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Systematic Literature Review: The Effect of Fraction Boards on Elementary School Students' Mathematics Learning Outcomes

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A B S T R A C T
The purpose of this study is to thoroughly examine how Fraction Board media affects primary school pupils' learning outcomes in mathematics. Fraction is a fundamental yet abstract concept that often becomes a learning obstacle for students in lower grades. Therefore, concrete and manipulative media are required to support students' cognitive development at the concrete operational stage. This research employed a Systematic Literature Review (SLR) method by collecting and analyzing 30 relevant articles published between 2020 and 2025 obtained through Google Scholar using Publish or Perish. Articles were chosen according to predetermined inclusion criteria and their media type was examined, learning model integration, and impact on student outcomes. The results indicate a consistent pattern showing that fraction board media effectively improves students' conceptual understanding, learning mastery, and learning motivation. Many studies reported significant increases in average scores and mastery levels after implementing concrete manipulatives combined with active learning models such as *discovery learning*. Fraction board media is an effective, practical, and developmentally appropriate learning tool to enhance elementary students'.

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INTRODUCTION

thinking that trains accuracy, reasoning skills, and skills in solving everyday problems (Mulyasari *et al*., 2024). Therefore, the success of mathematics learning at the elementary school level will have a significant impact on students' readiness to face higher levels of education (Purwandari, 2024).

However, the reality in the field shows that mathematics learning still faces various challenges. One of the most common problems is students' low understanding of abstract concepts, especially in fractions. This material is often considered difficult by elementary school students because it tends to be presented in a symbolic and abstract manner without the support of concrete learning media (Kamid *et al*., 2024).

According to Jean Piaget's theory of cognitive development, second-grade elementary school pupils are in the concrete operational stage of development, in which they understand concepts through real experiences that can be observed and manipulated directly (Firdaus *et al*., 2022). When learning is delivered verbally or symbolically without the aid of concrete media, students tend to have difficulty understanding basic fraction concepts and lose interest in learning. This condition results in low learning outcomes and a lack of independence in learning mathematics (Vitantri & Syafrudin, 2022). Effective mathematics learning should integrate concrete experiences through manipulative media that are relevant to children's cognitive development (Zito *et al*., 2021).

The use of Fraction Boards is important because they provide a fun, concrete learning experience and motivate students to actively engage in the learning process. This medium allows students to manipulate fractions directly and compare fraction sizes through play activities. This can improve conceptual understanding (Arofah & Ningsi, 2023).

Various studies have proven the effectiveness of concrete media in improving mathematics learning outcomes. For example, research (Nufus *et al*., 2022) shows that fraction board teaching aids can improve mathematical problem-solving skills. Samo *et al*. (2023) also found that the use of effective learning media improves student learning outcomes. The majority of previous studies have focused on upper-grade students. There has not been much research on the use of simple physical media such as fraction boards designed specifically for lower grade students, especially second graders who are still in the concrete operational phase. Therefore, this study has two main novelties, namely: the research subject, which focuses on second-grade elementary school students, and the variables that measure learning outcomes.

This study is based on Piaget's constructivism theory, which states that children construct knowledge through direct experience. Piaget's cognitive development theory is an important basis for the use of concrete media. Children in the concrete operational stage (ages 7–11) need direct experience through the manipulation of real objects to understand abstract concepts such as fractions (Slavin, 2018). Therefore, concrete media such as the Fraction Board are highly relevant to the cognitive development needs of lower grade students.

In addition, Lev Vygotsky's Zone of Proximal Development theory emphasizes the importance of support (scaffolding) through learning media and

interaction to help students achieve higher levels of understanding (Vygotsky, 1978). In line with this, recent research in Indonesian elementary schools demonstrates that integrating concrete media, such as fraction boards (papan pecahan), acts as an effective scaffolding tool within the student's Zone of Proximal Development to improve learning outcomes on basic fraction concepts (Nurfadhillah & Rahmawati, 2024).

Based on the above description, This study's goal is to ascertain the impact of using Fraction Board Media on Elementary School Students' Mathematics Learning Outcomes. The study was also conducted to enrich the study of the effectiveness of concrete media in mathematics learning, especially for lower grade students. Practically, it is to provide simple, applicable, and enjoyable learning media alternatives.

LITERATURE REVIEW AND RESEARCH GAP

Constructivism Theory (Jean Piaget)

Constructivism theory, proposed by Jean Piaget, highlights how students actively create knowledge by interacting directly with their surroundings. In the stage of concrete operation (ages 7–11), students develop understanding through the manipulation of tangible objects and real experiences rather than abstract reasoning (Slavin, 2018). Therefore, learning media that provide concrete experiences are essential in helping students understand abstract mathematical concepts such as fractions.

Previous studies support the effectiveness of concrete learning media in improving students' understanding of mathematical concepts. For instance, Nufus *et al*. (2022) found that the use of fraction board teaching aids significantly enhances students' problem solving skills. Similarly, Arofah and Ningsi (2023) reported that manipulative media improve students' conceptual understanding of fractions. These findings indicate that learning media based on constructivist principles can positively influence students' learning outcomes.

Sociocultural Theory (Lev Vygotsky)

Vygotsky's sociocultural theory highlights the importance of social interaction and instructional support in the learning process. Through the concept of the Zone of Proximal Development (ZPD), students can achieve higher levels of understanding with appropriate guidance and scaffolding (Vygotsky, 1978). Learning media play an important role as scaffolding tools that facilitate interaction and support students in constructing knowledge more effectively.

Empirical studies also support this perspective. Fadillah and Nurafni (2022) found that the use of manipulative media increases students' confidence and engagement in learning mathematics. Additionally, Samo *et al*. (2023) showed that appropriate instructional media significantly improve student learning outcomes. These findings suggest that the integration of supportive learning tools, such as Fraction Board media, can enhance students' learning performance.

Overview of Mathematics Learning in Elementary School

Mathematics learning in elementary school plays a fundamental role in developing students' logical thinking, problem solving abilities, and conceptual understanding. At the lower grade level, students begin to construct basic mathematical concepts that serve as a foundation for more advanced learning.

However, many studies report that students experience difficulties in understanding abstract mathematical concepts, particularly fractions, due to the dominance of symbolic instruction without adequate concrete representation.

From a cognitive development perspective, elementary school students especially those in lower grades are in the concrete operational stage, where they require direct interaction with tangible objects to construct understanding. Therefore, instructional approaches that integrate concrete and manipulative media are considered essential in facilitating meaningful learning experiences.

Manipulative Media in Mathematics Learning

Physical items that students may touch, move, and manipulate to investigate mathematical ideas are referred to as manipulative media. An increasing amount of research demonstrates how manipulative media might enhance pupils' conceptual comprehension and engagement.

Several studies indicate that the use of concrete learning tools significantly enhances students' comprehension of mathematical concepts. Manipulative media help bridge the gap between abstract symbols and real world understanding by providing visual and experiential representations. As a result, students are more actively involved in the learning process, which leads to improved learning outcomes and higher motivation.

Fraction Board as a Learning Medium

Fraction Board is a type of manipulative media specifically designed to help students understand fraction concepts through direct interaction. It allows students to visualize, compare, and construct fractions in a concrete manner. The literature consistently shows that the use of fraction boards supports students in:

- Understanding part-whole relationships.
- Comparing fraction values.
- Developing conceptual rather than procedural knowledge.

Empirical studies report that students who learn using fraction boards demonstrate better conceptual understanding compared to those who rely solely on traditional instruction. In addition, the use of this media creates a more engaging and interactive learning environment, which positively influences students' participation and interest.

Impact of Manipulative Media on Learning Outcomes

A synthesis of previous studies reveals that the integration of manipulative media has a significant positive impact on students' mathematics learning outcomes. This includes improvements in problem solving ability , learning outcomes, and student engagement.

Moreover, the effectiveness of manipulative media is closely related to students' cognitive readiness. For lower grade students, who are still developing abstract thinking skills, the use of concrete media becomes even more crucial.

However, despite the positive findings, most existing studies tend to focus on higher-grade students or emphasize higher order thinking skills such as problem-solving. There is relatively limited research that specifically examines the impact of simple, concrete media like fraction boards on basic learning outcomes among lower-grade students.

Research Gap and Contribution of the Study

Based on the synthesis of the reviewed literature, several gaps can be identified. First, although numerous studies have confirmed the effectiveness of manipulative media in mathematics learning, most of them focus on upper-grade elementary students. Second, previous research predominantly emphasizes higher-order skills, such as problem-solving and critical thinking, rather than foundational understanding of fraction concepts. Third, there is still limited research that investigates the use of simple and practical media, such as fraction boards, specifically designed for second-grade students who are in the concrete operational stage.

Therefore, this study aims to fill these gaps by systematically examining the effectiveness of Fraction Board media in improving mathematics learning outcomes among second-grade elementary school students, with a particular focus on conceptual understanding of fractions.

METHODOLOGY

The method applied in this study refers to Systematic Literature Review (SLR). SLR is an evaluation of existing research by applying clear and measurable research methods (Lu'luilmaknun & Novitasari, 2024), which includes the introduction, examination, assessment, and interpretation of all relevant studies. By utilizing this method, researchers conduct reviews and find related articles systematically, following the procedures established at each stage.

To conduct this research, researchers collected articles from the Google Scholar database using the Publish or Perish application as a tool. The keywords used in this study were "media," "fraction board," and "mathematics learning outcomes." The articles obtained were exclusively those published within a specific time frame (2020 to 2025, if still relevant). From the collection of articles, the researchers carefully selected a number of articles (30 articles) that showed a strong relationship with the specified keywords. The article selection process is illustrated in Figure 1 (which will be included in the research document).

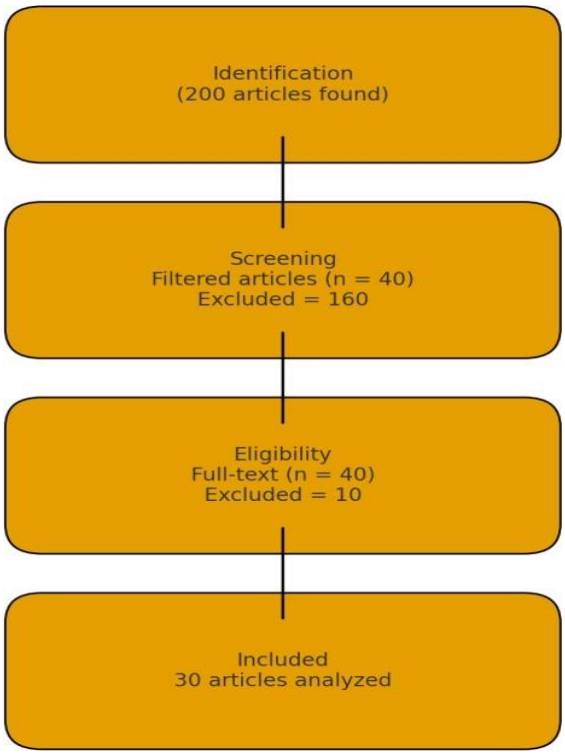

Figure 1. Article Selection Flowchart

The next phase involved categorizing scientific articles that used fraction boards as educational tools aimed at improving elementary school students' mathematics learning outcomes, both in aggregate (overall) and in relation to individual components of learning outcomes (e.g., cognitive aspects, problem solving skills, or student attitudes).

The information obtained from these articles has been systematically organized into a table, which includes the author's name, year of publication, and research results. Furthermore, the researchers conducted a comprehensive review and analysis of these articles, with a particular emphasis on the research findings articulated in the discussion and conclusion segments. Finally, the researchers compared the results described in the articles and articulated their conclusions (Zawacki *et al*., 2020).

RESEARCH RESULT

The 30 articles that were selected as relevant to the use of fraction boards to improve student learning outcomes were categorized into two main sections. These articles discussed concrete media such as fraction boards, fraction puzzles, flannel boards, rotating fraction boards, and game media (snakes and ladders, fraction cards) and the use of media in learning based on innovative models such as d*iscovery Learning*.

The use of fraction boards in mathematics learning at the elementary school level shows great potential for improving student learning outcomes. This media is able to bridge the conceptual gap that students often experience in understanding fractions, which is one of the basic concepts in mathematics. The interactivity and visualization provided by this media encourages students to be more active and critical in the learning process.

The findings generated from the research data summarized in this literature review are a comprehensive analysis and synthesis of scientific articles relevant to fraction boards as a learning aid in mathematics, which aims to improve student learning outcomes, as described in the following table.

Table 1. Implementation of fraction board media

Researcher	Research result
Jannah & Setyawan	Puzzle pieces greatly improve the learning outcomes of lower grade students.
Mutiara *et al*.	Media board fraction are effective used in fraction learning for third-grade students at SDN 62 Palisi Elementary School.
Ningrum	Learning outcomes can be enhanced by using fraction boards.
Sholehah *et al*.	For third-grade pupils at SDN Tirtayasa, fraction puzzle media has an impact on their learning outcomes.
Wisesa *et al*.	Fraction Puzzle learning media can improve students' learning outcomes in Mathematics subjects, Fraction material.
Pramudita *et al*.	There was an increase in student learning outcomes after the use of simple fraction board media with an increase of 7.09%.
Suryani *et al*.	There is an effect of the PBL Model Using Puzzle-Based Learning Media on Mathematics Learning Outcomes in Class IIA.
Rahman *et al*.	The use of the Talking Stick learning model assisted by fraction boards significantly improved the learning outcomes of fifth-grade students at SDN 1 Limboto.
Rizky	Fraction board media proved effective in improving understanding and learning outcomes of students on fraction material.
Wahyuni & Wiratsiwi	The application of effective media can contribute significantly to improving students' mathematics learning outcomes.
Khasanah & Patta	There is an effect of using math puzzle learning media on students' understanding of mathematical concepts in fraction material for fourth-grade students at SD Inpres Lakiyung, Gowa Regency.
Saily *et al*.	Felt board learning media fragments were used effectively so that students achieved a learning outcome percentage of 89.47%.
Viviana	The development of learning media has produced learning media products that have been declared highly valid.
Taufikurrahman	The Felt Board Fragments teaching tool was used at SD N 006 Bengkong Batam to enhance students' comprehension of mathematics concepts related to the theme of caring for plants and animals.
Andreastya & Luqmana	Shows that the use of fraction boards significantly affects students' ability to determine fractions at MI Darul Ulum 2 Jogoroto.
Afra *et al*.	Learning using puzzle boards influence the conceptual understanding of mathematics among third-grade students in simple fractions at SDN 01 Semanget.
Azizah	Grade III students at SDN 4 Mrayan who used puzzle teaching aids Fractions as a learning tool provide a deeper overall understanding of the concept.
Novri &	Fraction board learning materials have an impact on the

Suryanti	mathematics learning outcomes at SDN 08 Tiumang both before and after the media treatment (pretest and posttest).
Putri & Andaryani	The snake and ladder game media can be one of the learning options that can improve learning outcomes, motivate students, and strengthen students' skills in performing basic fraction calculations.
Firnanda & Indianasari	The *Discovery learning* model assisted by interactive fraction board media significantly increased the learning activities of fourth-grade students in learning fractions.
Distira & Faruq	Rotating fraction board media effectively improves concept understanding fractions and can be an interactive and enjoyable learning alternative in elementary schools.
Ramandita *et al*.	The use of fraction board media (field) can increase student learning outcomes.
Jumri *et al*.	The use of fraction media for enjoyable mathematics learning in grade V of SDN 65 Kota Bengkulu has a positive impact positive impact on mathematical concept understanding.
Lubis *et al*.	Teaching by media is more effective because teaching tools make it easier for students to understand.
Khurriyati *et al*.	Third-grade students at SD 5 Cendono can achieve better learning results with PACAPI media.
Anjani *et al*.	The application of the PBL learning model with manipulative media can improve learning outcomes in fractions for fifth grade elementary school students.
Telaumbanua	For primary school students, the use of teaching aids in mathematics instruction is crucial.
Panjaitan *et al*.	The fraction board learning media is valid, practical, and effective for use in teaching fractions with the same denominator in third grade elementary school.
Hadijah *et al*.	This teaching aid or fraction board learning media can be used as an intermediary to help students understand fraction material fractions in the fourth grade of SD Negeri 105365 Lubuk Bayas.
Herayani & Sudihartinih	Students' ability to solve division problems involving fractions has improved. Therefore, there is a need to develop teaching aids on other topics to help students learn mathematics.
Widyawati *et al*.	The use of fraction boards can improve learning outcomes in mathematics, specifically in the study of fractions, and has been successfully implemented.

Based on data in the table above, it can be concluded that research on the use of fraction boards and fraction puzzles in mathematics learning in elementary schools has consistently found that these concrete manipulative media are effective in improving student learning outcomes, both in terms of conceptual understanding and learning achievement.

Research by Jannah & Setyawan (2022) demonstrates how using fraction puzzle media significantly improves students' learning outcomes in mathematics. This is consistent with the traits of pupils in lower grades who are still in the concrete operational stage, and manipulative media significantly aids in their comprehension of abstract ideas like fractions.

Research by Mutiara *et al*. (2023) also confirms that there is mastery of learning outcomes, student activity, implementation of learning by teachers, and

student response, indicating that fraction board learning media is effective for teaching fraction material in third grade mathematics. A similar finding is shown in Ningrum's (2025) study, which states that the use of fraction boards can improve learning outcomes, meaning that this media is suitable as the main alternative in fraction learning.

The research by Sholehah *et al*. (2024) proves that there is a significant impact of fraction puzzle media on third-grade elementary school pupils' mathematical learning outcomes. This reinforces the finding that manipulative media can reduce students' misconceptions about fractions, especially in understanding the relationship between parts and wholes.

Wisesa *et al.* (2024) Fraction Puzzle Students' learning outcomes in mathematics courses and fraction content can be enhanced by educational media. According to the study's findings, using Fraction Puzzle learning materials could enhance students' pre-cycle learning outcomes by 54%. It then climbed by 58% in the first cycle and by 71% on average in the second cycle.

Pramudita *et al*. (2023) reported a 7.09% increase in learning outcomes after using simple fraction sticker board media. Although this increase is moderate, it shows that the use of concrete media still has a positive impact on student understanding. This shows that the effectiveness of media does not always have to be spectacular, but it consistently improves learning outcomes.

Suryani *et al*. (2023) found that employing worksheets with fraction puzzle media to support the problem-based learning paradigm had a substantial impact on students' learning results in mathematics. These findings show that the effectiveness of manipulative media will be more optimal when combined with innovative learning models that encourage students to actively construct their knowledge through problem solving.

The results of research conducted by Rahman *et al*. (2024) show that the use of the Talking Stick learning model assisted by fraction board media significantly improves the learning outcomes of fifth-grade students at SDN 1 Limboto. The application of the Talking Stick learning model assisted by Fraction Boards not only improves student learning outcomes but also provides a more interactive and challenging learning experience.

The results of research conducted by Rizky (2025) show an increase in the average score of students from 70.33 in cycle I to 82.33 in cycle II, with classical mastery increased from 53.3% to 86.7%. Thus, the fraction board media proved to be effective in improving students' understanding and learning outcomes on fraction material.

Research by Wahyuni & Wiratsiwi (2025) shows that the application of effective media can contribute significantly to improving students' mathematics learning outcomes. The results of the study show that in Cycle 1, there were 7 students or 72.7% who experienced an increase in learning outcomes, then in Cycle 2, there were 10 students or 90.9% who experienced an increase in learning outcomes.

Research by Khasanah & Patta (2025) shows that there is an effect of using math puzzle learning media on students' understanding of mathematical concepts in fraction material for fourth- grade students at SD Inpres Lakiyung,

Gowa Regency. This is evidenced by the average posttest score in the experimental group, which was in the very high category.

Research by Adaba *et al*. (2022) shows that the average final result of the validation of the Flannel Board learning media for fractions was 93.75% with a category of Very Valid. Meanwhile, the material validation obtained an average score of 92.5% with a category of highly valid. Meanwhile, the learning outcomes of the students obtained a percentage of 89.47%, so it can be concluded that the Felt Board media for fractions can be used for the learning process.

Research by Viviana (2022) demonstrates how the creation of learning media has resulted in learning media products that learning practitioners, media design experts, and material experts have deemed to be very valid. The results of the validity and practicality percentages obtained from media experts were 94.03% or can be categorized as highly valid.

Research by Taufikurrahman & Nurhaswinda (2021) on the use of fraction board teaching aids to enhance comprehension of mathematical ideas in the theme of Caring for Plants and Animals at SD N 006 Bengkong Batam. The results of the study show that the application of fraction board teaching media improves mathematical concept understanding by 89% of the 28 students who received good grades. In other words, the students have mastered the material, with an average student score of 78.21.

Research by Andreastya & Luqmana (2024) shows that the use of fraction boards significantly affects students' ability to determine fractions at MI Darul Ulum 2 Jogoroto. The average score of the experimental class, which reached 87%, was higher than the average score of the control class, which only reached 69%.

Research by Afra *et al*. (2021) shows that learning using puzzle boards influences the conceptual understanding of mathematics of third-grade students in SDN 01 Semanget. This is evidenced by the increase in students' mathematical concept understanding after being given treatment with puzzle board media, which resulted in an average student score of 72 with a standard deviation of 14 and a student mastery percentage of 77.27%.

Research by Azizah *et al*. (2023) demonstrates the data analysis results, showing that student mastery was 75% in cycle I, 87.5% in cycle II, and 100% in cycle III. Therefore, it can be concluded that third-grade students at SDN 4 Mrayan who employed fraction puzzle teaching aids as learning materials have a more thorough comprehension of the topic overall.

Research by Novri & Suryanti (2025) shows that there is an impact of fraction board learning materials on math learning outcomes at SDN 08 Tiumang both prior to and following the media treatment (pretest and posttest). The alteration in learning processes prior to and following the use of media was that only 3 students completed the test before the treatment, and after the treatment using the media, there was an increase in student learning outcomes to 7 students who completed the test.

The results of research by Putri & Andaryani (2025) show that the snake and ladder game media can be one of the learning options that can improve learning outcomes, motivate students, and strengthen students' skills in performing basic

fraction calculations. The feasibility evaluation results show that the snake and ladder game media received a rating of 91.25% from media experts, categorized as very feasible, and a rating of 89.70% from subject matter experts, also categorized as very feasible.

Research by Firnanda & Indianasari (2025) shows that the Discovery learning model, assisted by interactive fraction board media, significantly increases the learning activities of fourth-grade students in fraction learning. This intervention resulted in a substantial average increase of 1.73 points in learning activity scores and successfully eliminated all examples of passive learning behavior, with 81.8% of students achieving active or very active engagement levels.

Research by Distira & Faruq (2025) states that rotating fraction board media effectively improves comprehension of fraction concepts and can be a fun and engaging teaching method in elementary schools. The results of the study show that before using the media, only 14.29% of students understood fractions correctly. After the application of rotating fraction board media, student understanding increased to 71.43%.

The results of research conducted by Ramandita *et al*. (2025) fraction board media (field) can increase student learning outcomes. The experimental class's average posttest score was 82.96, which was higher than the control class's 67.04. There is a significant difference between the two class groups, according to the t-test results, which showed a computed t value (4.193) > t table (2.006) with a Sig. value (2-tailed) of 0.000 < 0.05.

Research by Jumri *et al*. (2024) states that the use of fraction media for fun mathematics learning in grade V at SDN 65 Kota Bengkulu has a positive impact. With this approach, there is an increase in student interest in learning, better understanding of mathematical concepts, improved critical thinking skills, and the development of social skills through group work.

Research by Lubis (2023) teaching by media is more successful because instructional tools help students comprehend and delve deeper into the information being taught to them, resulting in a cohesive knowledge that maximizes achievement and enhances student outcomes and abilities.

According to research by Khurriyati et al. (2022), third-grade students at SD 5 Cendono can enhance their learning results by using PACAPI media. The number of students who received a score of 10 in cycle 1, with a percentage of 67% matching the good criteria, and the number of students who received a score of 12 in cycle 2, with a percentage of 80% achieving the very good criteria, demonstrate this.

Research by Anjani *et al*. (2021) states that fifth-grade elementary school pupils' learning outcomes in fraction content can be enhanced by using the PBL learning paradigm with manipulative media. The results of this study have the following implications: students participate in learning activities; they are trained to continue working together; they can solve problems; they gain confidence; they become more motivated and interested in discussion during the learning process; they are given opportunities for collaboration and multisensory learning; and they are given variety in their education.

Research by Telaumbanua (2020) states that the use of teaching aids in mathematics learning is very important and essential for kids in elementary school since they require something abstract. The use of teaching aids is particularly successful and efficient in the learning process and in accomplishing learning objectives since elementary school-aged youngsters find it easier to grasp abstract concepts.

Research by Panjaitan, *et al*. (2022) states that fraction board learning media is valid, practical, and effective for use in teaching fractions with the same denominator in third grade elementary school. The results of the fraction board development research are valid, meeting the validity criteria obtained from the question validator with a score of 89% after making improvements and consulting with media experts.

Research by Hadijah *et al*. (2023) states that this teaching aid or fraction board learning media can be used as an intermediary to help students understand fraction material in the fourth grade at SD Negeri 105365 Lubuk Bayas. This media serves as a tool to convey fraction material in a concrete and clear manner. This is because the media itself becomes an attraction for students to pay more attention to the teaching material delivered by the teacher.

Research by Herayani & Sudihartinih (2024) states that students' ability to solve division problems involving fractions has improved. Thus, there is a need to develop teaching aids on other topics to help students learn mathematics.

Research by Widyawati *et al*. (2024) states that the use of fraction boards can improve learning outcomes in mathematics on the topic of fractions and has been implemented well. It can be seen from the teacher's activity scores in the pre-cycle that most of the students' scores were still below average, continuing in cycle I, which was 72.5 (fair), increasing to 82.5 (good) in cycle II.

In summary, the results of this systematic literature review demonstrate that:

1. Fraction board and similar manipulative media are consistently effective in improving mathematics learning outcomes.
2. These media enhance both conceptual understanding and student engagement.
3. Their effectiveness increases when integrated with innovative learning models.
4. The media are valid, practical, and suitable for classroom implementation.

However, research on lower-grade students and basic fraction understanding remains limited, indicating an important area for future investigation.

DISCUSSION

Based on a series of studies conducted by various experts, it can be concluded that the use of manipulative media, especially fraction boards, contributes significantly to improving elementary school students' mathematics learning outcomes. Almost all of the studies reviewed show that concrete media such as fraction boards, fraction puzzles, flannel boards, rotating fraction boards,

and game media fraction cards can improve understanding of fraction concepts and encourage active student involvement.

First, research by Rahman *et al*. (2024) and Rizky (2025) shows that the application of learning models such as Talking Stick with the help of fraction boards can significantly improve students' average scores and learning completeness. Fraction boards not only function as visual aids but also support a more interactive learning process.

Other studies, such as those conducted by Wahyuni & Wiratsiwi (2025), Khasanah & Patta (2025), and Afra *et al*. (2021), also reinforce the finding that concrete media help enhance comprehension of fundamental mathematical ideas, particularly fractions. The experimental group consistently had greater posttest average scores than the control group, demonstrating the effectiveness of using this media.

The results of development studies by Saily *et al*. (2022), Viviana (2022), and Panjaitan *et al*. (2022) confirm that fraction boards have been validated by experts as Very Valid and Very Practical, making them suitable for use in learning activities. This aspect of validity is important to ensure that the media is not only effective but also appropriate for the cognitive needs of elementary school students.

Furthermore, research by Taufikurrahman & Nurhaswinda (2021), Andreastya & Luqmana (2024), and Jumri *et al*. (2024) shows that manipulative media can improve students' ability to solve fraction problems, strengthen their interest in learning, and develop critical thinking skills. Manipulative media serve as a concrete bridge that makes abstract concepts easier to understand for elementary school students who are in the concrete operational stage.

In addition, research by Lubis *et al*. (2023), Khurriyati *et al*. (2022), and Anjani *et al*. (2021) confirms that concrete media can gradually improve learning completeness from cycle to cycle. The use of media in innovative model based learning such as *discovery learning* has been proven to increase student activity, motivation, and collaboration skills.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results and discussion of the various studies reviewed, it can be concluded that these studies show a consistent pattern of findings, namely: Board or fraction puzzle media improve understanding of fraction concepts. Learning completeness increases significantly after the application of manipulative media. Motivation and learning engagement increase because students can manipulate concrete objects. The use of media is more effective when combined with active learning models such as *discovery learning*. The form of media affects its effectiveness; for example, circular fraction puzzles are easier for students to understand. Fraction boards are an effective, valid, and practical learning medium for improving the mathematics learning outcomes of elementary school students, especially in the subject of fractions.

ADVANCED RESEARCH

Although the findings of this systematic literature review indicate that fraction board media and other manipulative learning tools are effective in

improving students' mathematics learning outcomes, several limitations remain evident in the existing studies.

First, most previous studies focused on upper-grade elementary school students, particularly grades III to V, while research involving lower-grade students, especially second graders, remains limited. This is important because students in lower grades are still at the concrete operational stage and may require different instructional approaches and media designs to support conceptual understanding effectively.

Second, many studies primarily measured students' cognitive learning outcomes, such as test scores and mastery levels, with less attention given to other important variables, including learning motivation, mathematical communication skills, critical thinking, and long-term retention of fraction concepts. As a result, the broader educational impact of fraction board media has not been comprehensively explored.

Third, most studies employed short-term classroom interventions with relatively small sample sizes and limited research settings. Consequently, the generalizability of the findings across different educational contexts remains restricted. In addition, variations in the design and implementation of fraction board media among studies make it difficult to determine which media characteristics are most effective for supporting student learning.

Fourth, only a limited number of studies integrated fraction board media with digital technology or interactive multimedia. Considering the increasing integration of technology in education, future studies may explore the development of digital or hybrid fraction board media to create more engaging and adaptive learning experiences.

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