

THE USE OF GAMES TO IMPROVE ELEMENTARY SCHOOL STUDENTS' UNDERSTANDING OF RATIOS

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Abstrak

Pembelajaran matematika di tingkat sekolah dasar masih mengalami tantangan yang signifikan, terutama pada topik rasio. Hal ini disebabkan oleh dominasi penggunaan metode konvensional yang bersifat abstrak, sehingga siswa lebih cenderung menghafal rumus tanpa memahami konsep di baliknya. Pembelajaran berbasis permainan menjadi solusi inovatif yang mampu menciptakan suasana belajar yang lebih interaktif dan menarik. Penelitian ini bertujuan untuk menganalisis secara sistematis literatur terkait penggunaan permainan dalam meningkatkan pemahaman konsep rasio pada siswa sekolah dasar. Metode yang digunakan adalah Systematic Literature Review (SLR) yang dipandu oleh protokol PRISMA. Melalui strategi pencarian berbasis kata kunci, diperoleh 330 artikel awal yang kemudian disaring secara ketat hingga menyisakan sejumlah artikel relevan untuk disintesis, termasuk studi dari Sari et al. (2017), Putra et al. (2022), dan Hidayah et al. (2025). Hasil dari analisis menunjukkan bahwa baik permainan digital maupun non-digital memiliki dampak yang konsisten dalam meningkatkan pemahaman siswa terhadap konsep, hasil belajar mereka, serta keterlibatan mereka secara aktif. Namun, terdapat celah dalam penelitian di mana sebagian besar studi sebelumnya masih fokus pada materi pecahan, sehingga penelitian khusus mengenai materi rasio masih sangat terbatas. Studi ini memberikan manfaat teoretis dalam pengembangan media pembelajaran matematika serta memberikan dampak praktis bagi para guru dalam merancang pembelajaran yang bisa disesuaikan dengan kebutuhan siswa.

Kata Kunci: Rasio, Perbandingan, Pembelajaran Berbasis, Sekolah Dasar

Abstract

This article examines the concept of the teacher as an “edupreneur” an educator who goes beyond merely performing instructional duties to act as an innovator, value creator, and agent of change within the educational ecosystem. The discussion focuses on how teachers can shift their mindsets to create high-value innovations and learning media, while simultaneously fostering a spirit of independence and creativity among their students. Through a literature review based on Indonesian journals, the article critically analyzes the mindset barriers faced by teachers, strategies for transforming mindsets toward an edupreneurial approach, creative project-based learning designs, and the ways school ecosystems can support a culture of innovation. The findings indicate that transforming teachers into edupreneurs is not merely a matter of mastering technology; rather, it involves a paradigm shift from viewing the teacher as a curriculum implementer to seeing them as a creator of meaningful learning experiences. Consequently, this requires systemic policy support, active teacher learning communities, and

institutional environments that grant teachers the freedom to experiment and innovate. Mathematics instruction at the elementary school level still faces significant challenges, particularly when it comes to the topic of ratios. This is due to the predominant use of conventional, abstract methods, which lead students to memorize formulas without understanding the underlying concepts. Game-based learning offers an innovative solution that can create a more interactive and engaging learning environment. This study aims to systematically analyze the literature on the use of games to improve elementary school students' understanding of the concept of ratios. The method used is a Systematic Literature Review (SLR) guided by the PRISMA protocol. Through a keyword-based search strategy, 330 initial articles were identified and then rigorously screened to select a number of relevant articles for synthesis, including studies by Sari et al. (2017), Putra et al. (2022), and Hidayah et al. (2025). The results of the analysis show that both digital and non-digital games have a consistent impact on improving students' understanding of concepts, their learning outcomes, and their active engagement. However, there is a gap in the research, as most previous studies have focused on fractions, so specific research on ratios remains very limited. This study offers theoretical benefits for the development of mathematics learning media and provides practical insights for teachers in designing lessons that can be tailored to students' needs.

Keywords: *Ratio, Proportion, Game based learning, Elementary school.*

INTRODUCTION

Mathematics learning at the elementary school level continues to face various complex challenges, particularly in the topic of ratio and proportion. Many students experience difficulties in developing a deep understanding of these concepts because classroom instruction is still predominantly based on traditional approaches, namely direct instruction and exercises that are less relevant to real-life situations. As a result, students tend to memorize procedural formulas without understanding their meaning, underlying concepts, or how to apply them in everyday life. To address this issue, game-based learning has increasingly been implemented because it is considered capable of creating a more interactive and enjoyable learning environment. By incorporating games as an instructional intervention, students' enthusiasm for learning can be enhanced, they become more motivated to participate actively, and complex mathematical concepts can be more easily understood through hands-on learning experiences.

Several previous studies have attempted to integrate various types of games into elementary school mathematics learning to examine their effectiveness. For example, studies conducted by Fatimah et al. (2023) and Putra et al. (2022) focused on the development of digital game-based learning media, such as the educational game Fraction Bakery and mobile games, which were found to be valid, practical, and effective in improving students' mathematics learning outcomes. In addition to digital media, non-digital or conventional games have also proven to be adaptable for mathematics instruction. This was demonstrated by Sari et al. (2017)

through the use of a fraction domino game, which improved students' creative thinking skills, and by Rahmawati et al. (2025) through the board game Jelajah Pecahan, which significantly increased students' engagement during classroom learning. Further empirical evidence was provided by the experimental studies of Pratama et al. (2024), who employed the Fraction Game Media (MAGECAH), and Hidayah et al. (2025), who implemented the interactive Wordwall game, both of which confirmed significant improvements in students' conceptual understanding and mathematics learning outcomes.

Although the use of games in mathematics education has been shown to produce positive impacts, an examination of the existing literature reveals a clear research gap. Based on previous research trends, most studies, including those by Fatimah et al. (2023), Putra et al. (2022), Sari et al. (2017), Rahmawati et al. (2025), and Pratama et al. (2024), have primarily focused on fractions and arithmetic operations. In contrast, studies specifically investigating the implementation of games for teaching ratio and proportion remain relatively limited, with Hidayah et al. (2025) representing one of the few studies beginning to address this topic. Furthermore, the variety of games examined in previous studies has not been particularly diverse, as most investigations have evaluated only a single type of game without comparing the strengths of different game formats. Moreover, previous research has largely emphasized experimental and research-and-development (R&D) approaches, leaving a lack of studies that provide a comprehensive global overview of the effectiveness of integrating games into mathematics learning.

To address these limitations, the present study proposes an innovative approach by employing a Systematic Literature Review (SLR) based on the PRISMA protocol. Unlike previous primary studies, which were context-specific and generally limited to individual schools, this SLR systematically collects, screens, and synthesizes evidence from a wide range of scientific publications. The main novelty of this article lies in its specific focus on analyzing publication trends, various types of games (both digital and contextual), their effectiveness, and the challenges associated with their implementation, with particular attention given to ratio and proportion learning at the elementary school level. Therefore, this study aims to complement the existing body of knowledge by providing insights that have not yet been comprehensively addressed in previous research.

Based on the background and significance described above, this study aims to systematically analyze all relevant literature concerning the implementation of games to

improve elementary school students' understanding of ratio concepts. Specifically, this literature review is designed to address three main research questions: to examine the trends and recent developments in scientific publications on this topic, to identify the various types of digital and non-digital games used in mathematics learning, and to analyze the impact and effectiveness of these games in enhancing students' understanding of ratio concepts. Through this study, it is expected that robust empirical evidence, patterns of the most effective game-based learning approaches, and valuable recommendations for educators and future researchers will be identified to support the design of more creative and innovative mathematics learning at the elementary school level.

RESEACH METHODS

This study employed the Systematic Literature Review (SLR) method, a research approach that aims to identify, review, evaluate, and analyze all existing studies relevant to the research topic and the specific research questions addressed in this study. The review was conducted by strictly following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to ensure that the article selection process was transparent, accountable, and reproducible. The first stage of the method involved formulating the research questions, which served as the primary guide for the data collection and extraction processes. These research questions were designed to address three key aspects: the development of publications concerning the use of games for teaching ratio concepts to elementary school students, the identification of the various types of games implemented in educational practice, and the examination of the impact or effectiveness of these games in improving students' understanding of ratio concepts.

The literature search was conducted comprehensively across reputable scientific journal databases using combinations of keywords and synonyms directly related to the research topic. The primary keywords employed in the search strategy included "Ratio," "Proportion," "Game-Based Learning," and "Elementary School." To broaden the scope of the search and minimize the possibility of overlooking relevant studies, additional synonymous terms such as "Ratio Concept," "Proportional Reasoning," "Educational Games," and "Primary" were also incorporated. All keywords were combined using Boolean operators, including AND and OR, to retrieve publications that were relevant to the scope of this study.

Based on the search strategy established under the PRISMA protocol, the article selection process was carried out through four main stages: Identification, Screening, Eligibility, and Inclusion. During the identification stage, the keyword search yielded a total of 330 potentially relevant articles from various databases. These records were subsequently screened to remove duplicate and irrelevant studies through title and abstract evaluation, resulting in 150 remaining articles. At the eligibility stage, the full texts of these 150 articles were assessed according to rigorous inclusion and exclusion criteria, including their relevance to the specific topic of ratio and proportion as well as their focus on elementary school students. Following this comprehensive evaluation, 32 articles met the eligibility criteria, from which the final set of included studies was selected for further analysis. These included key studies by Fatimah et al. (2023), Putra et al. (2022), Sari et al. (2017), Rahmawati et al. (2025), Pratama et al. (2024), and Hidayah et al. (2025).

The final stage of the research involved extracting and systematically organizing data from the selected studies. The extracted data included information regarding the identity of each study as well as essential details relevant to the objectives of this review, such as the authors, year of publication, country or location of the study, research design, sample characteristics, types of games implemented, mathematics topics covered, research instruments employed, and the main findings of each study. Information regarding study limitations and recommendations for future research was also extracted whenever available. All extracted data were systematically organized into a data extraction table to facilitate comparisons across studies, such as comparing the advantages of digital and non-digital games and identifying existing research gaps within previous studies. The findings from the data analysis and synthesis were then presented using a qualitative descriptive approach to provide a comprehensive understanding of the implementation of game-based learning in improving elementary school students' understanding of ratio concepts.

RESULT AND DISCUSSION

The systematic search and screening process conducted according to the PRISMA protocol resulted in a number of relevant studies addressing the implementation of games in mathematics learning at the elementary school level. To provide a comprehensive and specific overview of the methodological characteristics, types of game-based interventions, and their impact on students' conceptual understanding, a comparative summary of three representative

studies was prepared. These studies represent the development of research in this field, and their characteristics are presented systematically in **Table 1**.

No	Authors (Year)	Research Design	Game-Based Learning Intervention	Main Findings
1	Sari et al. (2017)	Research and Development (4D Model)	Fraction Domino Card Game (non-digital)	Improved students' conceptual understanding and creative thinking skills through manipulative learning activities.
2	Putra et al. (2022)	Research and Development (ADDIE Model)	Mobile Educational Game (digital)	The game was valid, practical, and effective in improving students' mathematics learning outcomes.
3	Hidayah et al. (2025)	Quasi-Experimental	Wordwall Interactive Game (digital)	Significantly improved students' understanding of ratio concepts and mathematics learning outcomes.

Table 1. Comparative Characteristics of Game-Based Learning Studies in Elementary Schools

Based on the data presented in Table 1, there is a clear transition and diversity in the methodological approaches employed by researchers to examine the effectiveness of games in mathematics learning. Early studies were predominantly characterized by the use of the Research and Development (R&D) approach, as demonstrated by Sari et al. (2017), who adopted the 4D Model (Define, Design, Develop, Disseminate), and Putra et al. (2022), who implemented the ADDIE framework (Analysis, Design, Development, Implementation,

Evaluation). The use of R&D methodologies plays a significant role in validating the feasibility of game-based learning media before their large-scale implementation in classrooms. In contrast, more recent studies have shifted toward directly examining the impact of game-based interventions through quantitative experimental methods. This trend is reflected in the study by Hidayah et al. (2025), which employed a quasi-experimental design to measure the extent to which game-based interventions produced significant improvements in the experimental group compared with the control group. Despite differences in research methodology, all three studies consistently focused on elementary school students, particularly those in Grade IV, who are transitioning from the concrete operational stage toward more abstract thinking.

An analysis of the three studies reveals clear differences in the types of game-based interventions implemented. Sari et al. (2017) relied on a non-digital game in the form of domino cards. This finding suggests that the direct manipulation of physical objects remains a highly effective instructional approach in elementary education. From a theoretical perspective, this is consistent with Jean Piaget's cognitive development theory, which states that children aged 7–11 years are in the concrete operational stage and therefore require tangible representations to understand mathematical concepts such as fractions and ratios. In contrast, Putra et al. (2022) and Hidayah et al. (2025) incorporated technological advances by implementing digital games, including mobile game applications and the interactive Wordwall platform. The use of these digital media aligns closely with modern constructivist learning theory and the concept of Digital Game-Based Learning (DGBL), in which visual stimulation, immediate feedback, and challenging game elements transform complex mathematical problems into interactive and engaging problem-solving experiences.

A comparison of the findings from the three studies consistently demonstrates that both digital and non-digital game-based interventions have significant positive effects, although each emphasizes different learning outcomes. Sari et al. (2017) found that the domino game not only improved students' conceptual understanding but also stimulated their creative thinking skills by requiring them to develop strategies throughout the gameplay. This advantage is supported by the findings of Putra et al. (2022), who demonstrated that a systematically designed mobile game was valid, practical, and effective in improving students' cognitive learning outcomes. More importantly, when digital game-based interventions were specifically applied to the topic of ratio by Hidayah et al. (2025), the experimental results revealed substantial improvements in both students' conceptual understanding of ratios and their mathematics learning outcomes.

This comparison indicates that although fractions (Sari et al., 2017; Putra et al., 2022) and ratios (Hidayah et al., 2025) share similarly abstract conceptual characteristics, game-based visualization effectively bridges students' procedural knowledge toward deeper conceptual understanding.

The findings of this comparative review provide meaningful contributions from both academic and practical perspectives. Academically, this literature synthesis enriches the field of mathematics education by reinforcing the role of game-based learning as an effective instructional approach for reducing mathematics anxiety among elementary school students. Furthermore, the review identifies that the implementation of game-based learning specifically for ratio instruction remains an underexplored area, as the majority of existing studies continue to focus primarily on fractions. From a practical perspective, the findings offer valuable insights for elementary school teachers and curriculum developers.

Teachers may recognize that effective game-based instruction is not limited to expensive digital technologies; appropriately designed conventional games, such as domino cards, can provide comparable benefits in stimulating students' cognitive development. In addition, for schools with adequate technological resources, platforms such as Wordwall can serve as effective instructional tools for creating more interactive mathematics classrooms, thereby challenging the long-standing perception that mathematics is a rigid and uninteresting subject.

CONCLUSION

Based on an in-depth review conducted through the Systematic Literature Review (SLR) method of various scientific publications, this study successfully achieved its primary objective of mapping and analyzing the implementation of game-based learning to enhance elementary school students' understanding of ratio concepts. The comprehensive synthesis demonstrates that the use of game-based interventions, both in the form of manipulative non-digital media and interactive digital platforms, consistently transforms abstract mathematics learning into concrete, engaging, and effective learning experiences that improve students' conceptual understanding as well as their cognitive learning outcomes.

The principal contribution of this article lies in its successful mapping of the current research landscape and the identification of a clear research gap, revealing that studies focusing specifically on the use of game-based learning for teaching ratio and proportion at the

elementary school level remain limited compared with research on other mathematics topics, such as fractions. The implications of these findings highlight the need for a paradigm shift among educational practitioners toward integrating more contextual and adaptive game-based learning activities into classroom instruction. Furthermore, this study provides a strategic foundation and valuable recommendations for future researchers to conduct broader investigations into the comparative effectiveness of different types of games in order to develop innovative mathematics learning models that are well prepared to address future educational challenges.

BIBLIOGRAPHY

- Faisal, M., Wulandari, A., & Faizal Amir, M. (2021). International Journal of Elementary Education Mobile Game for Equality of Fractions for Elementary School Students. 5(4), 525–536. <https://ejournal.undiksha.ac.id/index.php/IJEE>
- Haikal Cahaya, Ida Putriani, & Ida Putri Rarasati. (2024). Pembelajaran Matematika Materi Pecahan di SDN Nglekok 1 Blitar dengan Menggunakan Media Game Pecahan (MAGECAH). *Pentagon : Jurnal Matematika Dan Ilmu Pengetahuan Alam*, 2(4), 32–44. <https://doi.org/10.62383/pentagon.v2i3.278>
- Hendriyanto, A., & Juandi, D. (2022). Mathematics Achievement - Intelligence Quotient (IQ): A Study of Simple Relations in Class 10 High School Students. *Journal of Mathematics and Mathematics Education*, 12(2). <https://doi.org/10.20961/jmme.v12i2.67981>
- Irhas, I., Hidayat, I., Muhammad, M., Lutfi, M., & Hadi, H. S. (2025). Optimizing the Ratio Concept Learning through Game Wordwall in 4th Grade Elementary School. *MASALIQ*, 5(3), 1227–1236. <https://doi.org/10.58578/masaliq.v5i3.5861>
- Wibawati, B., Putra, A. P., & Nuraini, N. L. S. (2025). Pengembangan Media Pembelajaran Board Game “Jelajah Pecahan” pada Materi Pecahan Kelas VI di Sekolah Dasar. *Ilmu Pendidikan: Jurnal Kajian Teori Dan Praktik Kependidikan*, 10(2), 169–178. <https://doi.org/10.17977/um027v10i22025p169-178>