Bridging Socio-Economic Disparities Through Educational Infrastructure: A Bibliometric Analysis

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A R T I C L E   I N F O

A B S T R A K

Infrastruktur pendidikan telah menjadi pilar penting dalam mengatasi ketimpangan sosial ekonomi. Artikel ini secara sistematis mengkaji teori-teori terkait infrastruktur pendidikan serta mengeksplorasi status penelitian dan aplikasi infrastruktur pendidikan dengan menggunakan metode analisis bibliometrik visual berdasarkan data dari tahun 1846 hingga 2024. Hasil analisis menunjukkan bahwa isu infrastruktur pendidikan telah menjadi perhatian global selama lebih dari satu abad. Artikel yang dianalisis mencakup kontribusi dari 2.873 penulis dan diterbitkan di 237 jurnal berbeda, menyoroti keberagaman perspektif penelitian. Studi ini menemukan bahwa publikasi mengenai kontribusi infrastruktur pendidikan terhadap ketimpangan sosial ekonomi mengalami peningkatan signifikan, terutama sejak tahun 2015. Temuan ini menandakan bahwa pengembangan infrastruktur pendidikan merupakan area penelitian lintas disiplin yang semakin mendapat perhatian. Di tingkat nasional, negara-negara berkembang semakin aktif melakukan perbaikan infrastruktur pendidikan, berupaya menyusul atau bahkan melampaui beberapa negara maju dalam hal akses dan kualitas pendidikan. Hasil analisis kluster menunjukkan bahwa penelitian yang ada berfokus pada integrasi pendidikan inklusif, yang berupaya memecahkan masalah aksesibilitas dan kualitas pendidikan serta memberikan solusi untuk meningkatkan kesetaraan dalam pendidikan. Penelitian ini menyimpulkan bahwa pengembangan infrastruktur pendidikan dapat menjadi kunci dalam mengurangi ketimpangan sosial ekonomi dan mendukung pembangunan masyarakat yang berkelanjutan. Temuan ini memperkuat pemahaman mengenai hubungan antara infrastruktur pendidikan dan ketimpangan sosial ekonomi serta memberikan panduan kebijakan dan arah penelitian masa depan untuk menciptakan sistem pendidikan yang inklusif dan merata.

A B S T R A C T

Educational infrastructure has become a crucial pillar in addressing socio-economic disparities. This study systematically examines theories related to educational infrastructure and explores the current state of research and its application using a visual bibliometric analysis method based on data from 1846 to 2024. The analysis reveals that educational infrastructure has been a global concern for over a century. The analyzed articles reflect contributions from 2,873 authors and were published in 237 different journals, highlighting diverse research perspectives. The study finds that publications addressing the contribution of educational infrastructure to socio-economic disparities have significantly increased, particularly since 2015. This indicates that educational infrastructure development is a multidisciplinary research area gaining growing attention. At the national level, developing countries have become more active in improving their educational infrastructure, striving to catch up with or even surpass some developed countries in terms of educational access and quality. Cluster analysis results indicate that existing research focuses on inclusive education integration, aiming to solve issues related to educational accessibility and quality and providing better solutions to enhance educational equity. The study concludes that educational infrastructure development can be a key factor in reducing socio-economic disparities and supporting sustainable community development. These findings strengthen the understanding of the relationship between educational infrastructure and socio-economic inequality while offering policy guidance and future research directions to create an inclusive and equitable education system.

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1. INTRODUCTION

Facing the increasingly complex challenges of socio-economic inequality, educational infrastructure plays a very important role in creating equal and quality access for all students (Judijanto et al., 2024). Adequate educational infrastructure includes not only physical facilities such as school buildings and equipment, but also the resources needed to support effective learning (Marmoah et al., 2019, 2022). In addition, a strong educational infrastructure also supports the integration of various disciplines, enabling students to understand and address complex socio-economic issues more effectively (Muharam, 2023; Steven & Saearani, 2024). Therefore, developing educational infrastructure is not only about physical improvements, but also about creating an inclusive and equitable learning environment, which can help reduce socio-economic disparities in society (Dacholfany, 2024).

Educational infrastructure has become an increasingly important topic in discussions about socioeconomic inequality (Daulay, 2024). Although research on educational infrastructure has been ongoing for decades, there is still a lack of systematic understanding of the definition and development of educational infrastructure across different social and economic contexts. Many studies have shown that unequal access to educational infrastructure contributes to socioeconomic inequality, creating gaps in learning opportunities for students from different backgrounds (Entry, 2020). Educational infrastructure encompasses a variety of elements, including physical facilities, technological resources, and social support, all of which play an important role in creating an effective learning environment (Babullah et al., 2024; Lestari et al., 2023; Wijaya et al., 2022). In the context of socio-economic inequality, unequal access to educational infrastructure can exacerbate existing gaps, making it difficult for students from disadvantaged backgrounds to obtain a quality education (Pillay, 2021; Sasmiharti, 2023). By paying attention to developing educational infrastructure, we can help bridge this gap. For example, programs that focus on improving educational facilities in remote or disadvantaged areas can provide better opportunities for students to learn and thrive (Mubarak, 2023; Yustika Devi et al., 2020).

The solution is to improve the quality and accessibility of educational infrastructure, which is expected to reduce socio-economic disparities, enable students from all walks of life to get a better education and, ultimately, increase their social mobility. Compared to traditional approaches to education, the contribution of educational infrastructure to reducing socio-economic disparities has a number of significant advantages. First, adequate educational infrastructure helps create an inclusive and affordable learning system for all walks of life (Hafid, 2023; Sabaruddin, 2022). By providing good facilities and greater accessibility, schools can reach students from diverse backgrounds, thereby reducing the gap in learning opportunities (Fadil et al., 2023). Second, educational infrastructure supported by modern technology enables the implementation of more effective and interactive teaching methods (Adzkiya & Suryaman, 2021; Firmansyah et al., 2024). For example, the use of information and communication technology (ICT) in the teaching and learning process can enrich the learning experience and provide wider access to educational resources. Third, strong educational infrastructure can enhance collaboration between various stakeholders, such as government, educational institutions, and local communities, all of which play an important role in creating a conducive learning environment (Triarsuci et al., 2024). Thus, investment in educational infrastructure not only contributes to improving the quality of education, but also to reducing socio-economic inequalities more broadly.

Previous findings on the contribution of educational infrastructure to socio-economic inequality. Educational infrastructure can be defined as the totality of facilities and resources that support the learning process, including school buildings, equipment, technology, and access to information (Ardipal, 2016; Wijayanto et al., 2021). Adequate educational infrastructure can help reduce socio-economic disparities by providing equal opportunities for all students, especially those from disadvantaged backgrounds (Kyriakides et al., 2019). Educational infrastructure as one of the key factors influencing the quality of education and social development of students (Al Majeed et al., 2024; Muharam, 2023). In this context, the goal of developing educational infrastructure is to create an inclusive and quality learning environment, so that students from all walks of life can acquire the knowledge and skills needed to contribute to society (Nurpita & Khoirudin, 2023; Sasmiharti, 2023). By integrating various resources and facilities, educational infrastructure supports the creation of real-life relevant learning experiences, and helps students understand and address the socio-economic challenges they face. Therefore, investment in educational infrastructure is not only important for increasing access to education, but also for promoting social and economic equality in society (Salong, 2024; Xiong & He, 2024). In this context, developing countries often face greater challenges in providing adequate educational infrastructure, which is essential for achieving social and economic equality (Anggiasti & Nugraheni, 2024). This is due to the dependence of most developing countries on limited resources, where access to quality education is often uneven.

This study focuses on the role of educational infrastructure in reducing socio-economic inequality and evaluates the participation and relative contribution of each country in the effort to improve

educational infrastructure. The purpose of this study is to analyze the contribution of educational infrastructure to socio-economic inequality through bibliometric analysis method, and to identify the differences between developed and developing countries in this regard. This study makes significant contributions to the existing literature on educational infrastructure and socio-economic inequality in several ways. First, by conducting a systematic literature review, this study defines and explains various aspects of educational infrastructure and their impact on socio-economic inequality. Second, bibliometric analysis is used to assess the contribution of countries, institutions, and individuals in this research field, and to identify the main research focuses. Third, by examining real cases, this study highlights the challenges faced in educational infrastructure development, especially in developing countries, and explores the expected future trends. Thus, this paper not only describes the current state of research but also provides insights into the challenges and opportunities in educational infrastructure development to address socio-economic inequality.

2. METHOD

In this study, bibliometric methodology was chosen as the main approach. This method uses quantitative techniques that combine statistics and mathematics to analyse the relationship between research in a particular field (Kilinsky, 2024). Bibliometric analysis offers an objective and systematic way to identify patterns and structures of knowledge, reveal key themes and trends, and highlight existing challenges and issues (Wang & Su, 2020). Thus, this method makes an important contribution to the development of the discipline studied. For this study, the Crossref and Scopus databases were used to obtain a comprehensive data set. Both databases are primary sources for scientific literature, not only providing information on citations, but also being highly recommended references for bibliometric-based research, especially in the fields of education and social sciences. Although there is little overlap in citations between Crossref and Scopus, adding Scopus to the analysis is expected to provide a more comprehensive view of the scientific impact of this study. Therefore, both databases were utilized in this study to maintain the integrity and validity of the analysis.

This study aims to create a scientific map of integrated education through a bibliometric analysis of journals indexed in Crossref and Scopus until 2024. This analysis was conducted to explore research trends on educational infrastructure and socio-economic disparities over the past few years, summarize current research topics, and map future research challenges and directions. In the initial stage, inclusion criteria were determined, and a literature search was conducted in the Crossref database to find publications on educational infrastructure and socio-economic disparities. The keywords used in the search were "educational infrastructure" OR "educational facilities" AND "economic disparities," which were searched in the abstract, title, and keyword columns. From the initial search results, 1,878 documents were found. Furthermore, additional criteria were applied to limit the search to research articles in the field of education, resulting in 567 documents. Similarly, the same search was conducted in the Scopus database using similar keywords. In the initial search, 600 documents were found, and after applying additional criteria, the number of relevant documents was reduced to 321. Based on these two databases, a total of 888 documents were identified; 567 from Crossref and 321 from Scopus. The stages of this research methodology are described in Figure 1.
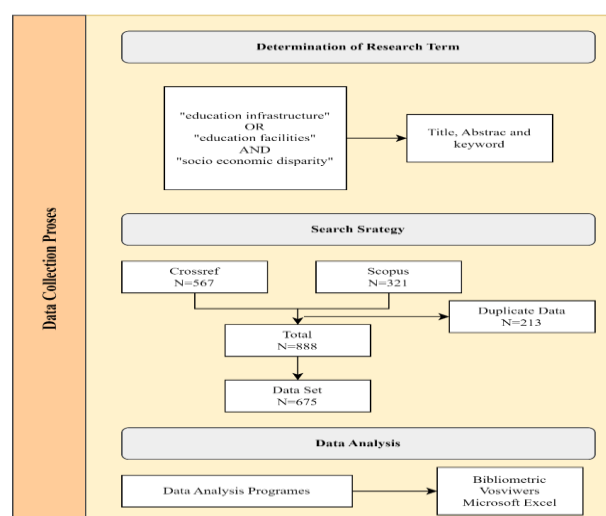

**Figure 1.** The Research Stages

3. RESULT AND DISCUSSION

Result

The results of the bibliometric analysis conducted on research on educational infrastructure and socio-economic disparities have identified 567 relevant articles. These articles were published in 237 different journals, covering a very long time span, namely from 1846 to 2025. This wide time span shows that the issue of educational infrastructure and its impact on socio-economic disparities has been of interest to academics and researchers for more than a century and a half. This reflects the importance of the topic in various contexts, both historical and contemporary, and how its relevance has persisted over time. In addition, the number of articles published in these journals shows the diversity of perspectives and methodological approaches used by researchers around the world. Each journal may have a specific focus in a discipline, such as education, economics, or public policy, which enriches the discussion on the topic of educational infrastructure and socio-economic disparities from various perspectives. This diversity can strengthen the validity of the findings and provide a more comprehensive insight into how educational infrastructure can affect economic disparities in different countries and regions.

Furthermore, out of the 567 articles analyzed, 2,873 authors contributed to the studies. This highlights the significant involvement of the academic community in the study of the relationship between educational infrastructure and socio-economic disparities. The participation of authors from various backgrounds and countries shows that this issue is global in nature and involves many countries with different socio-economic conditions. This confirms that the gap in access to quality education, which is often influenced by inadequate infrastructure, is a universal problem that requires serious attention from policymakers and academics. Of the total authors who participated, 44 articles were produced by the same author, indicating the existence of a highly productive group of researchers who consistently contribute to research in this area. These researchers are likely to have certain specializations and have conducted various in-depth studies on this topic, thus making a more significant contribution to enriching the existing literature. The continuous research of this group of authors may also indicate that they see a great urgency or challenge that needs to be resolved immediately in the context of educational infrastructure and its impact on socio-economic disparities.

The fact that 44 articles are from the same author suggests the possibility of developing or expanding the research topic in the long term, either through longitudinal studies or comparative research across different social and geographical contexts. As such, these researchers may have deep insights and extensive experience on how improvements or deficiencies in educational infrastructure can affect socio-economic inequality in the long term. Overall, this bibliometric analysis not only provides an overview of the volume and scale of research on the topic but also opens up opportunities for further study. For example, future research could map more specifically the emerging trends, whether there have been significant changes in research focus over time, and how education policies in different countries have responded to issues of educational infrastructure and socio-economic inequality. Furthermore, this research could help identify gaps in the literature that still need to be explored, such as the impact of technology or global pandemics such as COVID-19 on access to and quality of educational infrastructure at different socio-economic levels. These findings can serve as a basis for academics, policy makers, and practitioners in the fields of education and economics to better understand the relationship between investment in educational infrastructure and efforts to reduce economic inequality, as well as how concrete steps can be taken to ensure more equitable access to quality education across all levels of society.

Figure 2 depicts a Keywords Citation Network that visualizes the frequency and relevance of keywords in research on educational infrastructure and socioeconomic disparities. Each node in the network represents a keyword, with the size of the node indicating how often the keyword is used across studies. The larger the node, the more frequently the keyword appears. Different colours indicate clusters that group keywords that frequently appear together, indicating focused research themes. One of the main clusters is the green-yellow cluster, which relates to the topic of educational infrastructure. Keywords such as infrastructure, school, education facility, management, and teacher indicate a focus on the physical aspects of education, such as school facilities and learning environments, and the importance of effective management. This cluster reflects research interest in ensuring that adequate educational infrastructure supports better learning outcomes. The red cluster, on the other hand, focuses on socioeconomic disparities, with keywords such as disparity, socioeconomic disparity, population, and economic development. This cluster highlights how social and economic inequalities can affect access to education, especially in urban and rural contexts. Research in this cluster often seeks to understand the impact of economic inequality on access to and quality of education.
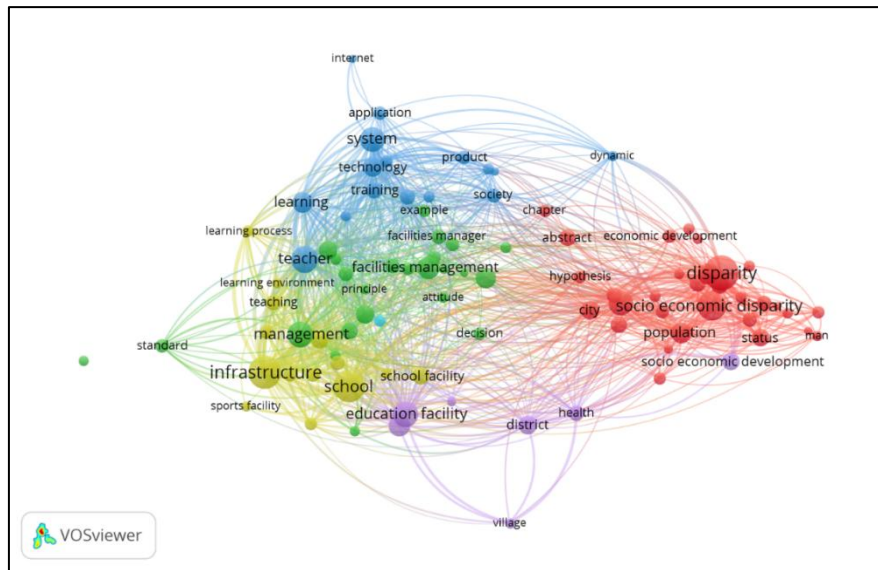
Figure 2. Keywords Citation Network

The blue cluster represents research focused on technology and education systems, with keywords such as system, technology, and training. This suggests that educational technology and education management systems are important themes in efforts to reduce disparities in access to and quality of education. Technology is seen as a tool that can help expand access to quality education, especially in underserved areas. The relationships between these clusters suggest a strong link between educational infrastructure, socioeconomic disparities, and the use of technology in education. Research often links the availability of educational infrastructure to broader socioeconomic impacts, as well as the potential of technology to address these challenges. Overall, this keyword network reveals a growing research focus on educational facility management, technology, and efforts to address socioeconomic disparities in education systems. Information on the citation analysis of publications on educational infrastructure and socioeconomic disparities is presented in Table 1.

Table 1. The Information Overview of Publication Citation Analysis on Educational Infrastructure and Socioeconomic Disparities

Author	Article Title	Source	Number of Citations
Parolin, Z., Lee, E.K. (2021)	Large socio-economic, geographic and demographic disparities exist in exposure to school closures	Nature Human Behaviour volume 5, 522–528	107
Ram, L. (2024)	Measuring Infrastructural Facilities Available for Education of Scheduled Caste Population in Rajasthan	International Journal of Research Publications and Reviews, 5(7), pp 3770-3776	74
Nainggolan, AN (2024)	The Influence of Environment and Facilities on Student Learning in Elementary Schools	International Journal of Student Education, 247–250.	427
Pidgeon, M.; Simon Fraser University, Surrey, BC, Canada. (2016)	More than a checklist: Meaningful indigenous inclusion in higher education	Social Inclusion 4(1), Pages 77-91	113
Gil-Flores, J., Rodríguez-Santero, J., Torres-Gordillo, J.J. (2017)	Factors that explain the use of ICT in secondary-education classrooms: The role of teacher characteristics and school infrastructure	Computers in Human Behaviour, 68, Pages 441-449	252
Ghufron, MI, Bustomi, AA (2022)	Infrastructure Development and Socio-Economic Disparities in Indonesian Society	IJED: International Journal of Economic Development Research, 1(2), 22-33	100

Author	Article Title	Source	Number of Citations
Ronsse, L.M., Lawless, M., Kanter, S.J., Carreon Bradley, D.T. (2021)	Higher Education Facilities: Completed 2015-2020	Springer, Cham, pp 169–246	100
Zavras, D., Tsiantou, V., Pavi, E., Mylona, K., Kyriopoulos, J. (2013)	Impact of economic crisis and other demographic and socio-economic factors on self-rated health in Greece	European Journal of Public Health, (23), 2, Pages 206-210	153
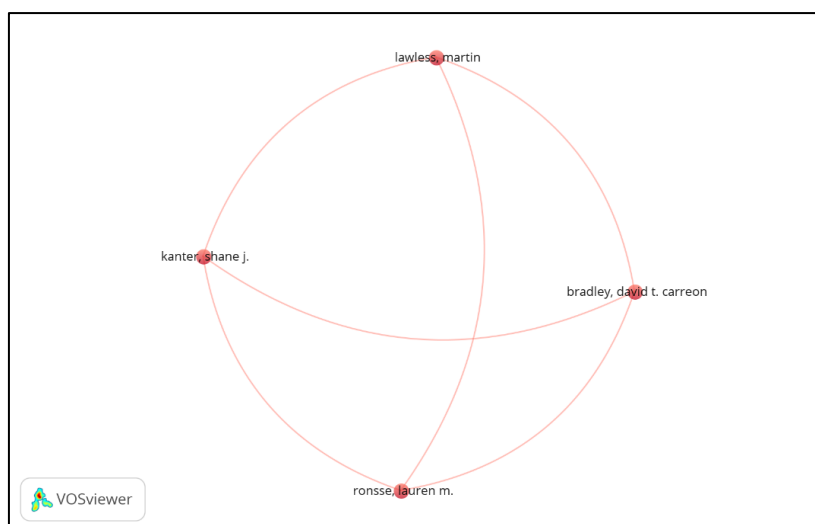
Figure 3. Author Cocitation Network

In this section, citation analysis is carried out to see the relationship between authors, articles, and journals that are frequently cited together. Citation analysis helps to understand how related studies are related to each other and form a network of knowledge in a field. In this analysis, it is measured how often two studies are mentioned or referred to together in the academic literature. In this way, we can identify articles or studies that are considered important and have a great influence in a particular field. Although the number of citations is often used to measure how influential a publication is, citation analysis provides more in-depth information. It helps to reveal the relationship between different publications, form a network of researchers who reference each other's work, and identify important changes in the direction of thought or theory. For example, if there is a new pattern emerging from the number of co-citations, it could indicate a change in approach or view on a topic. Citation analysis can also show which authors collaborate frequently or who are most influential in the research network. By mapping these citations, we can see how groups of researchers or key works are related to each other, providing insight into the intellectual structure of the scientific field. The author citation network, shown in Figure 3, shows how authors are connected to each other through their research. This helps us understand which authors have made major contributions, which works are frequently cited, and how ideas and theories in the field of study have developed. This analysis is very useful for identifying research trends and seeing how theories and ideas have evolved over time.

Figure 3 shows a co-citation network between authors, where multiple authors are cited together in multiple studies. In this context, co-citation means that two authors are frequently cited in the same article, indicating a relationship or similarity in their research topics. This co-citation network is visualized using circles and lines connecting multiple authors. The lines connecting the names of authors (such as Shane J. Kanter, Martin Lawless, Lauren M. Ronsse, and David T. Carreon Bradley) indicate a strong relationship or connection between them based on how often they are cited together in the scientific literature. The thicker or more numerous the lines connecting these authors, the more frequently they are cited together, indicating that their research may be in similar or complementary areas. Authors appearing in this network can be considered important actors in a particular field because they are frequently cited by other researchers in that field. The network also provides insight into clusters of researchers working on closely related topics, and can provide clues about key research groups or intellectual trends in the field being analysed. The final stage in bibliometric research is to interpret the findings and results obtained. Although analysis is the core of bibliometric research, simply presenting the results of the analysis and their visualization is not enough. Conducting analysis and listing relevant literature (performance analysis),

identifying relationships between scientific elements, and displaying visualizations (knowledge mapping) are only considered initial steps in bibliometric research.

Discussion

This study presents significant findings on the role of educational infrastructure and socio-economic inequality, showing that this topic has a wide geographical reach and involves various countries, sources, and authors. Despite its almost hundred-year history, this research remains relevant and important, with trends showing a significant increase in the popularity of integrated education studies. This study aims to explore the main trends in research related to educational infrastructure and socio-economic inequality, and to identify the publications and authors that have made the most significant contributions to this field. In addition, this study also focuses on the development of the intellectual, conceptual, and social structures that have been formed in this study. As part of the analysis, a total of 888 scientific publications were obtained from the Crossref and Scopus databases, which were then analysed in depth. In order to provide a systematic, objective, and comprehensive picture related to research in the field of integrated education, the data obtained from both databases were analysed using Bibliometric and VOS viewer software. Both tools were used to facilitate visual mapping that helps in revealing the overall performance of this field. In addition, this analysis also aims to map the intellectual structures underlying the field of integrated education, assess the main concepts that continue to develop, and understand the social networks that have formed among leading researchers in this field.

Developing educational infrastructure to address socio-economic disparities faces a number of challenges and offers significant opportunities. One of the main challenges is the lack of adequate funding, especially in developing countries, where budgets for education are often limited. In addition, the uneven distribution of resources, both in terms of teacher quality and educational facilities, can exacerbate the gap between urban and rural areas. On the other hand, the presence of digital technology opens up opportunities to increase access to education through online learning platforms, which can reach students in remote locations. In addition, collaboration between governments, the private sector, and civil society can create innovative models for financing and managing educational infrastructure. Educational infrastructure as one of the key factors influencing the quality of education and the social development of students (Al Majeed et al., 2024; Muharam, 2023). By capitalizing on these opportunities and addressing the challenges, educational infrastructure development can be an effective tool for reducing socio-economic disparities and promoting inclusive growth.

With this approach, the study not only provides insight into publications and research trends, but also helps in understanding how ideas and theories in integrated education have evolved over time. Therefore, bibliometric research should be able to describe the current state of the literature, organize existing knowledge neatly, identify emerging trends and patterns, and provide a basis for discussion on what is already known (Donthu et al., 2021; Kılınç, 2024). This study should also be able to show gaps in the existing literature, while also setting an agenda and roadmap for future research. In this way, bibliometric results can provide guidance on the direction of the literature that has been formed and answer the research questions posed. In addition, it is important to evaluate the extent to which bibliometric research supports the research objectives designed and how effective the research is in answering the key questions raised in this study. The visual mapping technique used also allows researchers to identify patterns of relationships between authors, institutions, and dominant research concepts, and shows how interactions between these researchers contribute to the advancement of theory in this field. The implications of this study can help future research in directing their focus on issues that have not been widely discussed, as well as assisting in the development of a more strategic and sustainable research agenda.

4. CONCLUSION

This study reveals significant findings regarding the role of educational infrastructure and socioeconomic inequality, showing that this topic has a wide geographical reach and involves a variety of countries, sources, and authors. Despite its almost hundred-year history, this research remains relevant and important, with trends showing a significant increase in the popularity of integrated education studies. The analysis shows active contributions from both developing and developed countries, especially the United States, as well as the spread of publications in various interdisciplinary journals that are more effective in communicating research results. Major contributing authors, such as Shane J. Kanter and Martin Lawless, have enriched the literature in this area, helping to understand the relationship between educational infrastructure and socioeconomic inequality. These findings reflect a significant growth in the number of relevant academic studies, as well as diversification in disciplines, suggesting that this area will continue to be a focus of research in the future. In this technologically influenced era, interdisciplinary approaches such as integrated education are essential to prepare students for the challenges of an ever-evolving world.

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