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BIBLIOMETRIC ANALYSIS OF GAME-BASED LEARNING TRENDS IN SCIENCE SUBJECTS IN ELEMENTARY SCHOOLS

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Abstract. Quality education is greatly influenced by the use of technology, especially in learning in the digital era. This study aims to analyze publication trends related to game-based learning in IPAS subjects in primary schools. The method used is qualitative with a bibliometric approach, where data is collected from publications indexed on Google Scholar using Publish or Perish and VOSviewer software. The research object included 100 documents published between 2023 and 2025. Data analysis techniques included keyword mapping, number of publications, and citation analysis. The results showed an increase in the frequency of publications on game-based learning, with Tuanku Tambusai University of Heroes as the top institution. The main keywords that emerged included 'learning,' 'game-based,' and 'learning media,' reflecting the focus on the interaction between games and the learning process. In conclusion, game-based learning has the potential to increase student motivation and engagement.

Keywords: Bibliometrics, Game-based Learning, Natural and Social Sciences

Abstract. Pendidikan yang berkualitas sangat dipengaruhi oleh penggunaan teknologi, terutama dalam pembelajaran di era digital. Penelitian ini bertujuan untuk menganalisis tren publikasi terkait pembelajaran berbasis game pada mata pelajaran IPAS di sekolah dasar. Metode yang digunakan adalah kualitatif dengan pendekatan bibliometrik, data dikumpulkan dari publikasi yang terindeks di Google Scholar menggunakan perangkat lunak Publish or Perish dan VOSviewer. Objek penelitian mencakup 100 dokumen yang dipublikasikan antara tahun 2023 hingga 2025. Teknik analisis data meliputi pemetaan kata kunci, jumlah publikasi, dan analisis sitasi. Hasil penelitian menunjukkan adanya peningkatan dalam frekuensi publikasi tentang pembelajaran berbasis game, dengan Universitas Pahlawan Tuanku Tambusai sebagai lembaga teratas. Kata kunci utama yang muncul mencakup "pembelajaran," "berbasis game," dan "media pembelajaran," mencerminkan fokus pada interaksi antara game dan proses belajar. Kesimpulannya, pembelajaran berbasis game berpotensi meningkatkan motivasi dan keterlibatan siswa.

Keywords: Bibliometrik, Pembelajaran Berbasis Game, Ilmu Pengetahuan Alam dan Sosial

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INTRODUCTION

Education has a role in influencing the progress of a country, which in turn can change the quality of a nation (Satria et al., 2025). To improve good education in the modern era, of course, it cannot be separated from technology to be able to easily access the information obtained and freedom in creativity for students. With careful planning and strong support, technology can

be a useful tool to facilitate effective and enjoyable learning (Bintang et al., 2024; Nopianti & Sukmanasa, 2024). In the digital era like today, the use of technology in learning has become an increasingly popular trend (Azhima et al., 2023; Wulandari & Sari, 2023).

Learning is a process of interaction involving teachers and students so that there is intense and directed communication in order to realize a good learning process to achieve the desired goals (Abidin, 2022; Fahmi & Wiguna, 2023; Harlita & Ramadan, 2024; Sarumaha et al., 2022). Learning is said to be innovative if learning is carried out based on games. Game-based learning is an approach applied in education, where teachers can use games to increase cognitive interest and motivation in learning (Ayulia & Perdana, 2022; Putra et al., 2024). According to Hermawan, (2024) Game Based Learning is the use of games with serious goals (i.e. educational goals), as a tool that supports the learning process. This approach integrates game components into the learning process with the aim of increasing student interest in learning, especially in learning Natural and Social Sciences (IPAS).

Science is a discipline and method that involves the study of natural phenomena through scientific methods including observation, experimentation, and analysis in it to obtain and use it (Purba et al., 2023). Science learning in elementary schools tends to be more about memorizing material than exploring, so that students get bored easily, are less active in giving opinions and have low learning outcomes (Damayanti & Dikta, 2022; Mentari et al., 2024; Molo, 2024). Another problem is that teachers and students only use teaching materials provided by the school, learning should be able to utilize various learning resources, media and teaching materials that vary so that students experience limited insight and knowledge (Herawati, 2023; Purnama et al., 2024). The problems of science learning require concrete solutions that can overcome and even provide a positive impact on student development in the future.

Therefore, in learning requires gamification to motivate students to be more active in learning activities and help teachers in conveying to students in a more enjoyable way. According to Qurrotaini et al., (2021) gamification is defined as the use of rules and the use of game-based thinking elements in order to provide a magnetic effect and impulse on students in solving a problem. In gamification must also create positive feelings, such as curiosity, competitiveness, fun, optimism and pride in the results obtained. The gamification that is designed must contain rules for the players and be explored during the game. Although during the game the feelings that will arise, such as disappointment, with this emotional experience will change it into a positive feeling (Ehrick et al., 2024; Friska et al., 2023; Gumilar & Permatasari, 2022).

There are several previous studies that examine game-based learning, namely Hikmah et al., (2023) that smart monopoly media based on educational games in science subjects for grade V of elementary school are stated to be very feasible and very practical to use in learning. Furthermore, research (Kusumawati, 2022) Scratch-based games can be used as an effective learning medium and can be recommended to improve student learning outcomes. Then research Nissa & Arini, (2021) with the presence of game learning media Ludo IPS for grade IV students that learning by utilizing games This ludo can Support students to be confident and more active in learning or answering the questions provided in the game. Research Arsyad et al., (2022) on the use of educational games based on develop is considered very practical in its use. Students agreed that the use of educational games as a learning medium can make it easier for them to understand science learning materials. While in the research Siregar & Ramadhani, (2022) The educational games developed have good quality and are suitable for use as supporting learning media for social studies subjects for fifth grade elementary school students.

In several previous studies, it is different from the one studied, namely in the subject of science and social studies, where science and social studies subjects are combined not as subject areas of study or thematically and exploring trends and frequency of publications related to game-based learning, providing a comprehensive picture of developments and academic attention in this field. Previous studies were more empirical and focused on practical applications in the classroom. While the similarities are that the research was conducted in elementary schools and game-based learning as an improvement in the quality of learning. By using game-based learning media, it can increase student motivation, engagement, and learning outcomes. So the purpose of this study is to analyze publication trends related to game-based learning, including the frequency and development of topics in academic literature, especially in science subjects in elementary schools.

METHOD

The research method used is qualitative with a bibliometric approach. Bibliometrics is an analysis method used in the field of library science and other fields related to scientific citations (Sayekti, 2023). Meanwhile, according to Simahate et al., (2024) bibliometric analysis, it is a study of science that has existed since the 1980 and is included in the field of library science, but over time this science can be applied and studied in all other fields. Bibliometric analysis has been widely used to analyze the scientific evolution of various fields of research such as in higher education (Sanusi et al., 2023). In collecting data using Publish or Persih (PoP) and VOSviewer software which facilitates research mapping. Based on the results of data searches

in PoP, the data is stored in RIS/Manager format for use in VOSviewer software. In this application, select articles or related journal data from Google Scholar. The keywords used are "Game-Based Learning". The topics selected come from the last 3 years between 2023 and 2025 by taking 100 articles for analysis. The criteria for articles or journals are that all information must be indexed by Google Scholar and Synta.

The data is then imported into VOSviewer. Once imported, the data is processed to match the desired or selected keywords. In addition, VOSviewer converts the input data into a suitable data map. In addition, it analyzes the variation in the number of publications per year and classifies the 10 articles with the highest citations, the 10 institutions that publish the most, the 10 publishers that publish the most documents, and the keywords that often appear from the specified keywords. Bibliometric analysis has five stages in the study, namely, 1) keyword research; where researchers determine keywords; 2) first reduction: after researchers determine keywords in the initial stage, researchers then search for these keywords using the Google Scholar database assisted by the publish or perish application; 3) reduction of the total initial search: in the third stage, researchers determine the limitations according to needs in the VOSviewer application to select relevant publications that have been obtained in the previous stage; 4) Description of the initial statistical picture: at this stage, researchers group data into topic descriptions that include keywords for institutions, journals, documents, and events with author keywords; 5) data interpretation in analytical narratives: in the last stage, researchers interpret data from visualizations obtained with VOSviewer. This is what researchers can develop.

RESULTS AND DISCUSSION

Literature is obtained from journal publications, articles, and proceedings in the period 2023-2025 in the PoP database with document analysis totaling 100 documents. Table 1. Describes the year, number and percentage of publications with the keyword "game-based learning". Table 2. Describes the institutions with the largest number of documents. Table 3. Describes the publishers with the largest number of documents.

Table 1. Year and percentage of publications (2023-2025)

Year	Amount	Percentage
2025	1	1%
2024	39	39%
2023	60	60%
Total	100	100

Source: Harzing's Publish or Perish

The table above shows data on the number and percentage of publications from 2023 to 2025. In 2023, there were 60 published documents. In 2024, there were 39 published documents, while in 2025 there was only 1 published document. The quantity and quality of publications can affect academic reputation and the development of science. According to Asuki & Ahmad, (2024), a high frequency of publication is often associated with increased visibility and recognition in the academic community, which in turn can contribute to increased collaboration and innovation in research.

Table 2. Institutions with the largest number of documents

No	Name of Institution	Number of Documents	Quote
1	Tuanku Tambusai Heroes University	10	203
2	National Institute of Technology Malang	5	30
3	State University of Gorontalo	3	6
4	Teacher Training College of PGRI Situbondo	2	14
5	Raden Rahmat Islamic University of Malang	2	11
6	Human Resources Development University	2	26
7	Muhammadiyah University of Jember	2	7
8	Islamic University of Kalimantan Muhammad Arsyad Al Banjari Banjarmasin	2	24

Source: Harzing's Publish or Perish

Pahlawan Tuanku Tambusai University is in the top position with 10 documents and 203 citations. Followed by the National Institute of Technology Malang which has 5 documents with 30 citations, and Gorontalo State University with 6 documents and 26 citations. In addition, STIKIP PGRI Situbondo recorded 4 documents with 10 citations, while Raden Rahmat Malang University has 3 documents and 8 citations. Budi Utomo University and Muhammadiyah University of Jember each have 2 documents with 5 and 10 citations. Lastly, the Islamic University of Kalimantan Muhammad Arsyad Al Banjari Banjarmasin has 1 document and 1 citation. Institutions with more publications and citations usually have a wider collaboration network, which increases the visibility and impact of their research. According to Judijanto, (2025), collaboration between institutions can improve the quality of research and accelerate innovation in various fields of science.

Table 3. Journals with the largest number of documents

No	Journal Name	Number of Documents	Number of Quotes
1	Journal of Informatics Engineering Students (Jati)	5	30
2	Inverted: Journal of Information and Technology Education	3	6
3	Community Development Journal: Community Service Journal	4	74
4	Journal of Education and Teaching Review (JRPP)	3	111

Informatics Engineering Student Journal (Jati) is in the top position with 5 documents and 30 citations. Followed by Inverted: Journal of Information and Technology Education which has 3 documents with 6 citations. Community Development Journal: Journal of Community Service recorded 4 documents with 74 citations. Jurnal Reviu Pendidikan Dan Pengajar (JRPP) has 3 documents but reached 111 citations, which shows that despite the smaller number of documents, the impact and recognition of published research is quite high. Journals with high citations reflect influence and relevance in the academic community. According to Mubarok, (2024); Wisnawa, (2024), a high impact factor is often associated with the quality of published research, which creates a better reputation among researchers and academics.

Table 4. Publications with the most citations

No	Author Name	Document Title	Year	Journal Name	Number of Quotes
1	Muhammad Alba, Parjito, Adhie Thyo Priandika	Android-Based Educational Game Media for Learning Living and Non-Living Things	2023	Journal of Informatics and Software Engineering (JATIKA)	1409
2	Ahmad Saiful Rizal	Learning Innovation to Improve Student Learning Outcomes in the Digital Era	2023	Attanwir: Journal of Islam and Education	60
3	Almira Ulimaz, Brian Sebastian Salim, Ika Yuniwati3 Marzuki, Arief Syamsuddin, Abu Bakar Tumpu	Increasing Motivation and Learning Achievement with the Implementation of Game-Based Learning	2024	Journal of Education and Teaching Review (JRPP)	59
4	Aisyah Nurhikmah, Hasnah Putri Madianti, Princess Aiko Azzahra, Arita Marini	Development of Learning Media Through Educandy Games to Improve Students' Learning Character in Elementary Schools	2023	Journal of Elementary Education and Social Humanities	48
5	Baso Intang Sappaile, Laila Mahmudah, Rudy Max Damara Sues, Baiq Fina Farlina, Ahmad Shofi Mubarok, Budi Mardikawati	The Impact of Using Game-Based Learning on Motivation and Learning Achievement	2024	Journal of Education and Teaching Review (JRPP)	34

Source: Harzing's Publish or Perish

Muhammad Alba, Parijto, and Aideh Thyo Priandito occupy the top position with a document entitled "Android-Based Educational Game Media for Science Learning" published in 2023, obtaining 1,409 citations. Followed by Ahmad Saifal Rizal with a publication entitled

"Learning Innovation for Character Education" which was also published in 2023 and received 115 citations. Aisyah Nurkhusna, with an article on "Increasing Student Motivation and Learning Outcomes in Elementary Schools," received 25 citations. Furthermore, Damar Agung Lestari and his colleagues wrote about "Game-Based Learning Media Development" which received 15 citations. These data show that relevant and applied publications in the context of education, especially those utilizing technology, tend to receive greater attention from the academic community.

According to Farida, (2020); Kurdi & Kurdi, (2021), citations are important indicators that reflect the influence and relevance of a research in a particular discipline. Research that focuses on innovation and practical applications in education, as shown in the table, usually attracts greater attention and gains wider recognition in the academic community. The number of keywords related to the term "Game-Based Learning," is 71. There are many studies, articles, or publications discussing this topic, in the academic community on the use of games as a learning tool. The use of games as a learning medium can create a more interactive and interesting environment, thus encouraging students to be more actively involved in the learning process.

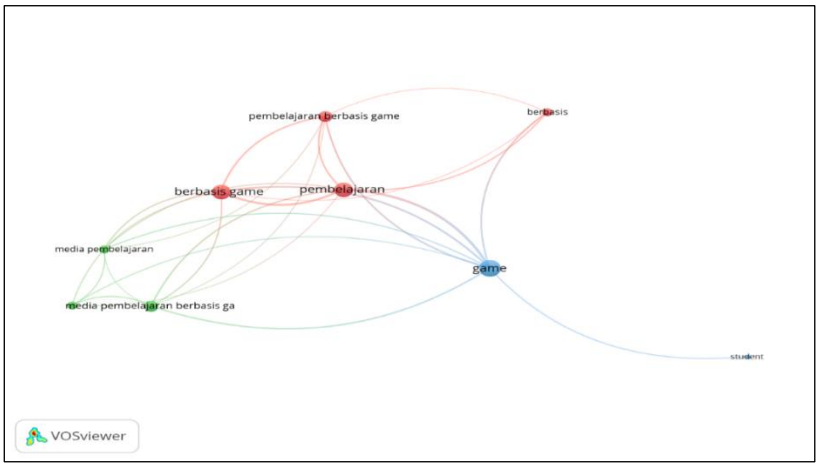

Figure 1. Network visualization of the occurrence of common keywords

The figure above is a visual representation of the keyword analysis related to “Game-Based Learning.” In this figure, keywords are presented as nodes connected by lines indicating the relationship between terms. The main keywords seen are “learning,” “game-based,” “game,” “learning media,” and “student.” The keywords “learning” and “game” have many connections, indicating that many studies focus on the interaction between the two concepts. “Learning media” is also connected to “game-based,” indicating that studies often explore the types of media used in the context of game-based learning. In this study, integrating game technology into the learning process. This reflects a new trend in education, where games are

not only seen as entertainment tools, but also as effective methods to increase student engagement and motivation in learning. Research that focuses on this aspect can contribute to the development of innovative learning methods.

Table 5. Cluster Mapping in VOS Viewer

Cluster	Color	Discussion Topics in Cluster
1	Red	Game Based Learning, Game Based, Learning, Based
2	Green	Learning Media, Game Based Learning Media
3	Blue	Games, Students

Source: VOS Viewer

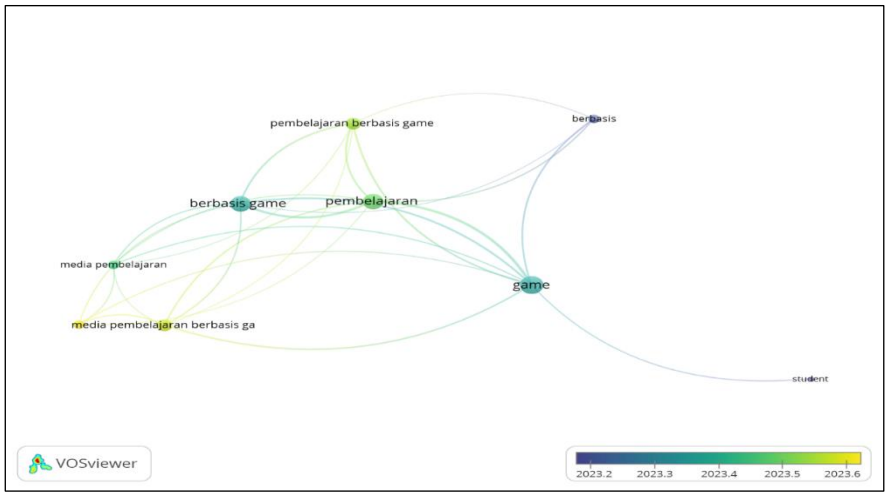

Figure 2. Visualization overlay of co-occurrence of keywords based on 3 years of publication

There are three different colors in the image above. Yellow indicates that the keywords will be used together around 2023.6 (mid), blue indicates that the keywords will be used together around 2023.2, 2023.3 (early), and green indicates that the keywords will be used together around 2023.4 and 2023.5 or between early and mid. The keyword for the new theme is “Game-Based Learning Media”. While the keywords in the old theme are “Based”, “Game”, “Student”, “Game-Based”, “Learning”, “Learning Media”, “Game-Based Learning”. The keyword “Game-Based Learning Media” does not have a direct relationship with the keyword “Student” so it becomes a gap that can be used for further research on game-based learning. The connection with "student" shows attention to the impact of game-based learning on students. The latest trends in education show that the use of games as a learning tool is not only for entertainment, but also as an effective method to increase student engagement and motivation.

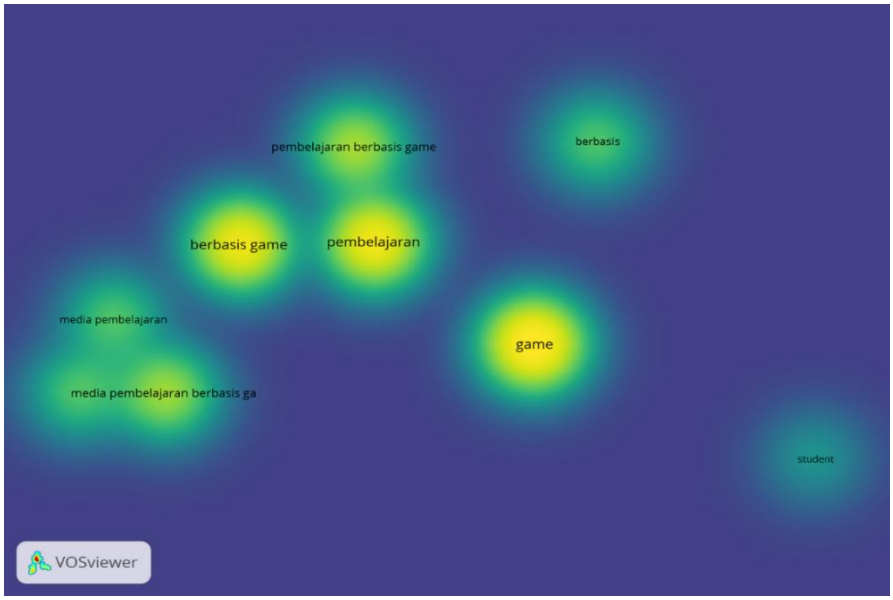

Figure 3. Density visualization VOS Viewer

The image above is a heatmap representation of the keyword analysis related to "Game-Based Learning." In this visualization, keywords are displayed as glowing dots, with the intensity of the color indicating the density or relevance of the term in the research context. The main keywords seen include "learning," "game-based," "game," "learning media," and "student." The keywords "game" and "game-based" appear with high intensity, indicating that they are the main focus in many publications. "Learning" also appears to signal the importance of the educational context in this study. Meanwhile, "learning media" is connected to other terms, indicating an exploration of the various methods and tools used in game-based learning. The connection with "student" emphasizes the attention to the impact of game-based learning on students. Research that integrates games into the learning process can provide new contributions in designing more interactive and engaging learning experiences, as well as creating new approaches to current challenges in education.

Although many publications focus on the effectiveness and application of games in education, there is a lack of exploration of the long-term impact of these methods on students' critical thinking and problem-solving skills. In addition, more in-depth research on differences in game effectiveness based on cultural and demographic contexts is also lacking. The use of games as a learning tool not only increases student motivation but also has the potential to change the way students interact with the subject matter. With the increasing use of technology in education, it is important to explore how games can be tailored to meet the needs of different groups of students. Active student engagement in the learning process can improve academic

outcomes. According to Srimuliyani, (2023), a deep understanding of the factors that influence student engagement is essential to designing effective learning methods.

Research could be directed to investigate less explored aspects, such as the influence of games on students' social and collaborative skills, and how the use of games can be integrated into the broader curriculum. In addition, studies on the effectiveness of educational games in different learning environment contexts, such as inclusive education or outdoor education, also promise to provide new insights. For further research, game-based learning still has great potential to be explored and can continue to be used with various updates. As technology advances and changes in the way students learn, this approach can be adapted to create more interactive and enjoyable learning experiences. Research could focus on developing more personalized games, tailored to students' individual needs and preferences. In addition, the integration of gamification elements into existing curricula could be an interesting area of research, where not only games, but also game elements such as points, badges, and challenges can increase students' motivation and engagement.

CONCLUSION

Game-based learning has become a trend in education, especially in elementary school science subjects. Bibliometric analysis using VOSviewer revealed an increase in the number of publications related to this topic from 2023 to 2025, with a high concentration of research on the use of games as a learning medium. The data shows that Universitas Pahlawan Tuanku Tambusai and Jurnal Mahasiswa Teknik Informatika are the most productive institutions and journals in publication. Frequently appearing keywords, such as "learning," "game-based," and "learning media," indicate that this research focuses on the integration of games into the learning process, which has the potential to increase student engagement and motivation. Although many studies have been conducted, there is still a lack of exploration of the long-term impact of game-based learning on students' critical and social skills. Therefore, further research is recommended to dig deeper into these aspects, as well as develop games that are more personalized and relevant to diverse educational contexts.

RECOMMENDATIONS

Further research on the implementation of STEM at the elementary school level is recommended to conduct longitudinal studies that evaluate the impact of STEM implementation on students' skills over time, in order to understand the sustainability of learning outcomes and the development of 21st century skills. In addition, a comparative

analysis of the effectiveness of STEM approaches and traditional learning methods in different contexts, such as urban and rural areas, can provide insight into factors that influence success. Research also needs to focus on developing more innovative and adaptive STEM learning models, including the use of the latest technology or mobile applications to increase student engagement. The integration of local wisdom in STEM learning should be further studied to make teaching materials more relevant to students' cultural contexts. Parental involvement in supporting STEM learning at home can affect students' motivation and learning outcomes.

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