Bibliometric Analysis: Digital Comics as a Learning Resource to Improve the Learning Effectiveness of Elementary School Students

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Abstract

This study aims to analyze trends and research correlations regarding the use of digital comics as a learning resource to enhance elementary school students' learning effectiveness in the IPAS subject (Integrated Natural and Social Sciences) over the past five years. The method used is a literature study with bibliometric analysis utilizing VOSviewer software. A total of 200 journals from various academic sources were analyzed to identify patterns of keyword relationships, research trends, and scientific gaps that have not been widely explored. The results show that there are three main clusters in the study of digital comics as learning resources: learning effectiveness, the role of teachers and learning media, and the development of innovative learning resources. Network visualization using VOSviewer reveals that digital comics contribute to increasing student engagement, clarifying conceptual material, and assisting teachers in delivering more interactive lessons. Based on these findings, it is recommended that future research focus on developing more adaptive digital comic-based learning models and integrating interactive technology to improve learning effectiveness in elementary schools.

Kata Kunci: *Bibliometric analysis, Digital Comics, Learning Resources, Learning Effectiveness, Elementary School*

Abstrak

Penelitian ini bertujuan untuk menganalisis tren dan keterkaitan penelitian terkait pemanfaatan komik digital sebagai sumber belajar dalam meningkatkan efektivitas pembelajaran siswa sekolah dasar pada mata pelajaran IPAS selama lima tahun terakhir. Metode yang digunakan adalah studi literatur dengan analisis bibliometrik menggunakan perangkat lunak VOSviewer. Sebanyak 200 jurnal dari berbagai sumber akademik dianalisis untuk mengidentifikasi pola hubungan antar kata kunci, tren penelitian, dan celah ilmiah yang masih belum banyak dikaji. Hasil penelitian menunjukkan bahwa terdapat tiga klaster utama dalam studi komik digital sebagai sumber belajar, yaitu efektivitas pembelajaran, peran guru dan media pembelajaran, serta pengembangan sumber belajar inovatif. Visualisasi jaringan dengan VOSviewer mengungkap bahwa komik digital berkontribusi dalam meningkatkan keterlibatan siswa, memperjelas konsep materi, serta membantu guru dalam menyampaikan pembelajaran yang lebih interaktif. Berdasarkan hasil ini, direkomendasikan agar penelitian lebih lanjut fokus pada pengembangan model pembelajaran berbasis komik digital yang lebih adaptif serta integrasi teknologi interaktif untuk meningkatkan efektivitas pembelajaran di sekolah dasar.

Kata kunci: *Analisis bibliometrik, Komik Digital, Sumber Belajar, Efektivitas Pembelajaran, Sekolah Dasar*

Introduction

The role of technology in education has become a crucial aspect that not only enhances the quality, efficiency, and effectiveness of the learning process but also equips learners with relevant skills, experiences, and knowledge to face modern-day challenges. The use of technology in education can improve the quality of learning by providing access to various digital resources and enabling personalization in teaching and learning (Tresnawati et al., 2016)(Salsabila et al., 2021). Technological advancements have opened up opportunities for educational institutions to adopt more flexible, online-based learning systems accessible to students from various geographical backgrounds (Dewi et al., 2024).

The use of technology in education not only improves teaching effectiveness but also creates a more collaborative and adaptive learning environment tailored to student needs (Salsabila & Agustian, 2021). Furthermore, the integration of technology into education systems plays a significant role in developing more dynamic, data-driven curricula that accommodate industrial developments and global job market demands (Natalia Natalia & Taufik Muhtarom, 2024). Various studies have shown that technology use in education is not merely a supporting tool but a key element in building a more effective, efficient, and responsive learning ecosystem.

The success of a learning system cannot depend solely on technology. Effective education results from a complex interaction between various internal and external factors supporting optimal learning outcomes. These include the student, the learning material, the teacher, parents, and the teaching strategies prepared by educators. In addition, learning objectives also play an important role in education. For students, the objective is to develop their cognitive, affective, and psychomotor potential (Dimyati, 2017). For the learning process to be successful, it requires support from all educational components, including effective learning media (Mansur & Rafiudin, 2020).

In this modern era, selecting appropriate learning media that align with technological advancements is a key factor in achieving effective learning goals. The development of information and communication technology has significantly transformed education, making learning more interactive and flexible. The use of technology in education not only improves the quality of teaching and learning but also drives educational innovation that is essential for preparing students to meet global challenges and dynamic developments in various fields. Literature studies indicate that integrating digital technology in learning can enhance student motivation and learning outcomes (Ambarwati et al., 2022).

The use of innovative, technology-based learning media is increasingly important to boost student engagement in the learning process. However, a main challenge remains: selecting and applying methods that not only utilize technology but also address low interest and focus among students, especially in understanding subjects like IPAS. One major cause of students' lack of enthusiasm is the use of ineffective teaching media (Wahyudin et al., 2020). Monotonous teaching methods, such as long lectures and minimally visual textbooks, often make it hard for students to maintain attention. As a result, many students become bored, lose focus, or even feel sleepy during lessons, leading to suboptimal understanding of the material.

Using technology in the form of digital comics can be an innovative solution in learning, especially for elementary students. The learning process should not only focus on educators and textbooks but also encourage students to seek diverse learning sources (Muhammad Hasby, Hamsi Mansur, 2021). In education, learning resources such as visual media are often used for subjects that require additional illustration to help students better understand the material taught by teachers (Fajar, 2020). Digital comics, with their engaging visuals and interactivity, can boost students' interest and comprehension in IPAS while making learning more enjoyable (Gunawan & Sujarwo, 2022). Besides being easily accessible, digital comics simplify information delivery, which is ideal for children who are more drawn to visuals than text. Comics offer a unique appeal with their combination of stories and images,

making them easy to digest and less preachy, making them suitable as learning media (Harismawan, 2020). The lack of media use in learning can be addressed through the development of learning resources such as digital comics (Narayani, 2019).

As an electronic format, digital comics facilitate students' understanding, especially for those with reading difficulties, by presenting material in both image and text formats (Riwanto, 2020). Reading comics can help students retain long-term information through the material presented (Tresnawati et al., 2016). Reading comics helps students retain information long-term and understand abstract concepts (Subroto et al., 2020). Several studies also show that digital comics enhance student understanding and make learning more effective (Suparmi et al., 2024; Wicaksono et al., 2022). Thus, digital comics play a significant role in increasing learning effectiveness through engaging visuals and simple language.

This study aims to analyze the effectiveness of using digital comic media in IPAS learning (Natural and Social Sciences). Learning effectiveness is a measure of the success of interaction in educational settings in achieving learning objectives (Chartier, 1972). Innovation in interactive learning media, particularly visual-based, can help students understand concepts more effectively (Rini et al., 2024). This research reviews various theories, research findings, and expert perspectives on the role of digital comics in enhancing elementary school students' understanding. Additionally, it analyzes the application of digital comics in learning and their benefits in improving conceptual understanding, information retention, and accessibility in increasingly technology-based learning environments.

Methods

This study uses bibliometric analysis with the help of VOSviewer software. Bibliographic techniques are a quantitative analysis of books, articles, or other publications (Guo et al., 2021). Bibliometric analysis is a commonly used method to track the development of knowledge within a research field and to analyze specific topics (Goyal & Kumar, 2021). The use of a bibliometric approach in the field of education is relatively new, with only a few studies employing this analysis to map literature in recent years (Ding & Yang, 2022). Bibliometric reviews offer an alternative approach to mapping research, allowing for broader coverage, less time and resource investment, and greater objectivity in selecting and analyzing available literature (Hernández-Torrano et al., 2022). This approach enables the visualization and analysis of relationships between studies based on publication metadata, thereby identifying research trends, concept interconnections, and research gaps in the use of digital comics as learning media for IPAS (Science and Social Studies) in elementary schools (Prasastiningsih et al., 2023; Suparmi et al., 2024).

The research stages began with collecting data from 200 journals from various academic sources, such as scientific journals, conference proceedings, and relevant books. The collected data was then analyzed using bibliometric techniques with the aid of VOSviewer, which maps connections among keywords, authors, and publications (Maryono, 2020). This step allows the identification of research patterns and conceptual relationships within the studied field. The use of VOSviewer in bibliometric analysis has proven effective in visualizing research networks and identifying scientific trends (Putri et al., 2022; Rahmawati & Nugroho, 2021).
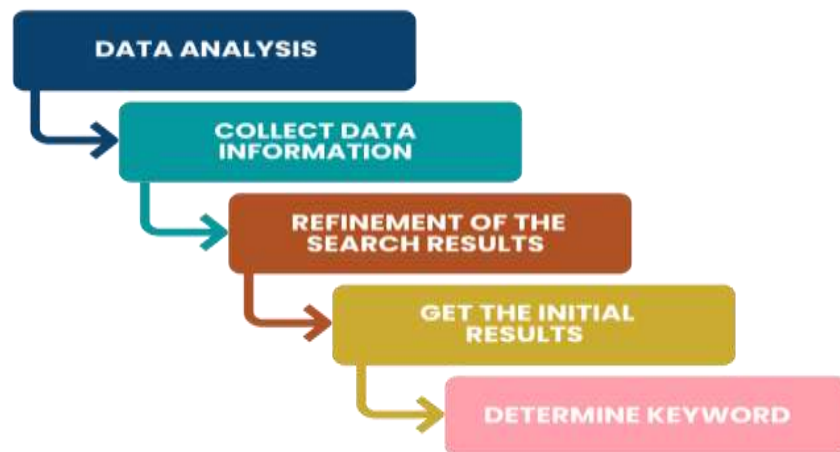
Figure 1. Bibliometric Analysis Workflow

The study began by determining relevant keywords such as "digital comics" and "learning effectiveness," followed by data searches using academic databases such as Scopus and Google Scholar. The collected data was analyzed using VOSviewer to produce a bibliometric map that visualizes relationships between concepts and research trends (Fauzan et al., 2019). The results of this analysis are used to understand research developments and identify scientific gaps within the studied topic. The bibliometric approach with VOSviewer has been used in various studies to analyze the development of research in multiple fields (Astuti et al., 2021; Sari, 2019).

Results and Discussion

The data analysis using VOSviewer revealed a total of 1,073 keywords, with 15 meeting the specified threshold. Further analysis classified the data into three clusters, each containing related keywords. This classification helps in understanding the thematic relationships found in the analyzed research. The table below presents the classification results from the VOSviewer data analysis, showing how the keywords in each cluster are interrelated and form specific patterns in the studied literature.

Table 1. Keywords Representing Each Cluster

Cluster 1	Cluster 2	Cluster 3
Learning effectiveness	Medium effectiveness	Learning Media
Digital comics	Teachers	
Material	Results	
Medium	Social studies	
Digital learning	Media and resources	
Medium development	Learning	
Elementary school		
Learning resources		

Source: VOSviewer Software Data 2025 by the reseachers

Network visualization using VOSviewer allows the researchers to analyze relationships between keywords and scientific articles. Different colors in the visualization represent different clusters, reflecting groups of interrelated research topics. This method helps identify research trends, topic focus, and conceptual connections in a scientific field (Eck & Waltman, 2014). Figure 2 shows the network visualization from the data analysis in VOSviewer.
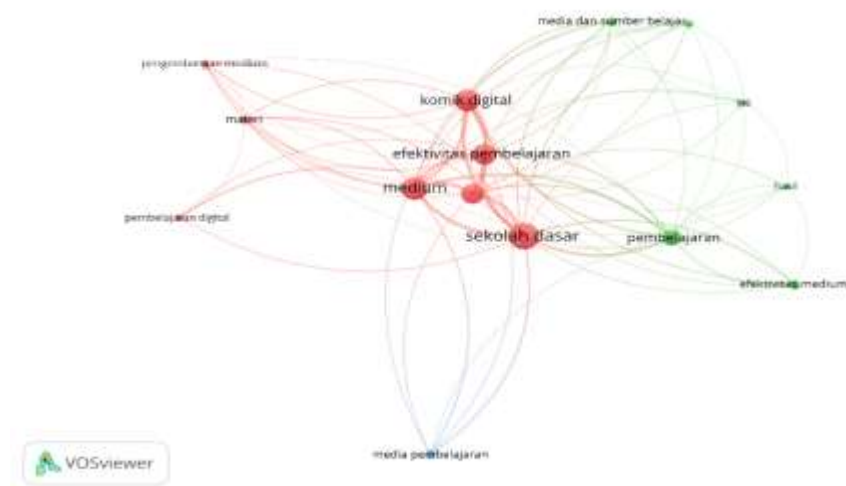
Figure 2 Network Visualization of Relationships among Digital Comics, Learning
Effectiveness, and Media
Source: Network Visualization Data and VOSviewer 2025 by the researchers

Based on the visualization, there is a significant relationship between the use of technology in education and the improvement of learning effectiveness. Each color represents a different meaning—darker colors indicate that a topic has been the subject of extensive research (Hanifah et al., 2022). The figure above is a basic example of a bibliometric map generated by VOSviewer. The interconnections shown in the visualization indicate that teaching aids are continuously evolving to match students' needs and characteristics. One widely studied method is the use of illustrations, such as digital comics, which are designed to aid material comprehension and enhance student engagement. Research indicates that this medium is effective in clarifying the concepts being taught, especially in elementary education (Akhir & Prihandani, 2018). With the rising use of the internet and digital devices, digital comics have the potential to become more effective learning media. Moreover, other studies show that teachers' ability to manage learning with the help of comic media is proven to be effective (Ula et al., 2019). Thus, research on the effectiveness of new educational methods continues to be conducted to ensure positive impacts in the learning process.

From the mapping results, these keywords were grouped into three main clusters that are closely related to research on digital comics as IPAS learning media in elementary schools: Cluster 1 is dominated by keywords such as "learning effectiveness," "digital comics," "material," and "medium," indicating that digital comics directly contribute to improved learning outcomes. As digital learning media, comics have been shown to enhance student absorption of material, especially in Social Studies subjects that require an understanding of social and historical concepts. Keywords like "medium development" and "elementary school" also suggest that digital comics are increasingly being developed as engaging and interactive learning resources for younger students.

Cluster 2 shows relationships among keywords like "medium effectiveness," "teacher," "results," and "Social Studies," indicating that teacher roles and appropriate media selection significantly influence the success of Social Studies learning. Keywords such as "media and learning resources" and "learning" emphasize that digital media, including digital comics, serve as alternative learning tools that help teachers deliver material more effectively. In the context of Social Studies, using interactive media like comics can boost student participation and help them grasp social concepts in more engaging and digestible ways.

Cluster 3 centers on the keyword "learning media," suggesting that media in general plays an essential role in enhancing educational effectiveness. In other words, appropriate

media use helps deliver content in more understandable ways, increases student engagement, and creates a more enjoyable learning experience. While this cluster is broader and not specifically focused on digital comics, the relationship between learning media and learning effectiveness remains relevant. This is especially important when developing innovative teaching methods suited for elementary students, who tend to understand concepts more easily through visual and interactive approaches.

In conclusion, the analysis confirms that digital comics play a significant role in improving the learning effectiveness of Social Studies in elementary schools, supported by more interactive media and learning resources. The three identified clusters demonstrate that the use of digital comics is not only related to learning effectiveness and media but also involves the teacher's role in optimizing its use and the development of innovative, engaging learning resources for elementary school students.
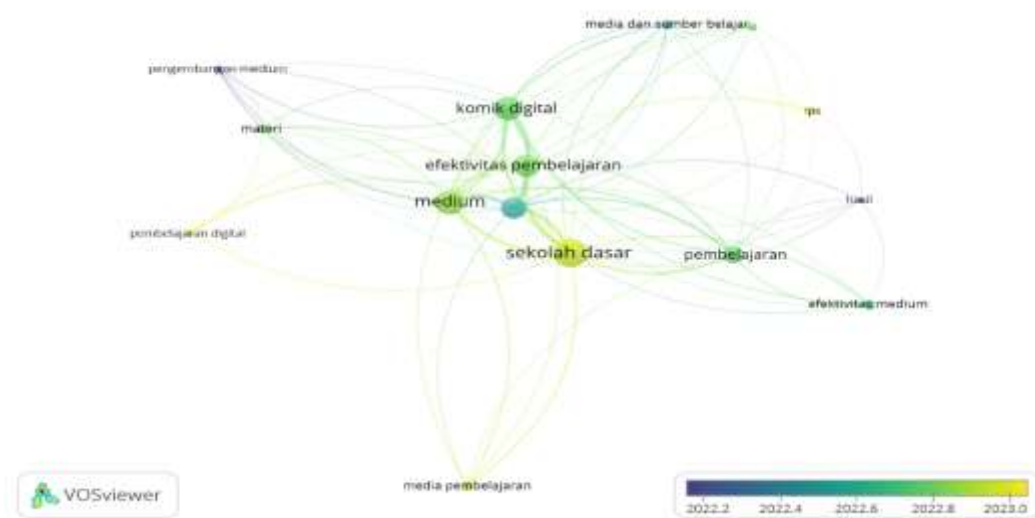

Figure 3. Overlay Visualization of the Relationship between Digital Comics, Learning Effectiveness, and Media

Source: Data Network Visualization and VOSviewer 2025 by the researchers

Based on the overlay visualization generated using VOSviewer software, research trends concerning digital comics in IPAS (Integrated Social and Natural Sciences) education experienced significant evolution between 2022 and 2023. This stage of analysis aims to examine the content, patterns, and trends of a set of documents by measuring term strength and calculating the frequency of co-occurring keywords in the studied articles (Chen, 2003; Russell, J.M.; Rousseau, 2015, as cited in Pisuko et al., (2022). Changes or shifts in scientific knowledge can be assessed through bibliometric analysis using the data from this figure (Ajinegara & Soebagyo, 2022). Darker colors (blue and dark green) indicate that in 2022, research mainly focused on developing digital learning media, particularly in the form of digital comics. Dominant keywords during this period include "digital comics," "materials," "medium development," and "digital learning." This suggests that early-stage research primarily explored how digital comics could be designed and implemented in elementary school learning.

Entering 2023, research began to focus on evaluating the effectiveness of digital learning media, as seen in the emergence of keywords such as "learning effectiveness" and "media and learning resources." This shift indicates that following the development phase in

2022, the next step was to measure its impact on learning—specifically in IPAS subjects at the elementary level. Lighter colors (yellow) in the visualization reflect the most recent research trends oriented toward evaluating how effective digital comics are in enhancing students' understanding. Previous studies have shown that digital comics can increase student engagement and help them better grasp concepts compared to conventional methods (Jannah & Rosyidi, 2022). Moreover, integrating digital comics with project-based learning strategies has been shown to improve critical thinking and problem-solving skills.

In terms of visual literacy, using digital comics not only makes content more engaging but also helps teachers convey complex concepts more simply and interactively (Ahsanah & Utomo, 2020). The visualization analysis shows that research on digital comics in IPAS education has evolved from media development to evaluating their effectiveness and impact on the learning process. Initially, studies focused on designing and adapting digital comics to align with curricula and students' needs. For instance, one study developed problem-based digital comics for IPAS subjects and found that the medium effectively improved students' cognitive learning outcomes. Now, the focus is shifting to how this medium can enhance conceptual understanding, learning motivation, and student engagement. Other research indicates that using digital comics as learning media can improve students' critical thinking skills (Putri et al., 2023).

As technology use in education increases, research also explores integrating digital comics with other learning approaches, such as project-based learning and other technologies, to create more interactive learning experiences. The effectiveness of digital comics is measured not only by how well they help students understand content but also by their impact on critical thinking, creativity, and visual literacy—making them an attractive and cognitively beneficial educational tool. Several studies indicate that with strong narratives and supportive visual illustrations, digital comics help students understand abstract concepts that are hard to explain through traditional texts—especially for visual learners. For example, research shows that digital comic media can improve students cognitive learning outcomes in IPAS education (Octaviana & Dewi, n.d.)

Research on digital comics in IPAS learning continues to grow, driven by academic contributions exploring various aspects—from design to effectiveness in improving learning quality. The growing interest in this medium shows that digital comics are not just a trend but a sustainable educational innovation. Using digital comics in elementary school IPAS learning has proven to significantly boost students' motivation and learning effectiveness. Furthermore, research by Yurti et al., (2023) reveals that well-designed digital comics that meet students needs can significantly improve learning outcomes. Similarly, Damarpuri & Taufik (2024) emphasized that digital comics can make learning more engaging and interactive for elementary students. Digital comic learning media are proven to be feasible and effective in increasing students' learning motivation and creativity in similar subjects (Nurhayati et al., 2019). With more related publications emerging, research in this field continues to expand, reflecting its relevance in modern education and potential for future development.
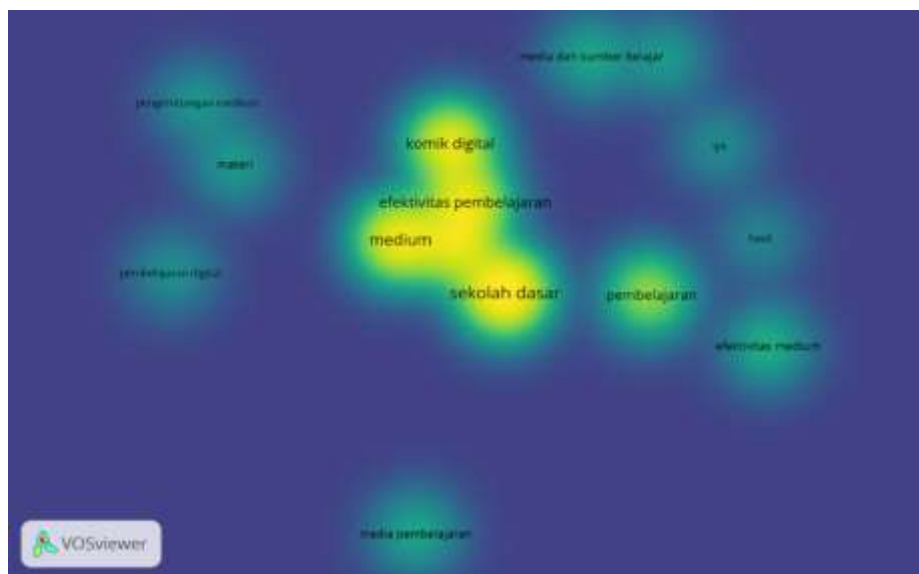
Figure 4 Density Visualization of Keyword Frequency

Source: Data Network Visualization and VOSviewer 2025 by the researchers

The image above shows a keyword density visualization of research on the use of digital comics as learning tools in elementary schools. Yellow areas indicate where keywords occur most frequently, meaning these topics are widely discussed across various studies. Words like "elementary school," "learning effectiveness," "digital comics," and "media" appear prominently in bright yellow in the center, marking them as the main research themes.

Conversely, green to blue areas show lower density, indicating less dominant but still relevant terms. Words like "digital learning," "learning media," "outcomes," and "IPAS" appear as supporting terms related to the main focus. These keywords provide additional context for the use of digital comics, such as which subjects are being studied or what other media are being compared. Thus, this visualization helps researchers understand the distribution of themes in existing studies and identify new directions or gaps in research on digital learning media effectiveness in elementary schools.

The top ten authors in research involving related keywords are dominated by academics who actively publish scientific articles. Almost all the authors on this list consistently explore various aspects of digital comics, particularly in the context of education and learning. Their presence reflects the strong academic interest in digital comics as an innovative and potential learning medium. These researchers have made significant contributions to the development of theories, concepts, and strategies for implementing digital comics in education. Through various scientific publications, they not only discuss the effectiveness of digital comics in improving learning quality but also explore development approaches and the challenges faced in applying them across different educational levels.

Furthermore, this list of the top ten authors provides insights into the current trends in research. With the growing number of studies conducted by experts in this field, it can be concluded that digital comics have great potential as a learning tool that continues to be developed and evaluated. The complete list of the top ten authors can be found in Table 2, which provides further information on their contributions to digital comic-related research.

Table 2. Top Ten Authors

Authors	Year	Total citation	Publication type
DRN Jannah, IRW Atmojo	2022	393	Article
A Putra, IF Milenia	2021	177	Article
MA Shomad, S Rahayu	2022	154	Article
A Indriasih, S Sumaji, B Badjuri et al.,	2020	88	Article
T Handayani	2021	81	Article
NLPA Laksmi, NW Suniasih	2021	76	Article
U Kurniawati, HD Koeswanti	2021	72	Article
Y Intaniasari, RD Utami	2022	65	Article
MR Muhaimin, NU Niâ, et al.,	2023	64	Article
KD Ningrum, E Utomo, A Marini, et al.,	2022	60	Article

Source: Data from VOSviewer Software 2025 by the researchers

From Table 2, which lists the top ten authors in digital comic research, it can be seen that most highly cited publications are from 2021 and 2022, with a few from 2020 and 2023. The highest number of citations was received by Jannah and Atmojo in 2022, with a total of 393 citations, indicating that their research had a significant influence on the development of studies on digital comics in education. This high citation count is likely due to the strong relevance of their research to the rapidly growing trend of digitalization in education. Additionally, the publication by Shomad and Rahayu also had a considerable impact, with a total of 154 citations in the same year. This further reinforces the idea that 2022 was one of the peak periods for research on digital comics, during which many academic studies gained widespread attention and contributed significantly to the development of digital-based learning methods.

Apart from publications from 2022, research from 2021 also showed a notable influence, such as the work by Putra and Milenia, which received 177 citations. Earlier publications by Indriasis, Sumaji, and Badjuri in 2020, with a total of 88 citations, suggest that interest in digital comics in education had already begun to grow before reaching its peak in the following years. However, the citation trend in 2023 appears to show a slight decline compared to the previous year, as seen in the publication by Muhaimin and Ni'ä et al., which received 64 citations. This decrease may be due to a shift in research focus toward other technological innovations in education or the emergence of new learning media that are more adaptive to the needs of students and educators. Therefore, it can be concluded that research trends in digital comics for learning saw a significant rise in 2021 and 2022, while 2023 showed a potential decline in the number of highly impactful publications. Nonetheless, research opportunities in this field remain wide open, particularly in exploring new methods that can enhance the effectiveness of digital comics as an innovative learning medium in the future.

Conclusion

This study demonstrates that using digital comics as learning media has great potential to improve the learning effectiveness of elementary students in IPAS subjects. Bibliometric analysis using VOSviewer identified three main clusters in this research: learning effectiveness, the role of teachers and learning media, and the development of innovative learning resources. Digital comics have been proven to increase student engagement, clarify concept understanding, and help teachers deliver content in a more interactive way.

The results show that research on digital comics in education continues to grow, with an increasing trend focusing on the effectiveness of digital learning media. However, there are still research gaps in developing more adaptive and integrated digital comic-based learning models with interactive technologies. Future studies are therefore recommended to further

explore effective implementation strategies for digital comics and their long-term impact on student learning outcomes.

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