisnaeni. 2021. “Journal Gema Librarian LAPAN-A4 for Maritime Traffic Monitoring Using an Automatic Identification System (AIS) which is capable of recording millions of ship data globally per day. Benefits of Rockets for Remote Sensing and Digital Image Data Processing." 9(1):16–25.

Sukarmin, S., H. V Putri, and ..2023. “Bibliometric Analysis of Research Trends "Implementation of the Project Based Learning (PjBL)–STEM Model in Physics Learning 2011-2021." … National Physics (SNF) 99–106.

Tupan, Tupan, Rochani Nani Rahayu, Rulina Rachmawati, and Endang SriRusmiyati Rahayu. 2018. "Bibliometric Analysis of Research Developments in the Field of Instrumentation Science." Read: Journal of Documentation and Information 39(2):135.

Ulum, Bakhrul. 2018. "Pasuruan Ethnomathematics: Geometry Exploration for Elementary Schools on the Pasedahan Suropati Batik Motif." Review Journal*Basic Education: Journal of Educational Studies and Research Results* 4(2):686.