



## Analysis of Mathematics Percentage Calculation Strategies Quickly and Accurately Based on a Literature Review

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### Abstract

Percentages are one of the important concepts in mathematics that are widely used in various contexts of daily life such as economics, commerce, and decision-making. However, various studies show that the concept of percentage is still a material that is quite difficult for students and prospective mathematics teachers to understand. These difficulties are generally related to the understanding of the basic concept of percentage, the use of the percent symbol (%), and the ability to relate the percentage value to the reference value in a problem. This study aims to analyze various percentage calculation strategies that can be carried out quickly and accurately based on the results of previous research. The method used in this study is a literature study by reviewing various scientific articles from SINTA-accredited national journals and international journals that are relevant to the topic of percentages in mathematics learning. Data is collected through documentation techniques by examining and analyzing research findings related to the percentage calculation strategy. The results of the study show that the use of mental calculation strategies, understanding the basic concept of percentages, and the use of visual models can help improve students' ability to calculate percentages more effectively and efficiently. Therefore, the right calculation strategy is essential to support the understanding of the concept of percentages in mathematics learning.

**Keywords:** *Percentage, quick calculation strategy, mathematical literacy, literature study, mathematics learning.*

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### 1. Introduction

Percentage is one of the basic concepts in mathematics that has an important role in daily life. This concept is widely used in various fields such as economics, trade, statistics, and decision-making in practical life. In the context of mathematics education, understanding the concept of percentages is an important part of social arithmetic material and students' mathematical literacy. Therefore, the ability to calculate percentages quickly and accurately is a skill that needs to be mastered by students and prospective mathematics teachers.

However, various studies show that the concept of percentage is still one of the materials that is quite difficult for students and prospective teachers to understand. These difficulties are generally related to understanding the basic concept of percentage, the use of the percent symbol (%), and the ability to relate percentages to the reference value used in a problem. Research conducted by Herani Tri Lestiana shows that less than half of the research participants are able to solve percentage problems correctly, and most still ignore the important role of percent symbols and reference quantities in the calculation of percentages (Lestiana, 2021). Although most students understand percent as a fraction with a denominator of 100, many have not been able to apply it in real contexts such as discounts or the calculation of certain values (Khairi et al., 2025). This difficulty is also related to the ability to understand the story and distinguish the meaning of "percent of" and "percent as". In addition, internal factors such as cognitive ability and math anxiety, as well as external factors such as learning methods, also affect students' low understanding of the concept of percentage (Hudiyagama & Farahsanti, 2026).

In addition, difficulties in understanding the concept of percentage are also related to students' low mathematical literacy in applying the concept to contextual problems. The results of international studies such as PISA show that the mathematical literacy ability of Indonesian students is still in the low category, especially in solving context-based problems involving comparisons and percentages (OECD, 2022). Research on mathematics literacy in grade VIII students also shows that some students have difficulty comparing two percentage values

because they do not consider the basic values that are the reference for calculation (Ihsan et al., 2024). This shows that the conceptual understanding of percentages is still not fully developed well in students.

Furthermore, some recent studies emphasize that the difficulty in understanding percentages is not only conceptual, but also related to limitations in proportional reasoning and numeracy. According to research by Reinhold et al. (2020), the ability to understand percentages is very closely related to the understanding of fractions and ratios as prerequisite concepts. Students who have not mastered the concept tend to experience misconceptions when faced with more complex percentage problems. In addition, a study by Van den Heuvel-Panhuizen & Drijvers (2020) confirms that learning mathematics that does not associate concepts with students' real experiences will make abstract concepts such as percentages difficult to understand in depth. Some studies also try to develop learning approaches that can help students understand the concept of percentages more concretely. One of the approaches used is the use of visual models such as percentage bars that help students understand the relationship between parts and the whole in the form of percentages. This model can be used as a reasoning tool as well as a strategy to help the percentage calculation process more systematically (Sarumaha et al., 2018). Another approach used in percentage learning is through realistic contexts that are close to students' lives, such as the use of egg shelves as visual representations to help students understand the relationship between fractions, percentages, and hundred values as the basis for calculation (Siligar et al., 2022).

In addition to the visual approach, the use of technology in mathematics learning has also begun to be developed to improve percentage understanding. Research shows that the use of digital media and adaptive learning systems can help students understand numeracy concepts in a more interactive and personal way (Zulkardi et al., 2021). The technology allows students to learn independently with direct feedback, so that errors in understanding concepts can be corrected immediately. In social arithmetic material, the concept of percentages is also often used in various contexts such as profits, losses, discounts, and price calculations. Therefore, learning strategies designed through hypothetical learning trajectories can help students gradually discover the concept of percentages through contextual activities related to buying and selling situations in daily life (Fitriani et al., 2023). This approach is considered effective because it allows students to build understanding gradually from the concrete to the abstract.

Based on these various studies, it can be seen that the understanding of the concept of percentages is not only related to the ability to do calculations, but also related to thinking strategies, mathematical literacy, and the ability to relate concepts to real contexts. Therefore, it is important to examine the various percentage calculation strategies that can be used to obtain quick and precise results. The study can be carried out through literature analysis from various studies that have been conducted previously.

Thus, this study aims to analyze various percentage calculation strategies in mathematics that can be used quickly and precisely based on the results of literature review from various relevant studies. The results of this study are expected to provide an overview of various approaches and strategies that can be used in understanding and calculating percentages more effectively in mathematics learning, as well as becoming a reference for teachers and prospective teachers in designing more innovative and meaningful learning.

## 2. Method

This study uses a literature review approach with the aim of analyzing various percentage calculation strategies in mathematics that can be done quickly and precisely based on the results of previously published research. Literature study is a research method that is carried out by studying, reviewing, and synthesizing various relevant scientific sources so that a more comprehensive understanding of a research topic can be obtained. This method was chosen because the research did not involve respondents directly, but rather used scientific articles as the main data source. According to John W. Creswell (2014), literature studies allow researchers to identify concepts, theories, and findings of previous research so that they can provide a comprehensive picture of the problems being studied.

The subject of this study is a scientific article that discusses percentage calculation strategies, numeracy skills, and quick counting methods in mathematics learning. The articles analyzed came from SINTA-accredited national journals as well as international journals relevant to the research topic. This research was carried out through a search of scientific journal databases such as Google Scholar, Garuda, and several international journal databases. The data collection process was carried out in the period from February to March 2026. The research sample was determined using the purposive sampling technique, which is the selection of data sources based on certain criteria that are in accordance with the research objectives. The criteria used include articles published in the last ten years, having discussions related to the concept of percentages or quick calculation strategies in mathematics, and being published in journals that have clear academic quality. Based on these criteria, a number of articles were obtained which were then used as data sources in this study.

The data collection technique is carried out through documentation, namely by collecting scientific articles relevant to the research topic, then reading, recording, and identifying important information related to the percentage calculation strategy in mathematics. The instrument used in this study is in the form of a literature analysis sheet that functions to record important information from each article, such as the identity of the research, the purpose of the research, the method used, and the main findings related to the percentage calculation strategy. To ensure the validity of the data, the researcher checked the suitability of the source and compared the findings of the various articles analyzed. Data validity is carried out through source triangulation, which is by comparing the results of several different studies but having similar topics, while data reliability is obtained through the consistency of the analysis process for all articles studied. Through these stages,

it is hoped that the results of the research can provide a systematic overview of the effective, fast, and precise mathematical percentage calculation strategy based on the results of previous research.

### 3. Results

Based on an analysis of 30 research articles, it can be concluded that the most successful percentage teaching strategies are those that combine various instructional approaches thoroughly.

#### 3.1. The effectiveness of contextual and realistic approaches based on the phenomena of daily life.

One of the key findings in this study is the effectiveness of using Indonesian Realistic Mathematics Education (PMRI) which utilizes the local context as a cognitive bridge in helping students understand the concept of percentages more deeply. This approach places the student's real experience as the starting point for learning, so that abstract concepts can be linked to familiar concrete situations. For example, research at SDN 2 Gumawang showed that the use of "Egg Rack" media can help elementary school students understand the concept of part of the whole more intuitively. Meanwhile, research at MTs Darul Ulum and SMP Negeri 1 Indralaya uses the context of trade such as "Pempek" and "Buying and Selling in Malls" to illustrate the concept of percentage in daily economic activities. Through this approach, students not only learn to count, but also understand the meaning behind the calculations.

Furthermore, the concept of a solid Learning Trajectory is an important element in the implementation of PMRI, where students are not directly confronted with abstract symbols or numbers, but through gradual and structured stages of understanding. Students are invited to explore contextual problems first, then slowly directed towards formal representations. In addition, innovations through creative drama methods in mathematics learning, such as those found in experimental studies, show that students' emotional and kinesthetic engagement can significantly improve conceptual understanding. This activity allows students to simulate mathematical problems in the form of real roles or situations, so that the learning process becomes more interactive and meaningful.

The impact of this approach is not only seen in improving understanding of concepts, but also in overall learning outcomes. Research shows an increase in academic achievement of up to 47%, which is accompanied by better long-term knowledge retention capabilities compared to conventional learning methods. This shows that learning that links real contexts, involves various aspects of students' learning experience, and is systematically designed through the right learning trajectory, is able to provide more optimal results. Thus, the application of PMRI is not only relevant to improve numeracy skills, but also to build a strong and sustainable conceptual understanding in students.

#### 3.2. The crucial role of visual representation and multimodal modeling as accelerators of computational speed and accuracy.

The use of *the Percentage Bar Model* emerged as one of the most dominant instruments in helping students visualize proportions quickly and intuitively. This model provides a concrete representation of the concept of percentages that students often consider abstract, making it easier for them to understand the relationship between parts and wholes. Exploratory research shows that through the bar model, students can make logical estimates of complex values before entering the formal calculation stage, so that the thinking process becomes more directed and not just dependent on formulas. Thus, students not only know "how to calculate", but also understand "why the results are obtained".

However, the effectiveness of this visualization depends heavily on how teachers communicate and implement the model in the classroom. The right presentation strategy is the main key in optimizing the function of the stem model as a thinking tool. In this case, *the partitioning scheme* (the division of units into proportional parts) has been shown to be superior in building the student's proportional reasoning compared to the *mirror movement scheme* which tends to emphasize only the procedural manipulation of numbers without deep understanding. Through *partitioning*, students are invited to see the structure of proportions as a whole, so that they are able to relate various representations and develop flexibility in solving problems.

The findings from a study in Finland on middle-class students further reinforce the importance of this approach, where success in mastering the concept of percentages is strongly influenced by the ability to multimodal expression. These capabilities include the integration of visual representations (images or diagrams), natural language (verbal explanations), and mathematical symbols (formal notation), which together form a more complete conceptual understanding. Students who are able to connect these three forms of representation tend to have a deeper understanding and are less prone to misconceptions.

#### 3.3. Systemic and technological factors that support calculation accuracy through strengthening mathematical language and big data analysis.

The literature shows that the main obstacle to the accuracy of percentage calculations often lies not in arithmetic skills alone, but in the aspect of linguistic understanding that underlies the interpretation of the problem. Many students have difficulty not because they are

unable to calculate, but because they fail to understand the meaning of the instructions or the narrative of the questions presented in complex mathematical language. Research in Germany on language-responsive learning confirms that the integration of linguistic approaches in mathematics learning is essential, especially in classrooms with students' diverse language backgrounds. In this context, the use of *language scaffolding* or step-by-step assistance, such as *structured language frames*, has proven to be effective in helping students parse important information in the problem, identify key words, and formulate systematic solution steps. This approach not only improves instructional comprehension, but also assists students in expressing their mathematical thinking process more clearly and in a more directed manner.

In addition, the development of mathematical language scales such as *the Mathematical Language Scale for Fraction Tasks* (MLSFT) is an important instrument to evaluate the extent to which students are able to use mathematical technical terms consistently and appropriately. With this measuring tool, teachers can identify students' linguistic weaknesses more specifically, so that learning interventions can be tailored to their needs. This shows that mastery of mathematical language is an important foundation that cannot be separated from success in understanding numerical concepts, including percentages.

On the other hand, advances in educational technology also make a significant contribution to overcoming this problem. The use of *Intelligent Tutoring Systems* (ITS) such as Bettermarks in the Netherlands provides empirical evidence on a large scale that basic arithmetic skills and understanding of fractional concepts are the single most significant predictors of student performance in solving percentage problems. This system works by analyzing students' answer patterns automatically, so that it is able to identify conceptual and procedural errors in real-time. Thus, teachers can make early detection of weaknesses of students' prerequisites, such as a lack of understanding of fractions or basic operations, before moving on to more complex calculation strategies.

Furthermore, the integration of technology such as ITS not only functions as an evaluation tool, but also as a means of adaptive learning that is able to adjust the difficulty level of the questions to the abilities of each student. This allows the learning process to be more personalized and effective, because each student gets a learning experience that suits their needs. By combining a strong linguistic approach through *language scaffolding* and the support of data-driven technologies, percentage learning can be designed more comprehensively, thus not only improving the accuracy of calculations, but also strengthening students' conceptual understanding and overall mathematical communication skills.

#### 4. Discussion

This discussion of the analysis of the percentage calculation strategy quickly and precisely reveals that "speed" and "precision" are two sides of the coin that must be developed simultaneously through a balance between visual intuition and procedural logic. Quick strategies found in the literature, such as the use of bar models and realistic contexts, serve as cognitive simplification tools that reduce students' working memory load when faced with complex problems. However, the aspect of accuracy requires sharpness in the transformation stage of the problem. Referring to the analysis of Newman's procedural errors which are widely discussed in journals, student failures often occur at the stage of turning the language of the problem into a mathematical model and at the skill stage of the calculation process. Therefore, this discussion emphasizes that a "fast" strategy without a deep understanding of the concept of "per hundred" will only give birth to mechanistic skills that are prone to error when the context of the question is changed.

More profoundly, the success of this strategy is also greatly influenced by the psychological variables of students and the quality of learning support instruments. There is a positive and significant linear relationship between learning independence and mathematical problem-solving ability, as evidenced in research at SMAN 1 Lubuk Basung. Students who have high initiative, responsibility, and confidence tend to be more persistent in re-verifying their calculations, which automatically increases the degree of accuracy. On the other hand, the analysis of textbooks shows that there is a gap; Although the material has begun to lead to mathematical literacy, the availability of high-level reasoning questions (HOTS levels 5 and 6 on the PISA standard) is still very minimal. This is a big challenge, because without practice at a high level of reasoning, students' quick calculation strategies will remain at the surface level and will not be able to handle complex problems in the real world.

Finally, this discussion highlights crucial challenges in the competence of educators and prospective educators. Findings in Japan and various regions in Indonesia show that many prospective primary school teachers still experience misconceptions in the concept of proportion and the formation of their mathematical identity. This indicates that to realize "good, correct, and detailed" learning outcomes, interventions should not only be carried out at the level of student learning media, but must start from improving the Mathematical Knowledge for Teaching (MKT) of teachers. Educators must be able to detect students' cognitive conflicts and provide targeted scaffolding, such as the use of the MURDER (Mood, Understand, Recall, Detect, Elaborate, and Review) model which has been proven to be effective in improving analytical skills. In conclusion, the optimal percentage calculation strategy is one that integrates a conceptual-realistic approach to logical speed, supported by learning independence and language literacy to ensure the accuracy of academically accurate final results.

## 5. Conclusion

This study concludes that a fast and precise percentage calculation strategy cannot be separated from the integration between conceptual-realistic approaches, visual modeling, and strengthening language literacy and learning independence. The "fast" strategy in percentage calculation is mainly supported by the use of visual instruments such as percentage bar models and the application of daily life contexts through the Indonesian Realistic Mathematics Approach (PMRI), which functions as a cognitive simplification to reduce the workload of students' working memory when facing complex problems. Findings from a study at SDN 2 Gumawang with the media "Rak Telur" and a research at MTs Darul Ulum that utilizes the context of "Pempek" trade prove that this contextual approach is able to significantly increase students' understanding compared to conventional methods. On the other hand, the aspect of "accuracy" is highly dependent on the ability of mathematical language literacy to transform story problems into correct mathematical models, as well as student learning independence as an affective factor that encourages the habit of re-verifying the calculation results.

The results of the study also showed that students' failure to solve percentage problems was often caused by misinterpretation of the question instructions or the inability to identify reference quantities, not solely due to weak basic arithmetic skills. Research in Germany on language-responsive learning reinforces these findings, where the use of language scaffolding such as language frames has been shown to be effective in helping students formulate systematic completion steps. Therefore, strategies that integrate language scaffolding such as structured sentence frames and increasing Mathematical Knowledge for Teaching (MKT) for educators are key factors that should not be ignored. Findings in Japan and Indonesia show that many prospective teachers still experience misconceptions about the concept of proportion, so interventions to improve pedagogical competence through learning models such as MURDER are very urgent. Overall, the effectiveness of percentage calculation in mathematics learning requires a balance between visual intuition to accelerate logic, a deep understanding of the concept of "per hundredth" to ensure accuracy, and the strengthening of language literacy and learning independence as a metacognitive foundation, so that the ability to calculate percentages quickly, precisely, and meaningfully can be realized more optimally.

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