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Eight-graders' Mathematical Literacy on Percentage Problem

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Abstract

Mathematical literacy involves mastery of concepts, procedures, and critical and creative thinking in applying mathematical knowledge to everyday life problems. The study examined the mathematical literacy used by 36 students for the percentage problems. The students were invited to solve two kinds of percentage problems called Best Buy and Savings Over problems. There are four response categories for correct answer, one for reasonable response, and two categories for incorrect answers. Analysis of the responses showed that at least half of the students understood that they could not compare percentages without considering what the percentages represented. The majority of this group solved the problem explicitly by showing that the answer depends on the list price. Some students did this indirectly by taking examples of items that had the same list price or nominal value in both stores and then performing the calculations. About half of the students compared the two percentages as absolutes. The other students proceeded in the same way but came to the wrong conclusion. This raises the issue of evaluating these responses. Although the correct answers were not given, it is clear that these students knew that the percentages were related to something. These responses were not scored as "approximately correct reading" or "performing the task correctly," but they were still considered and rewarded as reasonable responses.

Keywords: *Mathematical Literacy, Percentage Problem.*

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PENDAHULUAN

The introduction is structured into three parts. The first part examines the theory of mathematical literacy. In the second part, the theory of problem percentage in connection with the context of everyday life, the final part of the introduction presents research related to mathematical literacy and the study of problem percentage.

The competencies needed to face global challenges require abilities that go beyond technical and theoretical knowledge. Competencies such as critical thinking, creativity, collaboration, and effective communication skills are now key to success in a dynamic and competitive environment (Thornhill-Miller, et al, 2023). In this context, literacy serves as the main foundation that supports the development of these competencies (Pillai et al., 2017), not only the ability to read and write (Barton, 1994) but also the skills to understand, evaluate and utilize information in a variety of formats and complex situations (Smith, 2011). One of the literacies that has an important role in overcoming various global challenges is mathematical literacy, a literacy that not only understands numbers and calculations, but also involves critical thinking skills in overcoming complex problems (Jablonka, 2003; OECD, 2013).

Mathematical literacy involves various important aspects to understand and apply mathematics in everyday life. It involves mastering basic mathematical concepts, such as numbers and operations, and applying that knowledge in various situations (Sowder, 2020) to find effective solutions (Franklin & Muth, 2022). Solutions are found thanks to the ability to think logically based on data analysis and evidence in decision making (Lannin, 2021). In addition, mathematically literate individuals can transform real-life situations into mathematical models that can be analyzed to solve problems systematically (Ball, 2019). The ability to solve problems efficiently using a mathematical approach is also a crucial part of this literacy (Wang, 2023). In addition, mathematical literacy involves skills in communicating mathematical ideas and understanding to others, which supports productive collaboration and discussion (National Research Council, 2021). Mathematical literacy not only strengthens the understanding of

mathematical concepts, but also improves an individual's ability to solve real-world problems effectively using a mathematical approach (Stacey, 2015).

One of the challenges that students often face in everyday life is understanding the concept of percentage, which is often used in various contexts such as calculating discounts, taxes, and loan interest. Percentages are an important part of everyday life, especially when used to calculate price changes, discounts, or increases in value (Fuson, 2020). For example, when calculating a discount on a product, percentages help us determine the final amount that needs to be paid after the discount is applied (Lampert, 2018). In addition, this concept is also useful for calculating changes in value, such as fluctuations in fuel prices or changes in currency exchange rates (Stein, 2017). Understanding and applying percentages correctly will make it easier for someone to make better financial decisions, manage budgets, and analyze data more accurately in various situations (Jiang, 2021). With a good understanding of how percentages work, we can interpret numerical data accurately and use the results to solve problems effectively (Bishop, 2019).

The application of the percentage concept everyday life is closely related to mathematical literacy (Steen, 2021). Individuals who have a good level of mathematical literacy are not only able to calculate percentages but can also analyze and interpret numerical data in relevant contexts (Miller, 2020). For example, students who understand mathematical literacy well can use percentages to assess the impact of discounts when shopping, which helps them make wiser financial decisions (Stacey, 2015). In addition, mathematical literacy supports students in developing effective strategies to solve problems involving percentage calculations, such as changes in the value of goods or price fluctuations (Franklin & Muth, 2022). Therefore, increasing mathematical literacy not only deepens students' understanding of percentages but also improves their ability to think critically and make the right decisions in various everyday situations (National Research Council, 2021).

Mathematical literacy has been studied to be seen from the submission of problems (Ozgen, 2019) and problem solving (Meiningrum & Wahidin, 2021), the problems submitted and given are contextual, considering mathematical literacy the ability to apply mathematical knowledge in real life. Percentage material is one of the materials that is close to students' lives. Therefore, this study will look at students' mathematical literacy in solving percentage problems.

METHOD

This study is an exploratory qualitative study that aims to explore and describe mathematical literacy experienced by students in solving "problem percentage". This study was conducted at the high school level in the odd semester of the 2024/2025 academic year. The subjects of the study were 36 students. The instrument used in this study was a written essay test. The students' answer sheets were then examined and inductive analysis was used with a focus on students' mathematical literacy. Student responses are grouped into several categories. Furthermore, student responses are explained in a simple form along with their relationship to mathematical literacy.

RESULT

1. Problem 1 (Savings Exchange)

Table .1. Response Category of Saving Exchange Problem

	Response Category	Frequency (%)
Correct Answer	example-based reasoning	4
	Guess: depends on the amount of savings	2
	Describe what conditions to accept or reject	8
	Reject the offer due to the uncertain amount of savings	5
Total		19

Resonable Answer	want to know the nominal savings first before deciding	3
Incorrect Answer	Comparing the percentage absolutely	13
	taking the same money as an example; wrong conclusion	1
No answer		0

Analysis of the responses (Table 1) shows that at least half of the students (19 out of 36) understood that they could not compare percentages without considering what the percentages represented. They understood that 100 percent does not always mean more than 10 percent. Some students solved the problem explicitly by showing that the answer depends on the amount of savings each child has, explaining under what conditions he or she would accept or reject the offer. Three students explained the solution by taking the example of the same amount of savings and then stating that they would accept the offer. Approximately half of the students compared the two percentages as absolutes. Four students questioned the amount of savings and then came to the conclusion that they would not make any decision because the information on the amount of savings was not available. We categorize these responses as reasonable responses, not right or wrong answers. As a reward because even though the correct answer was not given, it is clear that these students know that percentages are related to something.

2. Best Buy Problem

Problem "Best Buy", keadaan dalam kehidupan nyata yang sudah lazim dijumpai siswa. Siswa diberitahu tentang penjualan oleh dua toko. Toko pertama menawarkan diskon 15%; yang lain juga 30%. Lalu siswa diminta untuk menjelaskan apakah ada kemungkinan harga barang di toko dengan penawaran diskon 15% lebih murah dibandungkan toko dengan harga barang di toko dengan penawaran diskon 30%? Siswa kemudian diminta untuk menjelaskan alasannya.

Table 2. Response Category of Best Buy Problem

	Response Category	Frequency (%)
Correct Answer	take various prices as an example, make conclusions from some conditions	5
	True conclusion	3
	Taking the same price as an example; true conclusion	15
Incorrect Answer	Comparing the percentage absolutely	9
	taking the same price as an example; wrong conclusion	1
	No Explanation	3
No answer		0

Analysis of the responses showed that at least half of the students understood that it was possible for the price of goods from a store offering a 15% discount to be cheaper than the price of goods from a store offering a 30% discount. They realized that they could not compare percentages without considering what the percentages indicated, they explained by showing that the answer depends on the prices of the goods in each store. Furthermore, some explained under what conditions the price at the store with a 15% discount would be the cheapest compared to the goods in the store with a 30% discount and vice versa. Thirteen students answered by only looking at the larger discount percentage that would give the cheapest price, they directly compared the percentages in absolute terms. Then they concluded that it was impossible for the store with a 15% discount to give a cheaper price than the goods in the store with a 30% discount.

Discussion and Conclusion

This study identified significant patterns in students' understanding of the concept of percentages, examined in two contexts: Savings Offers and "Best Buy" Problems. In the first

context, almost half of the students (19 out of 36) indicated that they understood that comparing percentages without considering the underlying real value is a mistake. They recognized that a larger percentage does not necessarily mean a larger amount. One student stated two conditions under which he would accept or reject the offer (see Figure .1), while another student stated, “I will only accept the savings exchange offer if Mona’s savings are more than 10 percent of my savings; otherwise, I will not accept it.” This demonstrates students’ understanding of the importance of consideration in the decision-making process, and their deep understanding of mathematical concepts allows them to apply them flexibly to a variety of real-world problems (Boaler, (2016).

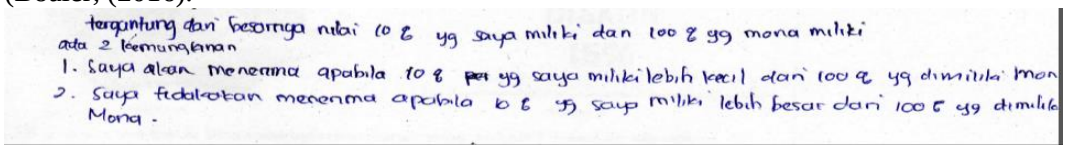

Figure .1. Correct Answer

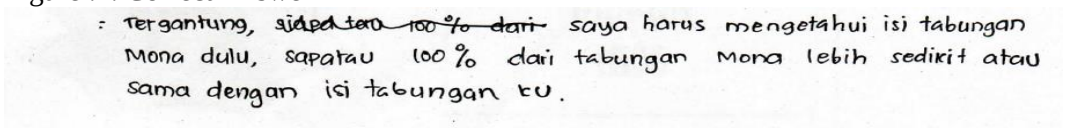

Figure .2. Reasonable response

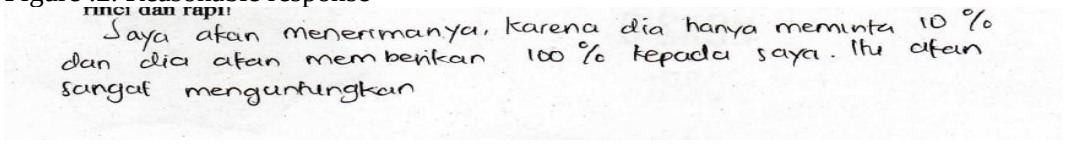

Figure .3. Incorrect Answer (Comparing percentage absolutely)

However, there were also some students who made the mistake of comparing percentages directly and ignoring the relevant context. For example, one student commented, "I would definitely take the offer because I would get 100 percent, while I only have to give 10 percent." This view reflects a lack of understanding of ratios and proportions, which are common challenges faced by students (Kilpatrick et al., 2001). This error also shows students' tendency to focus on large numbers without considering the underlying meaning, as stated by Hiebert & Carpenter (1992). Some other students gave more analytical answers, for example, "I don't know, because it's not clear how much the savings are," which shows that they recognize the importance of clear information before making a decision.

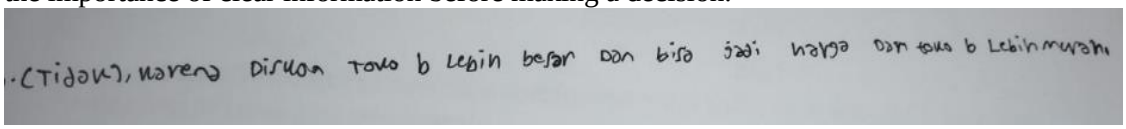

Figure .4. Incorrect Answer (Comparing percentage absolutely)

In the context of the second problem, “Best Buy,” students who answered correctly recognized that the price of an item affects the amount of discount applied. They provided examples of prices to explain how discounts work in different situations, with one student stating, “My answer depends on the price of the item at each store.” However, some students still compared discounts in absolute terms, assuming that a higher discount always results in a lower price. For example, one student stated, “I would choose the 30 percent discount, it would be cheaper.” This suggests that their understanding of discounts was limited. In addition, some students expressed an interest in gaining more information before making a decision, reflecting critical thinking skills that are essential to mathematical literacy. These skills are vital, especially in making informed decisions (OECD, 2019). Research also shows that mathematical literacy includes the ability to apply mathematical knowledge to real-world situations, in line

with the NCTM's (2000) view that emphasizes the importance of the relationship between mathematics and everyday life.

Although some students show good understanding, many of them still need additional support to improve their critical thinking skills. Problem-based learning has been shown to be effective in improving students' understanding (Firdaus et al., 2017). Van der Waerden et al. (2020) stated that a learning approach that focuses on real contexts can increase students' interest and understanding of mathematical concepts, by using everyday situations, students can be better at applying their knowledge in real situations (Bagdat, & Bagdat, 2020).

Therefore, in teaching mathematics, it is very important to provide problems that are relevant to everyday life that are close to students. By presenting a familiar context, students will be more motivated and ready to apply their mathematical knowledge in solving real problems. The OECD (2019) findings show that mathematical literacy focuses on an individual's ability to utilize mathematics in everyday life contexts. Linking mathematics learning to everyday situations will help students develop a deeper and more relevant understanding of mathematical concepts.

References

Barton, D. (1994). *The social basis of literacy: An introduction to the ecology of written language*. Oxford: Blackwell.

Barton, B., & Brisard, M. (2020). Mathematics and world problems: A critical approach. *Educational Studies in Mathematics, 104*(1), 33-50.

Bağdat, A., & Bağdat, O. (2023). Mathematics on news: How do students interpret percentages in daily life situations? *Research on Education and Psychology, 7*(Special Issue 2), 442–453. https://doi.org/10.54535/rep.1360056

Bishop, A. (2019). Understanding numerical data in problem-solving contexts. *Math Education Review, 45*(3), 215-230.

Boaler, J. (2002). *Experiencing school mathematics: Traditional and reform approaches to teaching and their impact on student learning*. Lawrence Erlbaum Associates.

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass.

Franklin, C., & Muth, K. D. (2022). Teaching mathematics in the 21st century: A practical guide for educators. *Routledge*.

Franklin, J., & Muth, A. (2022). Mathematical literacy: A pathway to effective problem solving. *Journal of Mathematical Education, 47*(2), 123-137.

Firdaus, F. M., Wahyudin, & Herman, T. (2017). Improving primary students' mathematical literacy through problem-based learning and direct instruction. *Educational Research and Reviews, 12*(4), 212-219.

Fuson, K. (2020). Applying percentages in everyday life. *Journal of Mathematics Education, 62*(2), 102-118.

Gomez, K. (2018). Mathematical thinking and problem solving in the real world. *International Journal of Mathematical Education in Science and Technology, 49*(6), 789-805.

Hiebert, J., & Carpenter, T. P. (1992). Learning and teaching with understanding. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 65-97). Macmillan.

Jablonka, E. (2003). Mathematical literacy. In A. J. Bishop, M. A. Clements, C. Keitel, J. Kilpatrick, & F. K. S. Leung (Eds.), *Second international handbook of mathematics education* (pp. 75-102). Springer.

Jiang, M. (2021). Financial decision-making through percentage calculations. *International Journal of Finance Education, 18*(1), 78-95.

Kilpatrick, J., Swafford, J., & Findell, B. (2001). *Adding it up: Helping children learn mathematics*. National Academy Press.

Lannin, J. K. (2021). *Developing mathematical thinking and problem-solving skills*. Springer.
Lampert, M. (2018). How students apply percentages in everyday situations. *Teaching and Learning in Math, 27*(2), 55-72.
Meiningrum, N. and Wahidin, W. (2021). 'Analysis of mathematics literacy ability based on problem solving ability for class VII students of SMP Bunda Rangkiang', *Daya Matematis: Jurnal Inovasi Pendidikan Matematika*, 9(2). doi:10.26858/jdm.v9i2.20592.
Miller, S. (2020). The importance of mathematical literacy in contemporary society. *Educational Research Review, 15*(1), 45-59.
National Research Council. (2021). *Mathematics learning in early childhood: Paths toward excellence and equity*. National Academies Press.
National Research Council. (2021). *Mathematical literacy for all: Strategies for education and practice*. Washington, DC: National Academies Press.
Niss, M., & Højgaard, T. (2019). Mathematical competencies revisited: A research-based framework for mathematics education. *Springer*.
OECD. (2013). *PISA 2012 assessment and analytical framework: Mathematics, reading, science, problem solving and financial literacy*. OECD Publishing.
OECD. (2019). *PISA 2018 Assessment and Analytical Framework*. Paris: OECD Publishing.
Ozgen, K. (2019). Problem-Posing Skills for Mathematical Literacy: The Sample of Teachers and Pre-Service Teachers. Eurasian Journal of Educational Research, 19(84), 179-212. https://doi.org/10.14689/ejer.2019.84.9
Pillai, S., Galloway, G., & Adu, E. O. (2017). Comparative studies of mathematical literacy/education: A literature review. *International Journal of Mathematical Education in Science and Technology, 16*(1-3), 67-72. https://doi.org/10.1080/09751122.2017.1311625
Schoenfeld, A. H. (2014). *Mathematical problem solving*. Academic Press.
Smith, F. (2011). *Understanding reading: A psycholinguistic analysis of reading and learning to read* (6th ed.). Routledge. https://doi.org/10.4324/9780203142165
Stacey, K. (2015). The PISA view of mathematical literacy in problem solving. *The Journal of Mathematical Behavior, 37*, 307-318.
Stacey, K. (2015). Mathematics education in the 21st century: The role of mathematical literacy. *International Journal of Mathematics Education, 41*(3), 239-252.
Steen, L. A. (2001). Mathematical literacy. In *Mathematics and democracy: The case for quantitative literacy* (pp. 1-14). Princeton, NJ: National Council on Education and the Disciplines.
Stein, A. (2017). The role of percentages in understanding economic changes. *Economic and Mathematical Studies, 14*(3), 123-135.
Thornhill-Miller, B. *et al.* (2023) 'Creativity, critical thinking, communication, and collaboration: Assessment, certification, and promotion of 21st Century skills for the future of work and Education', *Journal of Intelligence*, 11(3), p. 54. doi:10.3390/jintelligence11030054.
Wang, X. (2023). *Effective problem solving in mathematics education*. Palgrave Macmillan.