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The Challenges and Strategies in Solving Mathematic Word Problems in the terms of Mathematical Reasoning Ability

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Abstract: In the context of solving mathematics story problems, there are many challenges and strategies that can be elaborated by educators in improving students' cognitive abilities. The purpose of this study was to analyse the strategies and challenges of elementary school students in solving mathematical story problems. The research method used is SLR with the PRISMA model with the results of article searches totalling 36 articles indexed by Scopus. The results showed that the strategies in solving story problems are meta-cognitive strategy-based learning, developing linguistic skills, improving spatial abilities, using visual representations for students with learning difficulties and special needs, strengthening memory, and implementing Evidence-Based Learning. Meanwhile, the challenges faced by students in solving story problems are the lack of interaction between teachers and students in learning, inadequate language skills, not mastering the basic concepts of a material, lack of mathematical reasoning skills, and low memory ability. The role of mathematical reasoning ability in solving story problems is to help students think logically and deductively in drawing conclusions, understanding mathematical concepts, and connecting ideas logically.

Keywords: Maths story problems, Strategies, Challenges, Reasoning skills

Introduction

Early mathematical skills play an important role in students' future success (Decarli et al., 2023; Demir-Lira et al., 2020; Flores et al., 2023; Mayer et al., 2023). Students who always hone their mathematical skills will easily translate mathematical problems into their daily lives. It helps students to organise their perceptions and innovative discoveries in a systematic way (Cross et al., 2009; Parviainen, 2019). Cross et al. (2009) represent that mathematical ability invites students to reason, describe, understand the world and its phenomena. Therefore, strengthening mathematical skills and emphasizing mathematics learning is something that must be instilled from an early age (Sarama & Clements, 2009).

One of the mathematical abilities that students need to master is mathematical reasoning ability. According to (Mukuka et al., 2023) mathematical reasoning ability is one of the skills that contribute significantly to overall critical thinking in the sense that it allows them to reason logically when faced with challenging tasks inside and outside the classroom. Mathematical reasoning skills can enable students to move beyond the normal application of processes and learn concepts, properties, and procedures as logical, interrelated, and coherent aspects of mathematics (Mata-Pereira & da Ponte, 2017). Specifically, the application of mathematical reasoning skills can be seen in solving mathematical story problems that are often found starting at the elementary school level.

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Mathematical story problem solving is one of the most important mediums through which children can potentially learn to select and apply the strategies necessary to address everyday problems (Swanson, 2016). A mathematical story problem is a concise description of a problem involving a real-world problem described in natural language into mathematical symbols or equations, and deriving a solution to the problem (Swanson, 2016; Wang et al., 2024; Zong & Krishnamachari, 2023). To help students in the classroom, it is important for teachers to instill in students the strategies to solve mathematical story problems (Thanheiser & Melhuish, 2023). However, until now, solving mathematical story problems even at the High Order Thinking Skills (HOTS) level has been problematic at the primary school level.

In the last 5 years, there are many studies that describe the completion of mathematical story problems at the elementary school level. Based on previous studies that have been conducted, students' difficulties in solving mathematical story problems occur due to many factors. Some of these factors are child characteristics such as intellectual functioning, motivation, problem-solving ability, recall ability, strategy acquisition and application, and vocabulary (Babakhani, 2011; Fitzpatrick et al., 2020; Fung et al., 2014; Ng et al., 2017; Powell et al., 2020). Another important cause of difficulty solving mathematics story problems is the mismatch between individual students' learning characteristics and instruction (Schnepel & Aunio, 2022). Errors or fallacies may also stem from the fact that school mathematics does not prepare students on how to present valid mathematical arguments and justifications (Mukuka et al., 2020; Novak & Tassell, 2017). Therefore, problems related to mathematics story problems at the primary school level need special attention from teachers as a provision in exploring the secondary education level and improving mathematical abilities, especially mathematical reasoning.

To overcome the various difficulties experienced by students, teachers need to pursue various strategies and innovations such as implementing self-regulated learning and implementing appropriate strategies by teachers (Vula et al., 2017). In addition, strategies that can be pursued are integrating academic assessments with students' interests and potential, cognitive strategy interventions (Solve It!), and creating a learning environment for students. make connections between language, problem solving, and mathematical interconnections (Andi Saparuddin Nur et al., 2023; Daroczy et al., 2015; L. S. Fuchs et al., 2004, 2008; Jitendra et al., 2007; Vula et al., 2017). Students' success in solving story problems depends on several aspects, including the teacher's performance and strategies in teaching, the teacher's understanding of the material being taught, and the interaction between teachers and students in the classroom (Copur-Gencturk & Doleck, 2021; Mukuka et al., 2023; van Steenbrugge et al., 2014). Thus, it is necessary to conduct in-depth research related to strategies in the context of mathematical story problems for primary school students.

To analyze and explore information related to challenges and strategies in solving mathematics story problems, research is needed with a systematic approach, namely Systematic Literature Review (SLR). SLR is often used to address phenomena that are not fully understood (Piscitelli et al., 2020), identify problem themes and patterns, and help conceptualize theories (Lahane et al., 2020; Zhou et al., 2024). There are several studies that use the SLR method related to mathematical reasoning skills in solving mathematics story problems. First, research describes the HOTS learning method to improve mathematical reasoning ability (Ambarwati & Dasari, 2022). Second, SLR research on mathematics difficulties is viewed from the Italian and American perspectives (Lanfranchi et al., 2008). Third, SLR research examines students' mathematics learning difficulties over the past 10 years (2010-2020) (Deruaz et al., 2020). Fourth, SLR research examines primary school students' mathematical problem solving from 1969 to 2021 (Suseelan et al., 2022). And finally, SLR research that examines modified schema-based instruction as a teacher strategy in teaching mathematics story problem solving (Clausen et al., 2021).

However, there is no SLR research that examines the strategies and challenges in solving mathematics story problems in terms of mathematical reasoning ability, especially at the primary school level. Thus, it can be said that there is no research that examines the strategies and challenges in solving mathematics story problems in terms of students' mathematical reasoning ability comprehensively. Therefore, the purpose of this SLR research is to examine deeply and completely the strategies and challenges of solving mathematical story problems and summarize all research results that have been published in Scopus indexed journals. In addition, SLR research signifies an up-to-date understanding of the existing literature and develops understanding through new literature in the aspects reviewed (Paul et al., 2021). The focus of this SLR research is to publish previously unpublished articles on strategies and challenges in solving mathematics story problems and it is hoped that these articles can be used as a credible source of literature in the interests of mathematics learning.

Method

Research Framework

To examine more deeply the strategies and challenges in solving mathematics story problems of elementary school students, the researcher analyzed articles in reputable journals indexed by Scopus. To answer the research questions raised in this study, the researcher conducted a Systematic Literature Review (SLR) approach. To facilitate the extraction of articles that are in accordance with Researchers' needs, then researchers use the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) method. The following rationalization for researchers using the PRISMA method in this study is (1) it can provide a synthesis of the difficulties or challenges of school students in solving story problems; (2) it can provide a comprehensive picture of how strategies can be done to overcome students' difficulties in solving mathematical problems; and (3) complete systematics so that it affects the reader's trust in the findings in this study. (Page et al., 2021), and (4) it allows researchers to identify all relevant factors and studies according to the apparatus under study (Paul et al., 2021).

Research Questions

Research questions are designed to identify specific areas of study. The questions in this research are shown in Table 1, among others:

Table 1. Research questions

N°	Research Questions
RQ ¹	What challenges or difficulties do students experience in solving primary school mathematics story problems?
RQ ²	What are the strategies for improving students' ability to solve primary school story problems?
RQ ³	What is the role of mathematical reasoning ability in solving elementary school mathematics story problems?

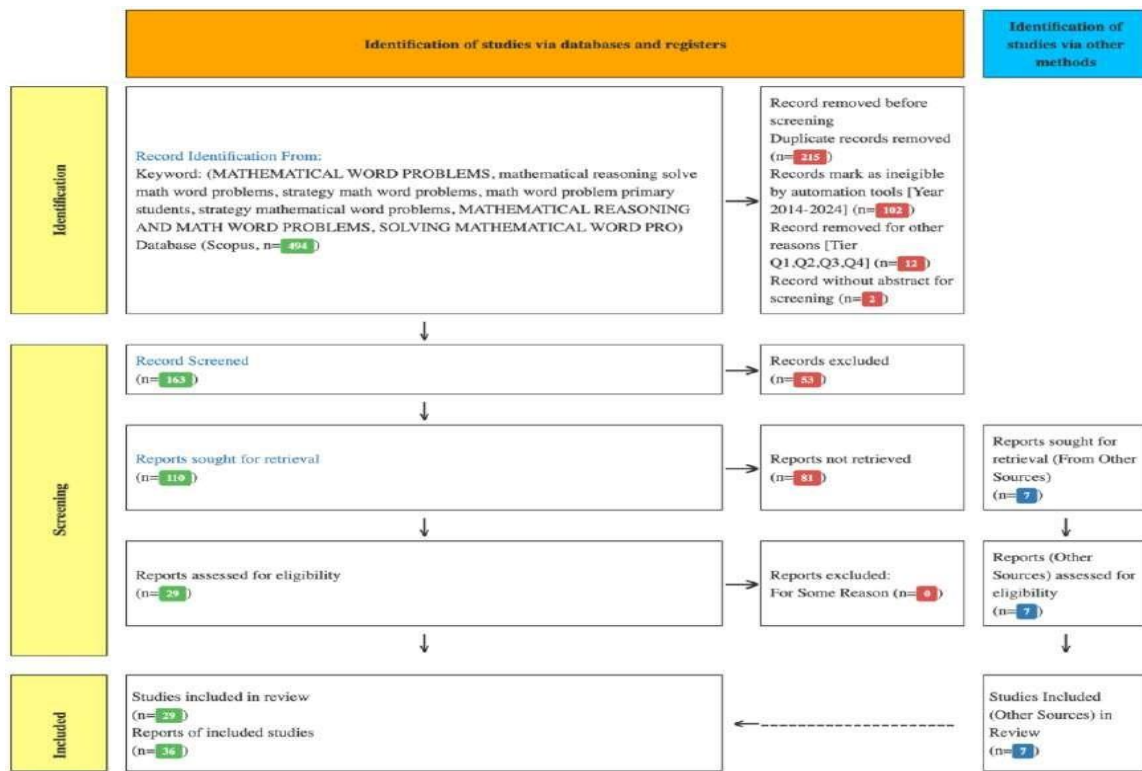


Figure 1. Flowchart of PRISMA model

To properly select the articles to be studied based on their scientific impact, the researchers filtered the defined criteria of the articles. The protocol criteria were (a) scientific studies focusing on the topic of solving mathematical story problems, (b) articles published in reputable journals indexed by Scopus (Q1-Q4), (c) articles published from 2014-2024, and (d) articles written in English. On the other hand, we excluded the

following criteria (a) articles not written in English, (b) articles related to other study focuses such as psychology, medicine, language or science, (e) articles published before 2014, and (f) non-credible sources such as book reviews, short surveys, short communications, newsletters, magazines, conference proceedings, product reviews, editorials, publishers' notes, discussions, book reviews, and correspondence (36 articles in total) to ensure the scientific integrity of this study. Next, the researcher deeply analyzed the articles found on the Watase Uake website based on the keywords written in a total of 494 articles. Next, the researcher reviewed the articles relevant to the research topic by removing 330 articles that did not meet the criteria. The researcher then reviewed the entire content of the article starting with the abstract, method, discussion and conclusion of the remaining 110 articles. After a thorough analysis of the article, 81 With the removal of 7 articles and the addition of 7 articles from other sources, 36 articles were selected to be analyzed and used as sources in this study.

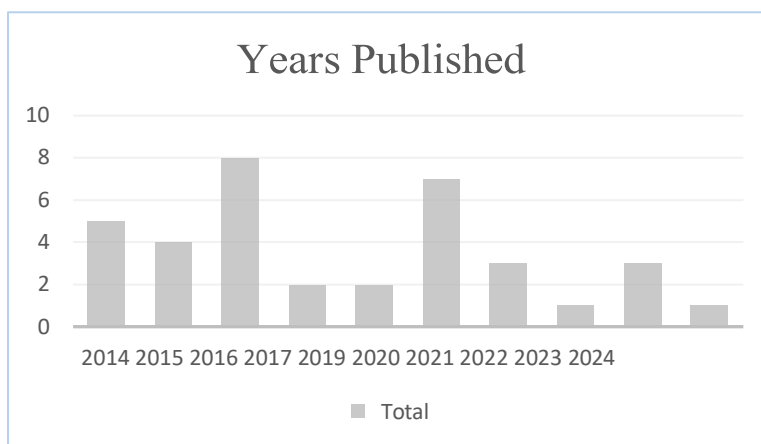


Figure 2. Years published

Based on Figure 2, the trend of research on students' ability to solve mathematics story problems has experienced fluctuating data in the last 10 years. In the graph, the data shows that the research trend showed a significant increase in 2016 and 2020. A significant decrease in the graph occurred in 2021 where only 3 articles were published in Scopus indexed journals. Although, in 2024 there is a decrease in the graph data, it is expected that there will be a systematic and impactful increase in the scientific study of primary school students' ability to solve story problems.

Countries and Cotinents of Reseachter

We grouped the authors' countries and continents after analysing the selected articles in Scopus-indexed journals on primary school students' ability to solve story problems in Figures 3 and 4.

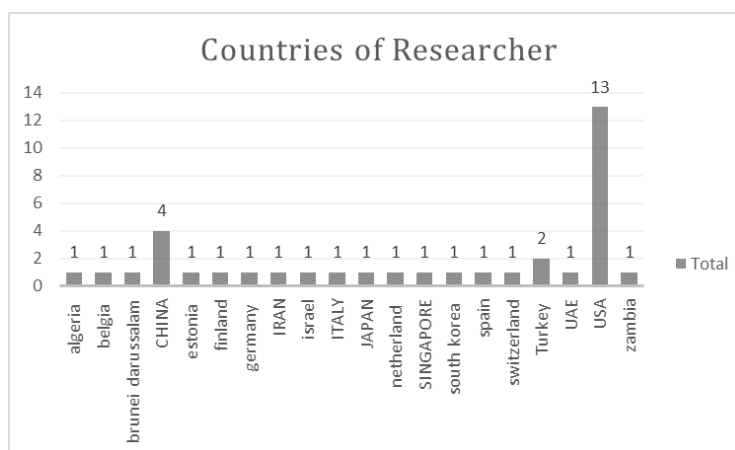


Figure 3. Countries of researcher

Based on Figure 4, it can be seen that authors from various parts of the world have contributed in the last 10 years related to students' ability to solve story problems. Authors from the United States have the highest

number of publications, namely 13 articles related to the ability of elementary school students to solve story problems. Then, the research trend related to this topic was also followed by authors from China in the second position which amounted to 4 articles, and authors from Turkey who managed to publish 3 articles. Only that, research in several countries was also carried out such as Algeria, Belgium, Brunei, Estonia, Finland, Germany, Iran, Israel, Italy, Japan, the Netherlands, Singapore, South Korea, Spain, Switzerland, Dubai and Zambia each published 1 article.

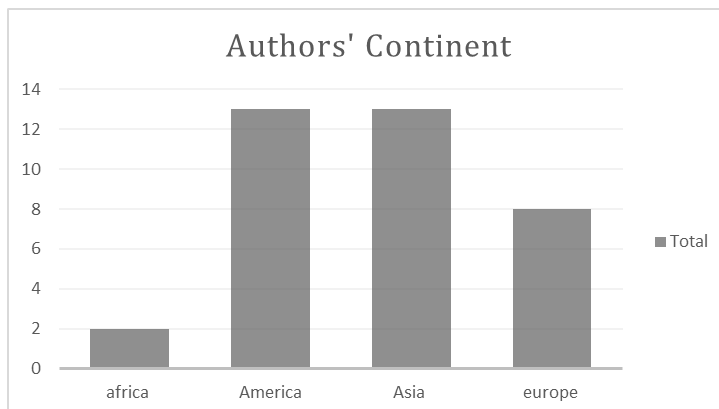


Figure 4. Authors' continent

Based on Figure 4, the trend of research on the ability to solve mathematics story problems is spread across various continents. Specifically, the continents that contribute a lot to this research topic are the Asian and American continents, each publishing 13 articles. Furthermore, the European continent in the second position managed to publish 8 articles and followed by the African Continent in the last position which has published 2 articles.

Numbers of Author and Author Collaboration Types

Based on the filtered articles related to the topic of the ability to solve mathematical story problems in Scopus indexed journals, researchers have categorized the following data based on the number of authors and the type of author collaboration in Figures 5 and 6.

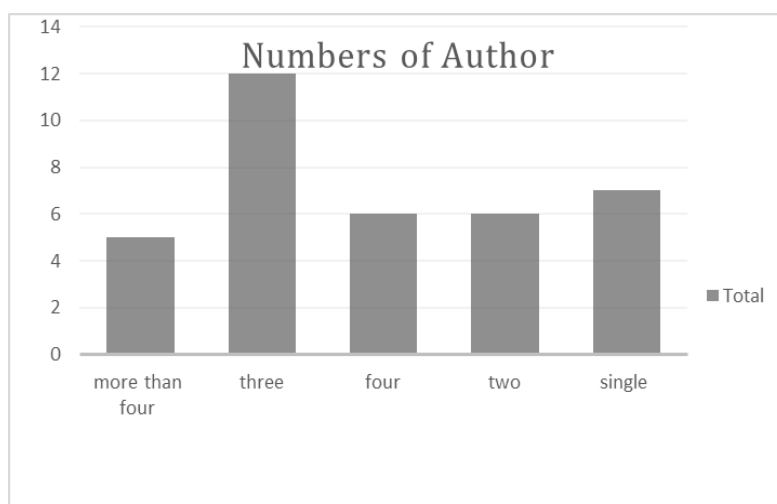


Figure 5. Numbers of author

Based on Figure 5, it is clear that the trend of research on the ability to solve mathematics story problems in school students is carried out by a varied number of authors. In Figure 5, articles with 3 researchers are in the first position among the number of other researchers. Then, articles with authors who did not collaborate with other authors took second place with 7 articles. Then, followed by articles written by 4 and 2 researchers totaling 6 articles. Finally, more than 4 authors are in the fourth position with 5 articles.

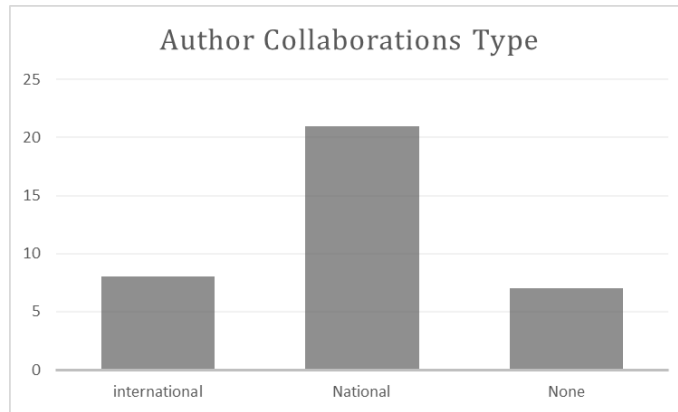


Figure 6. Author collaboration type

Based on Figure 6, it is known that the trend of research on the ability to solve mathematics story problems in 2014-2024 was carried out with various types of collaboration. Authors who collaborate with other researchers in one country occupy the highest position with 22 publications. Collaboration between countries also remains an option in contributing to scientific studies with a total of 8 publications. Finally, individual authors occupy the lowest position with a total of 7 articles.

Research Method Used

Based on the filtered articles related to the topic of the ability to solve mathematical story problems in Scopus indexed journals, researchers have categorized the following data based on the number of authors and the type of author collaboration in Figure 7.

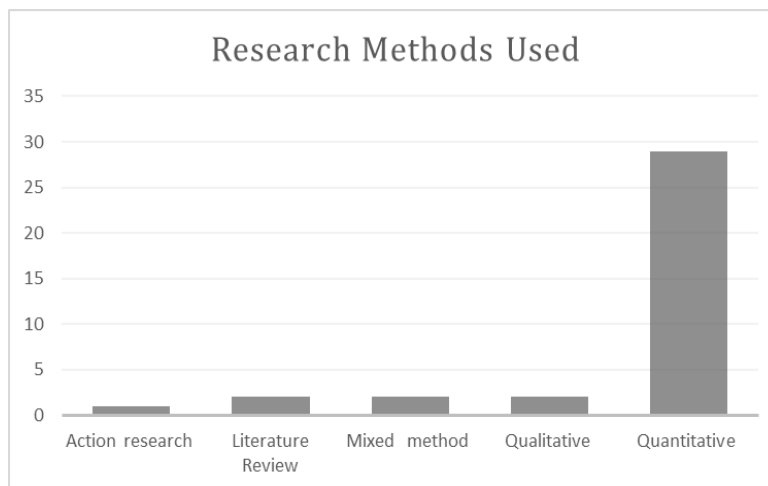


Figure 7. Research method used

Based on Figure 7, it can be identified that research on students' ability to solve mathematics story problems is researched using several methods such as Quantitative Research, Qualitative, Mixed Method, literature review, and Action Research. Research written with quantitative methods is the most research conducted by researchers with a total of 29 articles. In addition, research with qualitative research, mixed methods, literature review and action research are in the same range of under 5 articles that have been published.

Author Contributions

Researchers have reviewed 36 articles that have been selected and selected in Scopus indexed journals. From the results of the researcher's analysis, the following is an explanation of the contribution of researchers from various parts of the world in table 3.

Table 3. Author contributions

No	Authors	Contribution
1	Kingsdorf & Krawec, (2016)	<ul style="list-style-type: none"> • The importance of explicit instruction, modeling, guided practice, feedback, multiple examples, and the use of visual representations in effective word problem-solving instruction for third graders • Schema-based instruction and general strategy instruction are equally effective in improving math problem solving performance
2	NH Lee et al. (2014)	<ul style="list-style-type: none"> • The STARTUP scheme had a positive impact on students' problem-solving behavior, confidence level, and ability to persist in problem-solving tasks. • The STARTUP scheme is effective in improving the problem-solving skills and attitudes of fourth grade elementary school students.
3	Fuchs et al. (2020)	<ul style="list-style-type: none"> • Math difficulties are due to not having appropriate strategies to manage the working memory demands involved in word problem solving. • The importance of reasoning as a key skill in word problem solving, where stronger reasoning skills provide better responses to interventions.
4	Chadli et al. (2018)	<ul style="list-style-type: none"> • Computer-assisted math problem solving has been shown to be effective • This approach provides students with the opportunity to explore all stages of the problem-solving procedure, which has the potential to improve problem-solving skills.
5	Powell et al. (2020)	<ul style="list-style-type: none"> • This study highlights the importance of meta-cognitive strategies and explicit schema instruction in helping students with learning difficulties solve story problems effectively. • Students who frequently practice math story problems tend to be better at it • A combination of meta-cognitive strategies is effective in explicitly embedding math concepts
6	Rosli et al (2020)	<ul style="list-style-type: none"> • This study highlights students' misconceptions in solving math story problems. • Hybrid strategy successfully minimizes students' misconceptions
7	Jögi & Kikas (2016)	<ul style="list-style-type: none"> • Cognitive processes, linguistic abilities and non-verbal intelligence play a role in developing elementary school math problem-solving skills • The development of linguistic, cognitive and behavioral abilities plays an important role in improving mathematical skills and adaptive learning behaviors in students.
8	Dewolf et al., (2017)	<ul style="list-style-type: none"> • Visual representations did not prove effective for students in solving math story problems • This study highlights the need for teachers to guide students in solving math problems realistically and contextually based.
9	Swanson et al. (2015)	<ul style="list-style-type: none"> • Cognitive strategies, especially visual-spatial strategies are effective in improving math problem solving accuracy • Visual-spatial strategies are more effective for students with learning difficulties.
10	Zhu (2015)	Cognitive Strategy Instruction has a positive impact on math word problem solving in China
11	Swanson (2015)	Cognitive strategies and working memory capacity play a role in improving math problem solving skills for elementary school students
12	Di Leo & Muis (2020)	<ul style="list-style-type: none"> • Reinforced students will use more cognitive and metacognitive learning strategies, express more positive emotions, and effectively solve math problems. • The importance of self-directed learning strategies to students, including emotional components, to improve problem-solving skills
13	Riccomini et al. (2016)	Through the <i>Schema-Based Instructions</i> strategy, students with learning difficulties can improve their mathematical problem solving skills.
14	Kashihara & Fukaya (2023)	<ul style="list-style-type: none"> • The type of question format affects the accuracy of predicting the use of strategies in solving mathematical problems. • The choice of question type is very important in obtaining data on students' ability to select mathematical problem solving strategies.
15	Moussa-Inaty et al. (2020)	Presenting math story problems with dual teaching mode (Reading and Listening) in English is more effective than single teaching mode (reading only), especially in bilingual learning in Dubai.
16	Scheibling-Sève et al, (2022)	By teaching students to categorize situations in alternative ways, they can overcome prejudices and adopt expert strategies for mathematical problem

		solving.
17	Dröse & Prediger (2020)	Language skills affect the ability to solve math story problems
18	(Goulet-Lyle et al. 2020)	<ul style="list-style-type: none"> • Metacognitive strategies can improve math problem solving skills • Methods are taught as tools for students to reflect on and address math problems, not to limit their creativity
19	González-Castro et al. (2016)	Visual representation reinforcement shows significant effectiveness in improving basic math competencies and math problem solving skills in students with ADHD and math learning difficulties
20	Hughes et al, (2020)	Students' challenges in their mathematical reasoning in written form, difficulties in the use of vocabulary and misconceptions related to fractions and decimals.
21	Tolsberg et al. (2022)	<ul style="list-style-type: none"> • Visual representations have been shown to be effective in helping students complete math tasks correctly • Metacognitive learning and providing a consistent learning environment are critical in improving students' abilities
22	Chan, (2015)	Good language skills affect students' ability to solve math problems.
23	Copur-Gencturk & Doleck, (2021)	<ul style="list-style-type: none"> • Choosing the right strategy and the teacher's knowledge of math materials play an important role in solving math story problems • Improved number representation with hierarchical recursive tree decoding, as a strategy to improve mathematical reasoning in solving math story problems
24	Zhang et al., (2024)	The NERHRT model excels at solving complex problems in many ways, demonstrating its ability to effectively handle challenging mathematical reasoning tasks.
25	Aydoğan Yenmez & Gökçe (2023)	The growing importance of mathematical reasoning is likely influenced by educational standards that emphasize reasoning and higher-order cognitive processes in various countries.
26	Bishara, (2016)	<ul style="list-style-type: none"> • Self-directed learning more effectively improves students' mathematical competence compared to traditional teaching methods • Gender has no significant impact on the ability to solve complex math problems • The use of self-paced learning is recommended as it has the potential to increase strategic mathematical thinking, reduce dropout rates, improve student achievement, and increase social interaction.
27	Mukuka et al. (2023)	<ul style="list-style-type: none"> • Three main concerns in developing students' mathematical reasoning skills: lack of full support for students' reasoning, missed opportunities during teaching to improve reasoning, and lack of interaction during learning. • Good mathematical reasoning is related to improved performance, self-confidence, and better mathematical knowledge.
28	Jitendra et al. (2015)	<ul style="list-style-type: none"> • The integration of cognitive and metacognitive strategies is effective in improving students' mathematical problem solving skills. • The application of the strategy combination aims to increase students' procedural flexibility in mathematical problem solving
29	Babakhani, (2011)	<ul style="list-style-type: none"> • Applying cognitive and meta-cognitive strategies significantly improves elementary school students' verbal math problem solving performance • Gender differences are not significant in verbal math problem solving • Self-instruction and self-strategy development help students improve cognitive skills
30	Dewolf et al, (2014)	The combination of illustrations and warnings has no effect on improving students' ability to solve math problems
31	Oostermeijer et al. (2014)	<ul style="list-style-type: none"> • Spatial ability partially influences between children's constructive play activities and math problem solving performance in sixth grade students • Spatial ability allows individuals to visualize and mentally manipulate objects such as geometry and spatial reasoning. • It is important to understand the spatial aspects of math problems.
32	D.Lee et al. (2021)	<ul style="list-style-type: none"> • This study demonstrates the effectiveness of the TM generation model in improving the accuracy of solving mathematical word problems by utilizing language models and method identification techniques. • The TM generation model shows the importance of world knowledge and the relationship between numbers and variables in solving math word problems.
33	Freiman et al.	<ul style="list-style-type: none"> • Primary school children can engage in algebraic activities, analyzing and

	(2017)	modeling mathematical relationships using abstract symbolism letters
34	Wu (2023)	<ul style="list-style-type: none"> • Computer-based learning tasks facilitate students in thinking more generally and algebraically about story problems, demonstrating the potential of technology-rich environments in supporting relational thinking in mathematics <p>Video modeling provides a visual and interactive learning experience, allowing students to see problem-solving strategies in action, which can improve understanding and recall of mathematical concepts.</p>
35	Pongsakdi, et al. (2020)	<ul style="list-style-type: none"> • Combination of text comprehension and arithmetic skills needed to solve math problems • The complexity of math problems is influenced by various factors beyond linguistic and numerical characteristics
36	Swanson, (2016)	<ul style="list-style-type: none"> • Working memory capacity moderates the effectiveness of cognitive strategies on problem-solving outcomes in children with math difficulties • Children with low working memory capacity may have more difficulty completing problem-solving tasks

Results and Discussion

The Challenges of Solving Math Story Problems at the Primary School Level

The lack of interaction in learning mathematics is one of the challenges students face in solving mathematical story problems. Some previous research suggests that teacher-centered learning is the main point of the problem (Askew, 2020; Luneta, 2022; Mukuka et al., 2023). This results in a lack of interaction between students and teachers which results in students being unable to reflect on their own and others' views, hindering their ability to collectively correct misconceptions (Mukuka et al., 2019, 2023). Moreover, when students are not given the opportunity to engage in mathematical discussions and defend their arguments, their problem-solving skills can stagnate (Kwon & Capraro, 2021). Thus, interaction fosters critical thinking and reasoning skills, which are essential for effective mathematical problem solving.

Difficulty in mathematics skills experienced by students is a challenge that must be overcome by students. Inadequate language skills, information skills and number fact mastery skills hinder the efficiency of the problem-solving process. The lack of these leads to uncertainty, confusion and inaccuracies in decision-making and linkages between information (Dröse & Prediger, 2020). This leads to errors in mathematical problem solving. In addition, in retrospect, it was found that difficulties in making meaningful connections in the problem can affect the efficiency of each phase in problem solving. The inability to concentrate during the problem-solving process can also result in missing the third phase (confirmation of answer) in problem solving. This phase is seen as unimportant in the problem-solving process among students. Further research to analyze the above hypothesis needs to be conducted (Thanheiser & Melhuish, 2023).

Other findings show that when students do not understand a problem, they tend to make predictions of answers without using any mathematical thinking process, and are unable to think about what to assume and what information from the problem is needed to solve it, as well as having difficulty in understanding the keywords that appear in the problem so that they cannot interpret them into symbols (Myers et al., 2023). This is in accordance with (Tonéis, 2017) who said students cannot understand what is implied in the text and cannot start the thinking process to solve the problem. Students only know limited keywords or technical terms. This also supports (Phonapichat et al., 2014) who said the reason students get math problems wrong is because they lack knowledge of principles, rules and processes. Calculation and comprehension skills are also lacking. Therefore, they cannot interpret the meaning of some words correctly and fail to capture smaller details. This research is still in line with research (Cai et al., 2023) which states that teachers tend to make students only memorize "keywords" in problems just to make formulas.

The lack of mathematical reasoning in mathematics story problems is a challenge for teachers and students (Aydoğan Yenmez & Gökçe, 2023; L. Fuchs et al., 2020; Mukuka et al., 2023). This is based on the cognitive demands in the puzzles in mathematics story problems with cognitive demands in basic number knowledge or calculation tasks. The large number of cognitive resources required for puzzles makes these problems challenging to solve. Without strong mathematical reasoning skills, individuals may have difficulty in assessing situations, generating potential solutions, and making valid inferences when faced with math-related challenges. Hence, mathematical reasoning skills are required that involve various cognitive processes such as thinking,

induction, deduction, and creativity, all of which are essential for effectively solving mathematical problems (Aydoğan Yenmez & Gökçe, 2023; Herbert et al., 2015).

Low memory ability is also one of the factors that hinder students in solving story problems. Swanson (2016) states that children with lower working memory capacity face challenges in problem-solving tasks, especially in mathematics problems, because of these tasks are cognitively demanding. For example, students with low memory will have difficulty when they must remember formulas, operational verbs that are in accordance with the theory they have learnt, counting operations and so on. This is supported by Fuchs et al (2020) that memory plays an important role in allocating attention and retaining information when processing tasks, such as solving mathematical problems. Therefore, there is a need for memory strengthening strategies for primary school students to overcome difficulties in solving mathematics story problems.

The Strategies for Solving Math Story Problems at the Primary School Level

In solving mathematical problems, appropriate strategies are needed in learning, such as the application of cognitive learning and meta-cognitive strategies (Babakhani, 2011; Di Leo & Muis, 2020; Goulet-Lyle et al., 2020; Powell et al., 2020). Learning that applies cognitive strategies focuses on good problem solving, such as understanding, goal setting, planning, estimating results, calculating, and checking the truth. Meanwhile, meta-cognitive strategies act as a support for cognitive learning in assisting students in self- instruction, which underlies the executive processes associated with meta-cognition. By using self-instruction strategies such as self-instruction, self-questioning, and self-monitoring, students can effectively guide their cognitive activities during problem solving tasks. This is also supported by Goulet, et al (2020) that encouraging students to develop metacognitive strategies can improve problem-solving skills and adaptability to different types of mathematical problems.

The development of students' linguistic skills is also important to consider in solving mathematics story problems (Chan, 2015; Jögi & Kikas, 2016; Pongsakdi et al., 2020). Language skills affect how students understand and interpret the information presented in mathematical problems (Pongsakdi et al., 2020). This is also supported by Jogi et al (2016) that good linguistic skills are needed to interpret verbal instructions, understand mathematical symbols, and conceptualise problem formulations in mathematical problems. Especially when learning in English, teachers need to familiarise students with technical vocabulary by understanding common prefixes and suffixes to infer the meaning of unfamiliar words in a mathematical context. Teachers together with students identify action verbs such as 'calculate', 'find', 'build' and 'solve' commonly used in word problems to determine the specific operations required for different mathematical topics (Chan, 2015). Thus, good language skills play an important role in students' ability to solve mathematics story problems.

One of the abilities that students need to master since elementary school is spatial ability. Improving spatial ability early on is an important strategy in solving mathematical story problems (Oostermeijer et al., 2014; Swanson et al., 2015). Spatial ability allows individuals to visualize and mentally manipulate objects, which is essential for understanding spatial aspects of mathematical problems, such as geometry and spatial reasoning (Oostermeijer et al., 2014). Spatial ability helps in creating visual- schematic representations of word problems, facilitating the understanding of important information and spatial relationships in the problem. This is also supported by Swanson who stated that (2015) learning with visual-spatial strategies can facilitate problem solving by utilizing assessment report cards to support numerical representations. Thus, improving spatial ability helps students in solving mathematical problems at school.

In certain cases, visual representations are effective in helping students solve maths story problems. Visual representations are particularly effective in mathematics learning for students with special needs and students with learning difficulties (González- Castro et al., 2016; Kingsdorf & Krawec, 2016; Tolsberg et al., 2022; Wu, 2023). By watching learning videos, students with disabilities can visually observe the problem-solving process, which can help them better understand the steps involved in solving math problems (Wu, 2023). It is also supported by Kingsdorf & Krawec (2016) that the use of visual representations allows students to create their own diagrams, fostering independence and creativity in mathematical problem-solving approaches. However, there is research that exposes visual representations to be ineffective for regular students in solving mathematics problems (Dewolf et al., 2017). In the study, only about 23.8% of the reactions across all conditions were considered realistic, indicating that visual aids did not lead to substantial improvements in students' problem-solving approaches. Thus, the use of visual representations can be said to be effective in solving mathematics story problems for students with learning difficulties and special needs.

Memory reinforcement plays an important role in helping students solve mathematical problems. Memory has been shown to assist in managing the various steps required to solve word problems, such as understanding the problem, selecting appropriate operations, and monitoring the solution process (Swanson, 2015, 2016). This is also supported by (Swanson, 2015) that students who have good memory proved to be easy in applying mathematical problem solving strategies. This is inversely proportional when applied to students who have low memory, students tend to have difficulty in applying formulas, determining strategies and answering mathematical problems. Thus, it is necessary for teachers to help improve students' memory by providing reinforcement in the classroom.

Evidence-Based Learning is effective in assisting students in solving mathematical problems (Riccomini et al., 2016). Evidence-Based Learning involves categorizing word problems based on underlying structures and mathematical relationships, which enables students to identify problem types and apply appropriate problem-solving strategies. In this context, students are taught how to classify word problems based on underlying structures and mathematical relationships, followed by guided and independent practice in identifying problem types. This structured approach helps students develop a systematic method for solving problems. Thus, applying Evidence-Based Learning has shown positive effects on mathematics problem solving for students with learning difficulties.

The Role of Mathematical Reasoning Ability in Solving Elementary School Story

Mathematical reasoning is essential to problem solving in mathematics, as it helps students analyze, interpret, and apply mathematical concepts effectively (Jäder et al., 2017; Mata-Pereira & da Ponte, 2017). This is in accordance with (Mukuka et al., 2023) that mathematical reasoning has a crucial role in solving mathematical problems because it involves logical thinking and deduction that allows students to draw conclusions based on the premises given. The involvement of reasoning skills in solving story problems can provide an overview of strategic steps to answer problems related to mathematics. Thus, it is important for teachers to improve students' reasoning skills, especially in learning mathematics.

Math story problems, as defined by Verschaffel et al. (2020) are verbal descriptions of problem situations in an educational context that pose one or more questions that require mathematical operations to obtain a solution. Mathematical story problems are essential for developing students' mathematical reasoning skills, as they require students to apply mathematical concepts in a real-world context (Herbert et al., 2015; Jeannotte & Kieran, 2017). Math story problems often require spatial thinking, finding relationships, making estimates and justifying decisions, all of which are key components of mathematical reasoning. Students' competence in solving mathematical problems is closely related to the quality of teaching students receive and their level of mathematical reasoning ability. Thus, solving mathematical story problems is closely related to mathematical reasoning skills in solving them.

The role of mathematical reasoning skills is proven to be effective in helping students solve mathematical story problems. Reasoning ability helps students understand mathematical concepts by connecting ideas logically, which leads to a deeper understanding of mathematical principles and relationships. By engaging mathematical reasoning, students can effectively address complex problems, apply mathematical knowledge to real-world situations, and develop critical thinking skills (Aydoğan Yenmez & Gökçe, 2023; L. Fuchs et al., 2020; Mukuka et al., 2020, 2023). Students who have strong mathematical reasoning skills will be able to make valid inferences, justify decisions, reach logical conclusions, and formulate defenses when solving mathematical problems. Therefore, developing mathematical reasoning skills from the elementary level is the focus of an educator.

Conclusions

Strategies in helping primary school students solve mathematics story problems can be done in various ways. Based on previous research, strategies in solving story problems for students are meta-cognitive strategy-based learning, developing linguistic abilities, improving spatial abilities, using visual representations for students with learning difficulties and special needs, strengthening memory, and implementing Evidence-Based Learning. The strategies applied for students can help students in applying solution strategies, choosing appropriate operations, fostering independence and creativity, understanding mathematical symbols, and improving students' cognitive aspects.

Solving math story problems is inseparable from the challenges and obstacles experienced by students during learning. The things that underlie students' The factors that make it difficult to solve story problems are the lack of interaction between teachers and students in learning, inadequate language skills, not mastering the basic concepts of a material, lack of mathematical reasoning skills, and low memory ability. These factors cause students to have difficulty in understanding the context of the problem, inability to concentrate, inaccuracies in determining the solution strategy and stagnation in mathematical problem-solving skills.

Mathematical reasoning helps students analyze, interpret and apply mathematical concepts effectively. It is an important role in solving mathematical problems because it involves logical thinking and deduction, which allows students to draw conclusions based on given premises. Reasoning ability in solving story problems can help students understand mathematical concepts by connecting ideas logically, which helps them understand mathematical principles and relationships. Story problem solving and reasoning ability in solving them are closely correlated with each other.

Recommendations

Based on my analysis of the article, here are some key recommendations:

1. Implement metacognitive strategy-based learning approaches to help students develop problem-solving skills for math story problems. This can include teaching students' self-instruction, self-questioning, and self-monitoring techniques.
2. Focus on developing students' linguistic skills, especially technical mathematical vocabulary and comprehension of problem statements. This is crucial for interpreting word problems correctly.
3. Incorporate activities to improve students' spatial abilities and visual-spatial reasoning, as these skills support mathematical problem-solving.
4. For students with learning difficulties or special needs, utilize visual representations and video modeling to aid in understanding problem-solving processes.
5. Implement memory strengthening strategies, as working memory capacity plays a significant role in mathematical problem-solving ability.
6. Apply Evidence-Based Learning approaches like schema-based instruction to help students categorize and approach different types of word problems systematically.
7. Increase meaningful interaction between teachers and students during mathematics lessons to foster critical thinking and reasoning skills.
8. Focus on developing students' mathematical reasoning abilities from an early age, as these skills are crucial for effective problem-solving.
9. Create opportunities for students to apply mathematical concepts to real-world contexts through carefully designed story problems.
10. Provide differentiated instruction and support based on individual students' needs and learning characteristics.
11. Encourage the use of technology-rich environments to support relational thinking and algebraic reasoning in mathematics.
12. Conduct further research on effective strategies for improving students' abilities to solve mathematical story problems, especially focusing on the role of mathematical reasoning.

Scientific Ethics Declaration

The authors declare that the scientific ethical and legal responsibility of this article published in EPESS Journal belongs to the authors.

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