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Bibliometric Analysis: Indonesian Traditional Engklek Game as an Educational Tools in Elementary Schools' Mathematics Learning

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ABSTRACT

The lack of understanding of the trends and developments of research related to *engklek* games in the context of mathematics learning is the basis of this research. This study aims to map the development of the scientific literature related to the use of traditional *engklek* games as an educational game tool in mathematics learning in elementary schools through a bibliometric approach. The research method used was bibliometric analysis with data collection from Google Scholar, which was analyzed using Publish or Perish and VOSviewer software. The results of the study show a significant increase in the number of publications related to the *engklek* game in the period 2021 to 2023, with a peak in 2023 which recorded 408 articles. However, the number of publications has decreased drastically in 2025 to 84 publications. The implications of the results of this study are the importance of deepening the study of the implementation of *engklek* games in the classroom, focusing on the perception of teachers and students towards this method, and exploring the potential for integrating this game in the Independent Curriculum to support mathematics learning in elementary schools.

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Introduction

Mathematics learning at the elementary school level often faces challenges related to student engagement and motivation (Caesaria et al., 2024; Wijayanti & Yanto, 2023). Many students consider mathematics as a difficult and uninteresting subject (Lestari et al., 2024; Utomo et al., 2024), largely due to the predominance of conventional, teacher-centered instructional methods that offer limited opportunities for contextual and enjoyable learning experiences (Kero & Wewe, 2024; Nopianti et al., 2025). This condition contributes to low

levels of conceptual understanding, especially in basic mathematical domains such as number sense, measurement, and pattern recognition (Nurhayanti et al., 2021). Considering the cognitive development of elementary school students, who are in the concrete operational stage according to Piaget's theory (Marinda, 2020; Septiyanti et al., 2023), instructional strategies that incorporate direct experience and physical activities are essential to support their learning processes (Adatul'aisy et al., 2023; Aktorida et al., 2022). In response to this, there has been growing interest in utilizing traditional games as educational tools (Pratiwi & Bachri, 2023; Rahman, 2023). One such game is *engklek*, a culturally embedded, physically engaging activity that can be adapted to support mathematics instruction in a fun and meaningful way (Khoerunnissa et al., 2023). Research suggests that *engklek* can foster logical reasoning, numerical proficiency, and motor coordination (Yusuf et al., 2022), while also preserving local culture an aim aligned with the principles of the Merdeka Curriculum (Hayati et al., 2024; Wardani et al., 2024).

Despite its educational potential, there has been no comprehensive bibliometric analysis to systematically explore how *engklek* has been studied and applied in the context of mathematics education. Previous research has touched on the educational use of traditional games more broadly for instance, investigated hopscotch for early numeracy development (Indriyani et al., 2021), while the other one examined the integration of games in thematic learning to preserve cultural heritage. However, a focused, data-driven synthesis of the literature specifically addressing *engklek* in mathematics education is still lacking (Anisah & Holis, 2020). This represents a critical research gap, as understanding the existing landscape of scholarship can help direct future inquiries and innovation in this area.

Therefore, the aim of this study is to conduct a bibliometric analysis of scientific literature related to the use of the traditional *engklek* game in mathematics learning. Specifically, the study seeks to identify publication trends, dominant keywords, key contributors (authors, journals, and institutions), and the most cited works in this field. The significance of this research is twofold. Theoretically, it enriches the literature on culturally relevant pedagogical media and supports the development of knowledge in the integration of local wisdom into mathematics education. Practically, the findings can inform teachers, curriculum developers, and policymakers in designing innovative, student-centered, and culturally grounded learning strategies suitable for elementary education.

The novelty of this research lies in its bibliometric approach to mapping the use of *engklek* as an educational tool in mathematics learning, a topic that has received limited scholarly attention to date. By focusing on the integration of a traditional game within contemporary mathematics pedagogy, this study brings a new perspective to the field of education. Furthermore, it contributes to the growing body of knowledge on local cultural integration in educational strategies, particularly in the context of Indonesia's primary education system. By mapping the state of the art, this study offers a comprehensive understanding of the potential and future directions for *engklek* as an effective educational tool in elementary school mathematics instruction.

Method

This study employs a bibliometric approach to analyze trends, productivity, and the development of themes in research on the use of the traditional game *engklek* as a medium for teaching mathematics in elementary schools. Data was collected from Google Scholar using the Publish or Perish (PoP) application with the keywords "*engklek*, educational games, mathematics, elementary school." Inclusion criteria comprised articles relevant to

the topic of using *engklek* as a mathematical learning medium in elementary schools, published between 2015 and 2025. Articles that were not relevant or not indexed in Google Scholar were excluded from the analysis. The search resulted in 999 relevant articles with a total of 7,310 citations, averaging 731 citations per year. Citation analysis was conducted to identify academic contributions through the h-index and citation counts of the most influential publications. Further, the most productive authors, journals, and countries in this field were identified to highlight the dominant players in the area.

Publication trends were analyzed by year to track the growth of academic interest in this topic, using VOSviewer software. The year-by-year publication trend visualizations revealed an increasing interest, particularly between 2021 and 2023. Additionally, keyword analysis was conducted using VOSviewer to map topic clusters, thematic connections between keywords, and the temporal development of research themes. This analysis included: Network Visualization: To map relationships between keywords and dominant topics. Overlay Visualization: To show the temporal development of keywords and research trends year by year. Density Visualization: To illustrate the density of frequently used keywords and the strength of their relationships. The results of this analysis are used to formulate recommendations for future research directions and the development of models for implementing traditional games based on local culture in the context of global education.

Table 1. Research Flow

Data Source	Description
Search Strategy	Google Scholar (PoP) Keywords: "engklek", educational games, mathematics, elementary school Inclusion Criteria: Relevant articles, 2015–2025 999 Selected Articles 7,310 Total Citations Average 731 Citations per Year
Citation & Indicators Analysis	H-index, Most Cited Publications Most Productive Authors, Journals, Countries
Data Visualization	VOSviewer used for keyword clustering analysis Network, Overlay, Density Visualizations
Publication Trend Analysis	Based on year (2021–2023)
Development of Future Research Recommendations	Final stage: Propose future research directions based on findings from the analysis.

Each step in the research flow is strategically designed to ensure a comprehensive understanding of the academic landscape surrounding the use of traditional games in education.

Results and Discussion

Citation Analysis

Based on the search results using the Publish or Perish (PoP) application with the keywords "*engklek*, educational games, mathematics, elementary school" and data sourced from Google Scholar, 999 relevant articles were found. The total number of citations across all articles reached 7,310, with an average of 731 citations per year. This demonstrates that topics related to traditional games such as *engklek* in the context of mathematics learning in elementary schools are an active field of study in the academic community. The h-index value of 39 indicates that 39 articles have been cited at least 39 times, reflecting significant contributions to the literature and consistent study quality. Furthermore, there are 32 articles from the last decade that have been cited at least ten times, further demonstrating the topic's relevance to current research needs. In conclusion, the traditional game of *engklek* has considerable potential as an educational tool in elementary school mathematics learning.

Most Productive Authors, Journals, and Countries

Table 2. Publication Data for Articles on *Engklek* Games as Educational Games for Learning Mathematics in Elementary Schools

Author and Year	Title	Citation
G Anggraini, H Pujiastuti (2020)	The Role of Traditional Engklek Games in Developing Mathematical Skills in Elementary Schools	39
Laras Retno Widyastuti, Lina Revilla Malik, Abdul Razak (2020)	The Effectiveness of Traditional Engklek Games in Improving Mathematics Learning Outcomes	32
Ria Wijayanti, Anita Trisiana (2018)	The Influence of *Engklek* Games Based on Ethnomathematics on Critical Thinking Skills of Grade III Students	19

Table 2 lists a number of publications related to the use of traditional *engklek* games in mathematics learning in elementary schools. G. Anggraini and H. Pujiastuti highlighted the role of *engklek* in developing mathematics skills with 39 citations. Laras Retno Widyastuti, Lina Revilla Malik, and Abdul Razak studied the effectiveness of *engklek* games in improving mathematics learning outcomes, with 32 citations. Meanwhile, Ria Wijayanti and Anita Trisiana studied the effect of ethnomathematics-based engklek games on students' critical thinking skills, which received 19 citations (Anggraini & Pujiastuti, 2020; Widyastuti et al., 2020; R. Wijayanti & Trisiana, 2018).

Based on the bibliometric data analysis, several journals have shown a significant contribution to the development of research on traditional games in mathematics education. The journals that published the most articles include the Journal of Mathematics Education, International Journal of Educational Research, and Educational Studies in Mathematics. These journals provided a platform for disseminating research findings related to innovative educational methods using traditional games. In terms of countries, the most productive contributors are Indonesia. This trend reflects the cultural richness and educational focus on local wisdom in these regions. Researchers from Indonesia, in particular, have actively explored the integration of traditional games into mathematics learning, aligning with efforts to promote culturally responsive pedagogy

Publication Trends

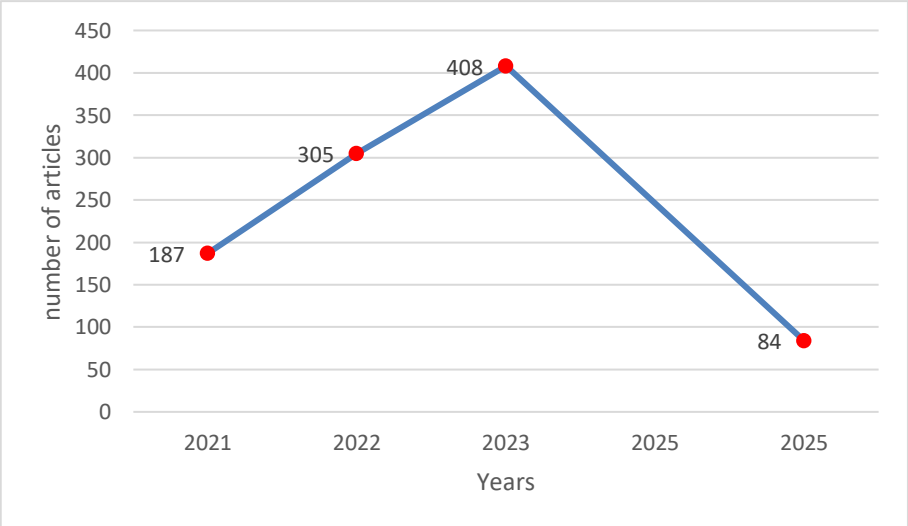

Figure 1. Number of publications of articles on hopscotch games as educational games for learning mathematics in elementary school

Figure 1 demonstrates that the publication data for articles examining the traditional hopscotch game as an educational tool for mathematics learning in elementary schools shows a significant upward trend from 2021 to 2023. In 2021, there were 187 articles on this topic, which increased to 305 articles in 2022. This trend indicates growing academic interest in using traditional games as contextual learning media, particularly aligned with the implementation of the Independent Curriculum, which promotes integrating local culture into teaching. The peak number of publications occurred in 2023, with 408 articles, reflecting the high popularity of this theme within the academic community. However, the number of publications sharply decreased in 2025, with only 84 articles. This decline might signal a shift in research focus toward other technology-driven learning innovations or contemporary approaches. Nevertheless, the remaining publications in 2025 show that engklek still maintains relevance as a medium for strengthening numeracy in elementary education.

Keyword Analysis: Emerging Themes and Topic Clusters

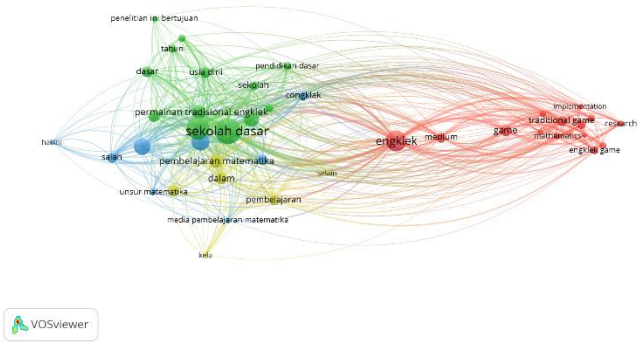

Figure 2. Network Visualization

Figure 2 shows a bibliometric visualization produced by VOSviewer software showing the mapping of inter-topic relationships in the study of traditional *engklek* games as educational game tools in elementary school mathematics learning. The figure shows four main clusters marked with different colors, each representing the concentration of themes and the relatedness of keywords in the analyzed literature. The green cluster, which dominates the visual map, is centered on the keywords elementary school, mathematics learning, and traditional *engklek* games. This cluster indicates that the most research focuses on the application of traditional games in the context of mathematics learning at the elementary school level. The strength of the relatedness between words in this cluster shows a strong integration between the educational context and the local culture-based approach.

The red cluster shows a greater focus on English terms such as game, medium, traditional game, mathematics, and implementation. This cluster indicates a contribution from international literature or studies that use a global conceptual approach to the game of hopscotch, with a focus on pedagogical aspects and general learning media. Meanwhile, the blue cluster leads to terms such as wrong, this, and elements of mathematics, which indicate a tendency towards reflective or critical studies of the implementation of learning methods through games, including discussing challenges, mistakes, or other evaluative aspects.

As for the yellow cluster, although not very prominent, it enriches the discussion with keywords such as mathematics learning media and classes, which reflect research on media design and its application in the classroom specifically. In general, this visualization shows

that the traditional game of *engklek* has become an object of cross-dimensional study, not only from a local and cultural perspective, but also in the context of developing modern learning media and broader pedagogical analysis. The relationship between clusters that are connected by thin connecting lines indicates a strong conceptual interconnection between mathematics learning, the elementary school context, and traditional games, both nationally and globally.

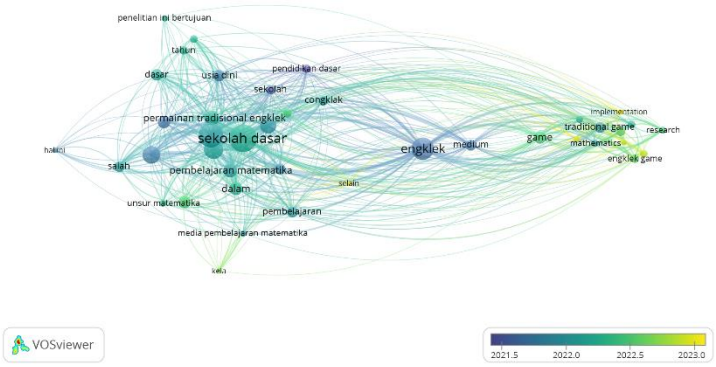

Figure 3. Overlay visualization

Figure 3 presents the temporal development of keywords related to the theme of integrating traditional hopscotch games into elementary school mathematics learning. This visualization allows readers to understand the dynamics of keyword emergence based on the year of publication, which is marked by a color gradient ranging from purple (earlier years, around 2021) to bright yellow (newer years, around 2023). Thus, this map not only shows the interconnectedness between topics but also provides information on the latest research trends in the field.

In general, the keywords "elementary school", "mathematics learning", and "traditional *engklek* game" appear in greenish blue, indicating that these topics have been the focus of researchers' attention for quite some time, especially in the period around 2021 to 2022. These keywords are in a central position and have a large node size, indicating a high frequency of occurrence and strong connectivity with other keywords. This shows that the contextual learning approach that integrates local cultural elements into the elementary school mathematics curriculum has become the main framework of thought in early studies in this field.

Interestingly, the latest research developments are indicated by the emergence of yellow to bright green keywords such as “game”, “traditional game”, “mathematics”, “implementation”, and “research” which are located on the right side of the visualization. These keywords represent the latest research directions (2022–2023) which indicate a shift in terminology and approach from local to global or international nuances. For example, the use of the terms “*engklek* game” or “traditional game” reflects an effort to construct the concept of local games within a more universal pedagogical and methodological framework. This shows that research on traditional games as a learning medium is starting to move beyond local boundaries and is integrated into broader academic discourse.

In addition, keywords such as “implementation” and “research” which also appear in yellow indicate that the latest research is not only conceptual or exploratory, but has entered the stage of practical application and evaluation. This indication confirms that the focus of

current research is more directed at how the effectiveness of traditional games, especially hopscotch, can be measured and implemented systematically in the mathematics learning process. Thus, there is an epistemological shift from descriptive studies to implementation and experimental studies.

Overall, this overlay map shows a significant evolution of science between 2021 and 2023. Initially, the study focused more on exploring the role of traditional games in local learning (especially at the elementary school level in Indonesia), but now it has begun to develop towards a more theoretical, methodological, and global approach. These findings reinforce the importance of further research that not only adopts local cultural heritage as a contextual learning medium but is also able to design a traditional game-based implementation model that can be empirically tested and adopted in various cross-cultural educational contexts.

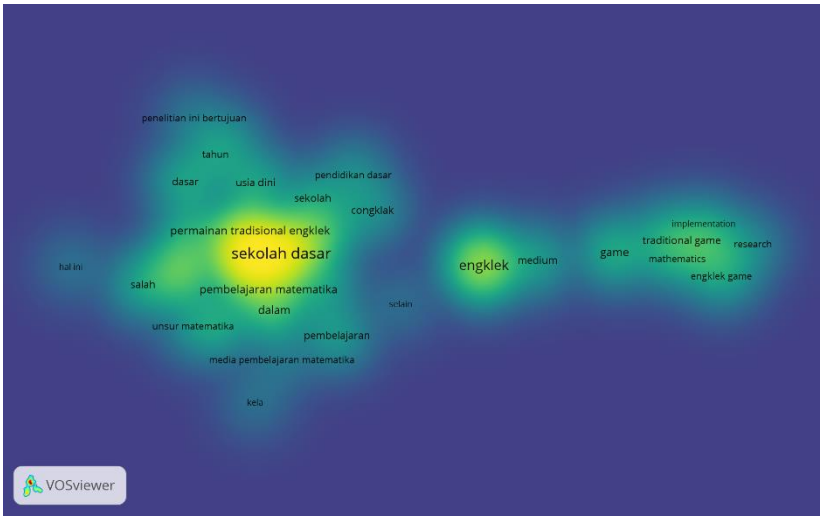

Figure 4. Density Visualization

Figure 4 represents a density map of keyword occurrences in scientific studies that raise the theme of using traditional hopscotch games as a medium for learning mathematics at the elementary school level. This visualization illustrates the density level (frequency and strength of connection) of each keyword found in various scientific publications. Lighter colors, especially bright yellow, indicate keywords that appear most frequently and have a high level of connection with other keywords. Conversely, green to bluish colors indicate keywords with lower frequency and connection.

The keyword "elementary school" is at the center of the visualization with the brightest yellow color, indicating that this theme is a dominant topic in the analyzed literature. Around it, there are several keywords in yellowish green such as "mathematics learning," "traditional *engklek* game," and "mathematics learning media," which show a close relationship between the context of elementary education and mathematics learning strategies through a local culture-based approach. This confirms that research on the integration of traditional games in mathematics learning in elementary schools has become a relatively established and fairly developed topic.

Interestingly, there are also clusters of keywords that form separate clusters on the right side of the visualization. Keywords such as "*engklek*," "medium," "game," "traditional game," "implementation," and "research" appear in green and are spread far from the main cluster. This shows that although the topic of the game of *engklek* as a "game" has begun to receive attention, research with an international terminology approach has not yet been fully

integrated into the main discourse based on the Indonesian language. This phenomenon can also be interpreted as a shift or expansion of the direction of research from a local-conventional approach to a more global and conceptual approach.

Overall, this visualization shows that the topic of using traditional engklek games in elementary school mathematics learning is still dominated by local approaches and Indonesian terminology. However, there are indications of the development of research focus towards cross-language and integrative approaches that use an international conceptual framework. In the future, opportunities for research development are wide open to integrate local and global pedagogical perspectives to enrich contextual but internationally standardized learning strategies.

The results of the bibliometric analysis regarding the use of the traditional game engklek as a medium for mathematics learning in elementary schools reveal a dynamic and rapidly growing research trend between 2021 and 2025. This development can be interpreted through the lens of constructivist learning theory and Contextual Teaching and Learning (CTL) theory, both of which emphasize the importance of meaningful, experience-based, and culturally relevant learning.

Traditional games like *engklek* serve as highly effective media for connecting mathematical concepts with students' everyday experiences. This aligns with Atmaja, who argues that learning based on local wisdom, such as traditional games, positively impacts student engagement by creating a lively and authentic learning context. (Atmaja, 2024). Similarly, Saputra emphasizes that elementary school children, who are typically at the concrete operational stage, more easily absorb mathematical concepts when presented through tangible activities like games involving real objects or scenarios (Saputra, 2024). Supporting this, Fitria and Muslimah show that learning progresses effectively through the enactive, iconic, and symbolic stages, with *engklek* naturally stimulating these stages of cognitive development (Fitria & Muslimah, 2023).

The increasing number of publications from 2021, peaking in 2023, highlights the educational sector's enthusiasm for exploring alternative, culture-based learning media, especially in the context of the Merdeka Curriculum that promotes differentiated and culturally grounded instruction. Bibliometric visualizations, including overlay and density maps, reinforce that-themes such as "mathematics learning," "elementary school," and "traditional games" have become central in the evolving academic literature. These findings are consistent with earlier studies, such as those by Widyastuti et al, who demonstrated that *engklek* effectively enhances students' understanding of numerical concepts and arithmetic operations (Widyastuti et al., 2020). Darmawan et al, further corroborate that traditional games increase students' interest and active participation in mathematics learning (Darmawan dkk., 2025). Idhayanti et al, add that traditional games are gaining global academic interest, with international clusters increasingly referencing terms like "traditional game" and "implementation." This suggests strong potential for integrating local cultural practices into global educational frameworks (Idhayanti et al., 2023).

However, the observed decline in publications in 2025, as shown in Figure 2, may indicate a shift in research focus toward digital-based educational technologies. Nevertheless, this does not imply the abandonment of traditional games like *engklek*; rather, it reflects a transitional phase where technology and local wisdom may converge to create hybrid learning models. This transition is supported by Sonjaya et al, who found that technology can enhance the appeal and effectiveness of traditional games, provided that the cultural richness is preserved (Sonjaya et al., 2021).

Given these findings, there is a pressing need for researchers and educators to design empirically tested models that incorporate *engklek* into mathematics learning. Moreover, the international emergence of terms such as "traditional game" and "implementation" suggests expanding opportunities for cross-country collaborations and global publications in this area. Overall, this discussion highlights that the traditional game of *engklek* holds significant potential not only for national education systems but also within the global academic community. Strengthening the connection between educational theory and empirical evidence will help optimize the use of culturally rooted practices like *engklek* in fostering students' mathematical abilities and enriching pedagogical strategies

Conclusion

Based on the bibliometric analysis of publication data related to the use of the traditional game *engklek* as an educational medium in elementary school mathematics learning, the study found a significant increase in the number of publications from 2021 to 2023, with a peak in 2023 reaching 408 articles. However, the number of publications sharply declined in 2025, with only 84 publications. This decline indicates a shift in focus within research related to learning media. The bibliometric approach provides valuable insights into the trends in *engklek* research, identifying key contributors, dominant keywords, and influential articles. This method is useful for mapping the development of this topic and understanding its research dynamics, offering a clearer picture of the state of the field and its future direction. However, this study has several limitations. It relies on a single database, which restricts the comprehensiveness of the analysis. Additionally, there are language restrictions that may limit the inclusion of non-English publications. The analysis only considers the number of published articles and does not explore the contextual application of the *engklek* game in the field, such as its effectiveness in different environments, cultural contexts, and education policies, which may vary across regions. The use of automated bibliometric software can also introduce noise, such as irrelevant keywords, which need to be filtered to improve the accuracy of the results. Future research is recommended to address these limitations by expanding the scope of databases and including publications in multiple languages. Further studies should focus on qualitative research, exploring teacher and student perceptions of the *engklek* game in mathematics learning and its practical effectiveness in elementary schools. Additionally, research could investigate how the *engklek* game could be better integrated into the Merdeka Curriculum and evaluate its impact on students' mathematics learning outcomes. Combining modern technology, such as game-based learning applications, with traditional educational practices is another promising direction for future research, enabling a fusion of local culture and global educational innovations.

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