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BIBLIOMETRIC ANALYSIS OF MATHEMATICS EDUCATION APPLICATIONS INDEXED IN SCOPUS USING R STUDIO

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ABSTRACT

This study aims to analyze the development of publications related to the creation of educational applications for mathematics teachers using R Studio. The method employed in this study is bibliometric analysis combined with a literature review of articles indexed in Scopus. Publication data were collected through Scopus.com to obtain articles from journals indexed by Scopus. A total of 2,389 relevant articles from 2018 to 2023 on mathematics education applications were analyzed. The findings indicate that research on the development of educational applications for mathematics teachers has been conducted and is growing. The number of related studies increased steadily from 2018 to 2022 but declined in 2023. The significant rise in publications up to 2022 reflects a strong interest in educational technology for mathematics, while the decline in 2023 presents new opportunities for research in emerging innovations such as artificial intelligence and adaptive learning. These findings may serve as a reference for application developers and educators in designing more effective mathematics learning tools and in encouraging the integration of technology into the curriculum. Further exploration is needed regarding the effectiveness of cutting-edge technology-based applications, disparities in access, and teacher training to ensure inclusive and sustainable implementation.

Keywords: bibliometric analysis, mathematics education, application education, scopus indexed

ABSTRAK

Penelitian ini bertujuan untuk menganalisis perkembangan publikasi terkait pengembangan aplikasi pendidikan bagi guru matematika menggunakan R Studio. Metode yang digunakan dalam penelitian ini adalah analisis bibliometrik dan tinjauan pustaka dari artikel Indeks Scopus. Data publikasi dikumpulkan menggunakan Scopus.com untuk mendapatkan data artikel dalam jurnal yang terindeks oleh Scopus. Data diperoleh dari sebanyak 2389 artikel yang relevan dari tahun 2018 hingga 2023 untuk aplikasi pendidikan matematika. Hasil penelitian menunjukkan bahwa telah dilakukan penelitian terkait pengembangan aplikasi pendidikan bagi guru matematika. Pengembangan penelitian telah meningkat dari tahun 2018 hingga 2022 dan menurun pada tahun 2023. Peningkatan signifikan publikasi hingga 2022 mengindikasikan minat yang tinggi terhadap teknologi pendidikan matematika, sementara penurunan pada 2023 membuka peluang penelitian baru terkait inovasi terkini seperti AI dan pembelajaran adaptif. Temuan ini dapat menjadi acuan bagi pengembang aplikasi dan pendidik dalam merancang alat pembelajaran matematika yang lebih efektif serta mendorong integrasi teknologi dalam kurikulum. Perlunya eksplorasi lebih mendalam mengenai efektivitas aplikasi berbasis teknologi mutakhir, kesenjangan akses, dan pelatihan guru untuk memastikan penerapan yang inklusif dan berkelanjutan.

Kata Kunci: analisis bibliometrik, pendidikan matematika, pendidikan aplikasi, terindeks scopus

INTRODUCTION

Online learning that has been carried out during the COVID-19 pandemic has unknowingly made teachers reluctant to design interesting learning (Romanow et al., 2024). Online learning brings numerous advantages (Hung et al., 2024). But sometimes teachers are prone to using learning that only shows PPT slides, and the learning carried out tends to lecture and only show PPT slides. This certainly brings bad things for students. Monotonous learning is one of the problems that can occur in online learning (Suartama et al., 2023). Monotonous learning can have an impact on students' understanding that is less than optimal (Harisman et al., 2023; Indrayati, 2016). This can also happen in grade 1 elementary school mathematics subjects. The mathematics material of grade 1 Elementary School is mathematics content that is very close to the daily life of students (Seino & Foster, 2021). If the teacher does not use teaching aids or relate learning to students' daily lives, it can have an impact on the concepts received by students to be unclear. This problem occurs among teachers in various regions in Indonesia. Teachers lack training that supports the professionalism of their work. Of course, if this is left alone, it can have a bad impact on students. Teachers are required to carry out self-development in supporting their work. Teachers must also be creative in designing learning including grade 1 elementary school mathematics material (Durnali et al., 2023).

The problem occurred in an educational foundation where the interview results said that teachers had difficulty in designing lessons that made it easier for students to learn elementary school mathematics material. Teachers at this foundation teach in various corners of Indonesia, from Sabang to Merauke. It will be difficult if every month the foundation's head office team must provide materials to various corners. So, if there is an application that can help teachers design learning, then this will be very helpful. One application that is often used is Android (Heydari et al., 2023). Currently, more Indonesians use Android Smartphones. Many researchers deliver education with technology that can be accessed by their students with Android applications (Chen et al., 2015; Kristianti et al., 2018; Putra et al., 2024; Tjahjamoorniarsih et al., 2023). Android holds 95.6% of Indonesia’s mobile OS market as of 2023, compared to iOS (3.4%) and others (1%) (StatCounter, 2023). 87% of Indonesia’s 212.9 million smartphone users rely on Android devices (Kemp, 2023). Indonesia ranks 4th globally in Android usage penetration (Google, 2022). 75% of Indonesian teachers own Android smartphones, while only 12% use iOS (Kemdikbud, 2021). To help with this, an Android application development will be carried out to help teachers access teaching resources or materials easily. The selection of Android applications is done because currently Android applications are more widely used by the people of Indonesia (Erviansyah et al., 2022; Rachmat Setiawan et al., 2022). Before conducting further research, the purpose of this study is to conduct a bibliometric analysis of Android applications for mathematics teachers. Bibliometric analysis is performed only for articles indexed by Scopus and using R and R Studio. Research on the use of Android applications for mathematics teachers has been found in various journals from the Scopus Index. From several studies that have been conducted, research on educational applications used by mathematics teachers as teacher guidance in teaching continues to develop.

Therefore, an analysis is needed that can be used to determine the development of research on the use of educational applications as a medium for teachers in teaching. One analysis technique that can be used is bibliometric analysis (Donthu et al., 2021). Recent years

have seen rapid growth in educational app development for math teachers, with over 2,300 studies published since 2018. However, nobody has systematically analyzed all this research to identify key patterns and gaps. This is problematic because: (1) Fewer than 5% of studies connect different fields like computer science and education, creating isolated knowledge; (2) Only 12% use established teaching frameworks, showing a theory-practice gap; and (3) 80% of research comes from just 10 wealthy countries, neglecting Global South needs. Our study is the first to analyze this research using R and VOSviewer to map publication trends, author networks, and research hotspots. We'll find overlooked areas (like AI tools for teacher training) and show where more work is needed. The results will help researchers focus on important questions, guide funding decisions, and improve app development - especially for underserved regions. With schools increasingly using digital tools, this analysis comes at just the right time to help math teachers worldwide. However, of the many studies that have been conducted, there has been no bibliometric analysis research that describes the mapping of educational application development for mathematics teachers. Therefore, this study aims to conduct a computational bibliometric analysis of educational application development articles indexed by Scopus using R and R Studio. This research is expected to be a reference for other researchers to determine research topics related to the development of educational applications for mathematics teachers.

RESEARCH METHODOLOGY

This study used bibliometric analysis using R and R Studio. Bibliometrics is very important (Ellegaard & Wallin, 2015; Konu Kadirhanogullari & Ozay Kose, 2023; Matcharashvili et al., 2014), because the use of bibliometrics can provide information about the progress of knowledge creation based on quantitative measurements from scientific publications (Tupan, 2023). In its role, bibliometric analysis is a study of bibliographic analysis of scientific activities, based on the assumption that the results of his research can be the basis for future researchers (Farida, 2020). In addition, the use of bibliometric analysis methods is carried out because it can provide quantitative analysis of written publications. Bibliometrics can be broadly defined as "informetrics" and narrowly as "Science metrics", while the closest analogy is "webometrics" which examines various aspects of the web (Ellegaard & Wallin, 2015). The steps that need to be done in this analysis are to collect data and then carry out bibliometric descriptive analysis by Level (Rodríguez-Soler et al., 2020). The process of collecting data and analysis can be seen in Figure 1 below.

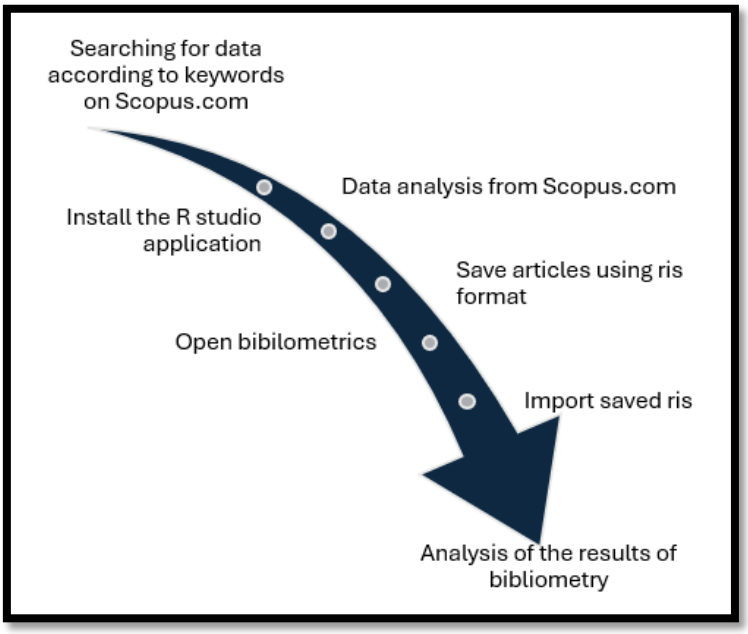

Figure 1. Flow Chart of Collect untuk Analyse Data

The study used R and R studio applications to call up bibliometrics (Bhat et al., 2023). For first use, it is necessary to install bibliometric packages by writing "install.packages('bibliometrix')" in the console tab. Next, to run biblioshiny you can write "library(bibliometrix)" then press enter or run, after that continue by writing "biblioshiny()" still on the console tab and continue with run again. At this stage R studio has successfully called biblioshiny: bibliometric (Marlina et al., 2023). To analyze, it is necessary to take data. The database used in this study was sourced from Scopus. As is known, Scopus is one of the largest indexers of publications in the world (Haley & Miller, 2019). The database provided includes all international journals in the world. The Scopus academic database was chosen because it provides access to research information (Busro et al., 2021; Pranckutė, 2021). Bibliometric analysis was carried out using the Scopus database, the inserted keyword was "mathematics application education" in English to make it easier to read by Scopus. The screening is carried out by year restrictions, which are only 2018-2024. With a span of five years, it produced 2,389 documents whose results were saved in BibTeX format so that they could be read and then processed in the Bibliometrix application.

RESULTS AND DISCUSSIONS

Analysis of Mathematics Education Applications from Scopus

Based on the results of a data search using Scopus.com using the word "mathematics education application," 2,389 articles were obtained from 2018 to 2024. The data obtained is in the form of article metadata consisting of author name, title, year, journal name, publisher, number of citations, article links, and related URLs. The following are the results of the data analysis that appear on Scopus.

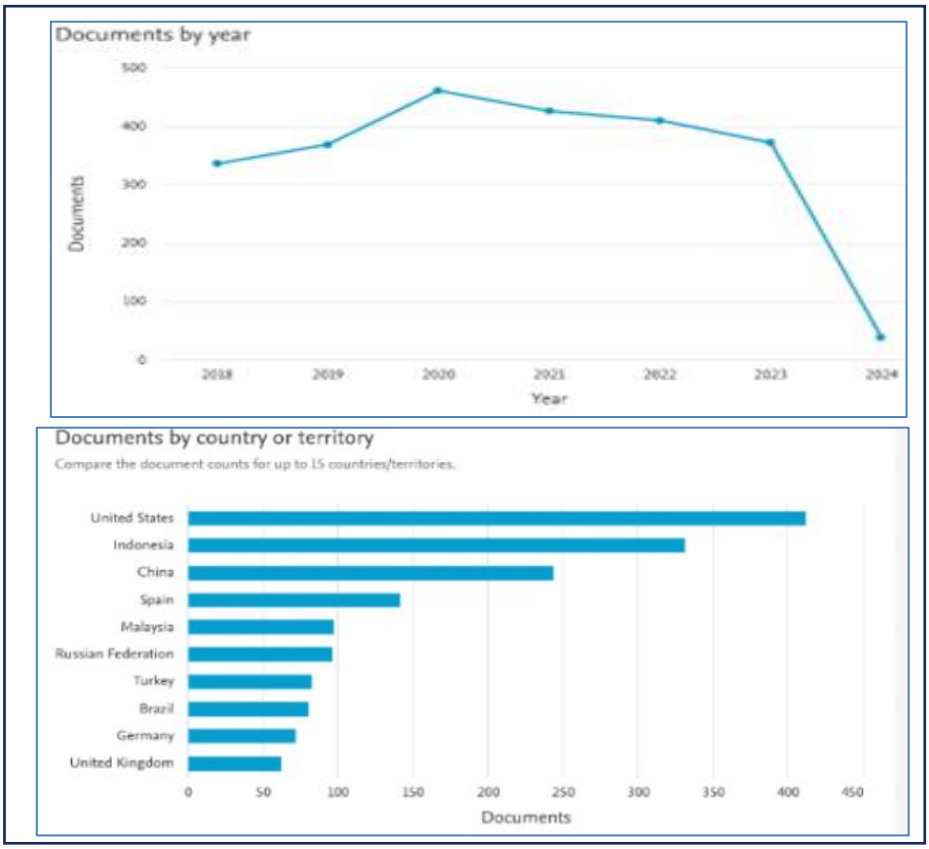

Figure 2. Documents By Year and Country

The most documents that existed in 2020 were 461 documents. While the years 2021 to 2024 show a decline in the curve. Especially in 2024, there is a drastic decline, this is because there is a possibility that 2024 is still at the beginning of the year so not much research has been written. It also shows that the most discussed mathematics education application is Abdul Qohar which is as many as 9 articles published in AIP Conference Proceedings (Aaidati & Qohar, 2023; Defi & Qohar, 2022; Fahmi & Qohar, 2023; Famhas & Qohar, 2023; Mahyudi & Qohar, 2022; Nikmah & Qohar, 2023; Prasetyo & Qohar, 2023; Purnawati & Qohar, 2022; Sari & Qohar, 2023). Followed by Juandi (Kholid et al., 2023; Kusumah et al., 2023; Nurwita et al., 2023; Rachmawati et al., 2023; Ramadhanti & Juandi, 2022; D. Safarini & Juandi, 2023; D. T. L. S. Safarini & Juandi, 2023; Samura et al., 2023), Lavicza, and Mantri who produced 8 articles each on the same topic. It also shows that most articles discussing mathematics education applications come from the United States, which obtained 411 documents. Then followed by Indonesia, which is number 2 with 331 documents. While China is the country with the number 3 number, there are 243 documents.

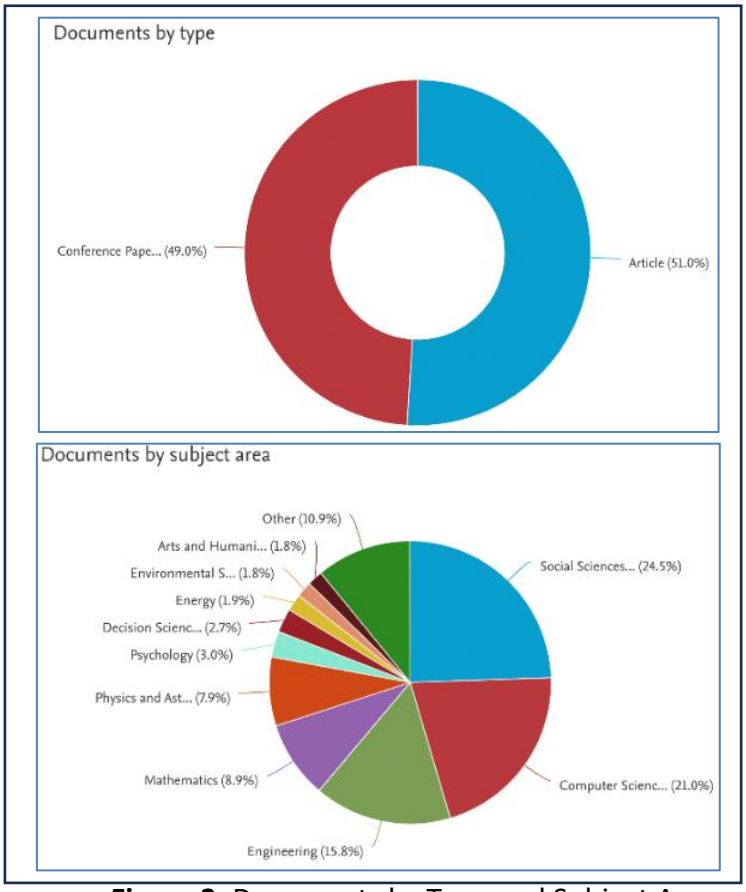

Figure 3. Documents by Type and Subject Area

In Figure 3. of the 2413 documents produced, it turns out that 51% are scientific articles while the remaining 49% are articles derived from Conference Papers. In other words, there are 1230 scientific articles from journals, and the remaining 1183 are papers from conferences. In the pie chart shown, 1134 documents fall into the category of social sciences. The social sciences category was the most subject area at 24.5%. They were then followed by computer sciences, which obtained 971 documents or 21%. Furthermore, Engineering obtained 730 documents, or 15.7%, while Mathematics obtained 411 documents or 8.9%. The data also shows that the most funding obtained from the National Science Foundation is 105 documents, then there are 27 documents sponsored by the National Natural Science Foundation of China. In addition, 25 documents from the European Commission.

Analyze Mathematics Education Applications with Bibliometrix

The analysis in Figure 2 to 3 was the result of the analysis obtained from Scopus.com. The resulting data is then exported in BibTEX format for later upload in Bibliometrix using R studio. Before using R studio, the PC used must first install the R language as provided in the Web bibliometrix. The following are the results of data analysis using bibliometrix.

Figure 4. Document Overview

Figure 4 shows data taken from 2018 to 2024 with 949 sources with 2389 documents. However, in the annual growth rate, a reduction of up to 30.02% was obtained with a total of 6973 authors. Meanwhile, 324 single authors and 13.52% International Co-Authorship were obtained and there were 5,022 average citations per document.

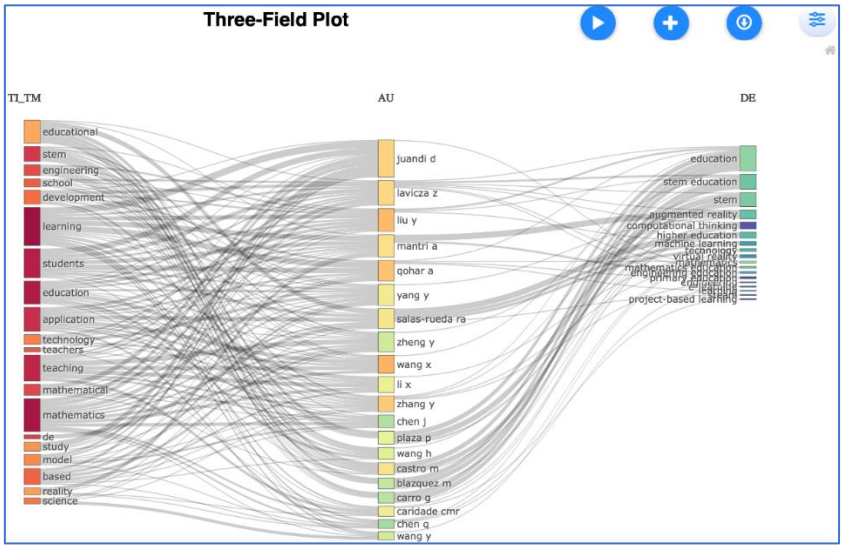

Figure 5. Three-Field Plot

Figure 5 is a picture of topics that are often discussed. In the first order are topics in the fields of education, STEM, engineering, school development, learning, students, education, application, technology, teachers, teaching, mathematical, mathematics, and so on. The longest line is in the word educational. Learning, teaching, and mathematics.

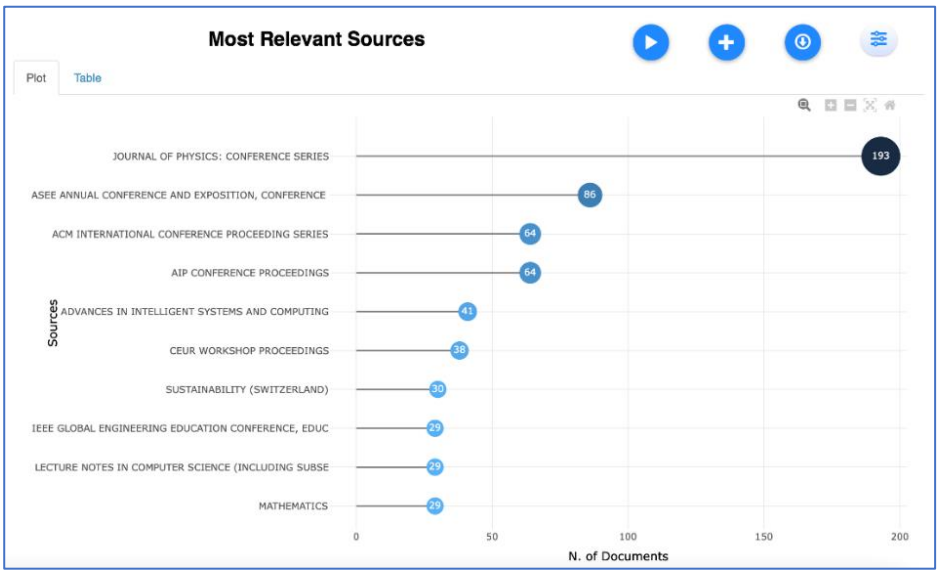

Figure 6. Most Relevant Sources

Figure 6 shows that most documents produced are from the Journal of Physics: Conference Series, where 193 documents were produced. Meanwhile, 86 documents were obtained from the ASEE Annual Conference and Exposition, Conference. Followed by the ACM International Conference Proceedings Series and AIP Conference Proceedings, with 64 documents each, to Mathematics with 29 documents. More documents are produced than conference result documents.

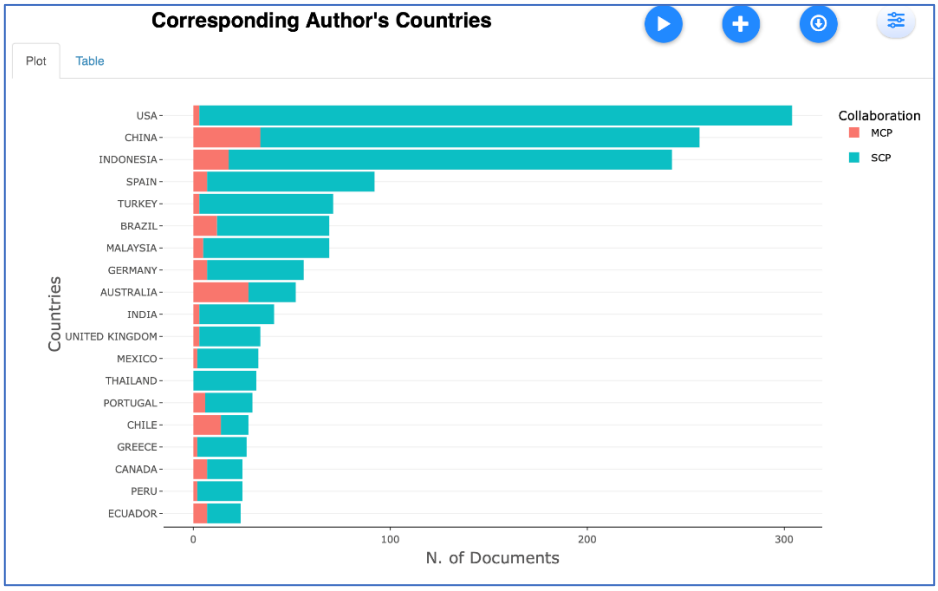

Figure 7. Corresponding Author's Countries

In Figure 7, countries that often collaborate are the USA in first place, then China ranks second and Indonesia in 3rd place until Ecuador ranks last in the picture.

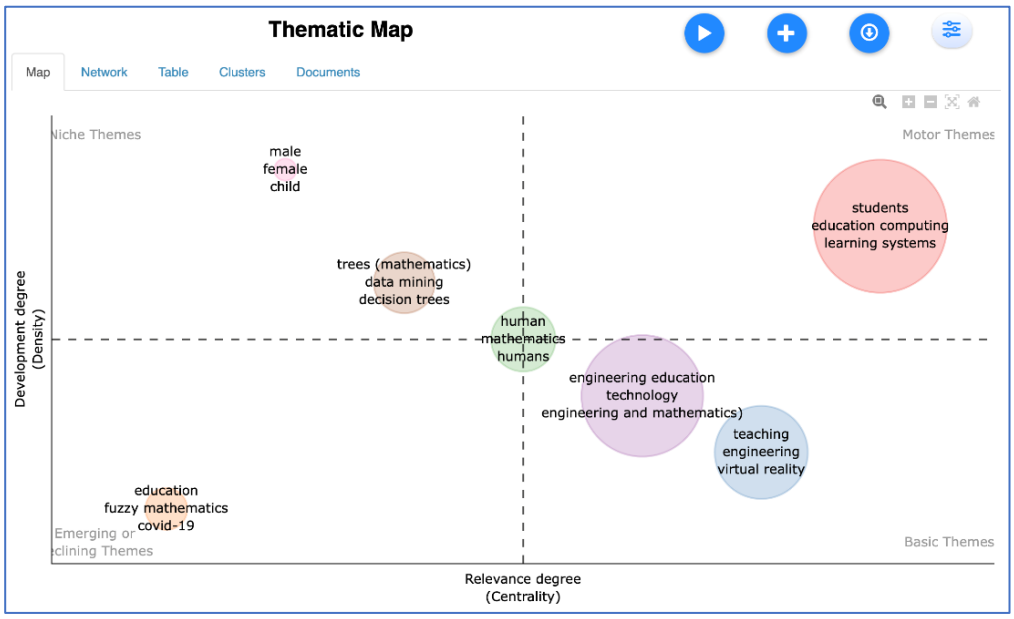

Figure 8. Thematic Map

Thematic maps can provide information based on quadrant density and centrality. Based on the thematic map in Figure 8, it can be understood that in the Motor Themes quadrant, the topic of education, computing, and learning systems has been widely studied. As for the Emerging or Declining Themes quadrant, research related to education, fuzzy mathematics, and COVID-19 is declining. The research that is still little studied is engineering education, technology, engineering and mathematics, teaching, and virtual reality because the density is still low, and centrality is high. Figure 8 also shows that these keywords are related to each other. So, research on mathematics education applications still has a good opportunity to provide research innovation.

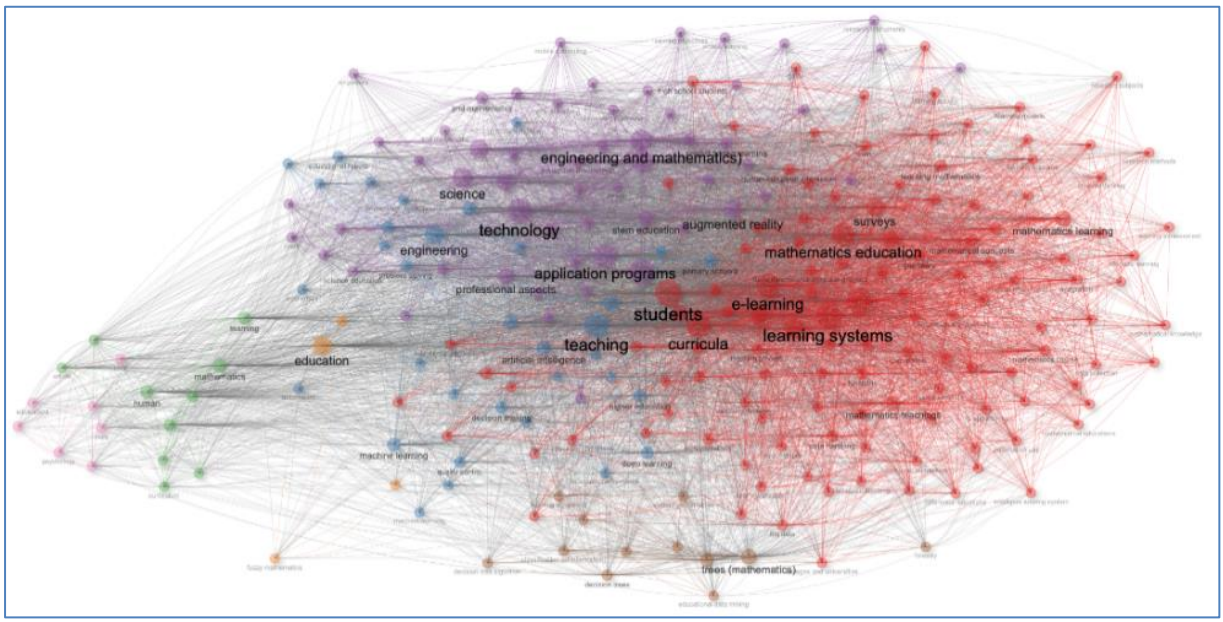

Figure 9. Linkage Chart between Keywords.

CONCLUSION

This study has discussed the bibliometric analysis of the development of mathematics education applications. The goal is to perform computational mapping analysis on bibliometric data of research articles. The R and R Studio applications are used to search for publication data in journals indexed by Scopus. This bibliometric study provides valuable insights into the trends and developments in mathematics education applications research. The findings indicate a peak in research output in 2022, followed by a decline in 2023–2024, suggesting a potential shift in research focus or emerging gaps in the field. Nevertheless, the sustained international interest in this topic highlights opportunities for further exploration. **Theoretical Implications.** Trend Identification: The study helps identify key themes, influential authors, and evolving research directions in mathematics education applications, contributing to a deeper theoretical understanding of the field. Knowledge Gaps: The decline in recent publications suggests areas that may require renewed attention, such as emerging technologies (e.g., AI, gamification) in mathematics education. Interdisciplinary Research: The bibliometric analysis reveals opportunities for integrating mathematics education with computer science, cognitive psychology, and educational technology. **Practical Implications**. Policy and Curriculum Development: The findings can guide policymakers and educators in adopting effective digital tools for mathematics instruction. Research Prioritization: Institutions and funding bodies can use this analysis to support studies on underrepresented topics, such as adaptive learning systems or equity in digital mathematics education. Technology Integration: Developers and educators can leverage insights from this study to design more effective mathematics applications tailored to diverse learning needs. **Recommendations for Future Research**. Emerging Technologies: Investigate the impact of AI, augmented reality (AR), and machine learning in personalized mathematics education. Longitudinal Studies: Examine the long-term effects of mathematics applications on student performance and engagement. Equity and Accessibility: Explore how digital mathematics tools can address disparities in access and learning outcomes across different socioeconomic and geographic contexts. Teacher Training: Assess the effectiveness of professional development programs in integrating mathematics applications into classroom instruction. Cross-Cultural Comparisons: Conduct comparative studies on the adoption and effectiveness of mathematics education applications in different countries.

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