



Exploration of Students' Mathematical Literacy Based on Opportunity to Learn Through Context-Based Questions

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Abstract

This study aims to explore what students' mathematical literacy skills look like through a series of opportunity to learn provided in the form of context-based questions. This activity was carried out at MTsN 1 Polewali Mandar in grade VII D students. The research instruments used included mathematical literacy tests, interview guidelines, and student work artifacts. The data collected was processed using content analysis techniques based on conceptual and correlational analysis. The results show that opportunity to learn can be prepared in the form of context-based math problems. Through such questions, students experience a learning process that supports the development of their mathematical literacy skills. This development can be seen from the ability of students to use their knowledge and reasoning in utilizing mathematical concepts to solve the given problems. Not all students can achieve the best level in learning mathematics. This is influenced by two factors, both internally and externally. Internal constraints can be in the form of misconceptions, inaccuracy, lack of knowledge and learning experience, and lack of initiative. Meanwhile, external constraints can be in the form of a conducive learning environment.

Keywords: *Opportunity to learn; Context-Based Questions; Mathematical Literacy Ability.*

INTRODUCTION

Opportunity to learn is the concept that fundamentally plays an important role in the progress of students. The concept of the relationship between mathematical literacy and opportunity to learn proposed by Hwang & Ham (2021) where opportunity to learn with procedural tasks can improve mathematical literacy and are indirectly related to self-control. Mathematical literacy ability is a basic ability needed to solve mathematical problems, especially those related to numbers, data, and mathematical symbols (Lange, 2015).

However, students' mathematical literacy skills are still a problem, especially students in Indonesia. Based on PISA, the results of the search for the mathematical literacy ability of Indonesian students are still low. In 2012, Indonesia was ranked 64th out of 65 countries, with a score of 375, while the international score was 494. The results of the 2018 PISA math test, which was followed by 15-year-old junior high school students, showed that Indonesia was ranked 73rd out of 78 countries, Indonesia shows a score of 379 out of an average score of 489 (Siew et al., 2015).

According to Wijaya et al. (2015), not only one factor that influences why student achievement is only at that level, namely a curriculum with low emphasis on basic concepts, textbooks that are not rich in presentation, and limited involvement of representational models for practice in the classroom. For the first factor, (Goldhaber & Brewer, 1996) suggests that the curriculum used in schools is a reference whose content ensures a learning process on the concept of learning has been given to students by established competency standards. Regarding textbooks, it is time for the content presented in them the form enriched concepts and learning. It is not uncommon for students to make mistakes and misconceptions because of the multiple meanings of a mathematical concept (Ni & Zhou, 2005). The representation model is a school resource that is supportive of learning activities, even the limited



resources are part of the limiting quality of instructional programs (Oakes, 1989). This is what needs attention in the exposure of learning and instructional strategies in the classroom.

Learning exposures and learning instructions given to students are input as well as processes that are prepared for students to be involved in activities designed in such a way that they can achieve the expected learning goals (Elliott & Bartlett, 2021). The involvement of students in learning activities that are applied in the classroom is the expected impact of preparing opportunity to learn. The response to the opportunity to learn provided is a form of activity that leads to better academic outcomes. If this happens it can be assumed that students make good use of or the exposure to learning and instruction provided interact well (Walshaw, 2012).

Challenges in learning activities, one of which is to get students involved with the activities prepared. Class or school is a space or time prepared for students to get a learning experience (Cogan & Schmidt, 2015). The preparation of activities means in this case that students take advantage of the opportunity to learn provided through exposure to learning materials and follow up on the teaching instructions delivered. However, the extent to which students can demonstrate their mathematical literacy skills can be said that they have taken advantage of the opportunity to learn provided to build mathematical literacy. For this reason, this article will examine the description of mathematical literacy skills possessed through a series of opportunity to learn in the form of mathematical problems is given.

METHOD

This type of research is descriptive qualitative research that aims to describe students' numeracy literacy skills in terms of student opportunity to learn. The research subjects were students of class VII D MTsN 1 Polewali Mandar in the odd semester of the 2022/2023 academic year. They were selected based on the responses given through the learning activity questionnaire and the results of the work on the problem of numeracy literacy. To support exploration, interviews were also conducted to obtain information from research subjects.

For test materials, the forms used are multiple-choice, complex multiple-choice, description, and brief description, where the subject is expected to be able to express ideas to solve problems in written form. The content of the test is in the form of literacy contexts related to personal, socio-cultural, and scientific contexts. The indicators for measuring numeracy literacy skills in this study are as follows: 1) Students can understand facts, procedures, and mathematical tools, 2) Students can reason to solve complex and non-routine problems based on their mathematical concepts, 3) Students can apply mathematical knowledge owned in different contexts. As for the interview activities, the pattern used is semi-structured by revealing in-depth and complete data about the subject's mathematical literacy ability.

For data analysis, the research results obtained were then processed and analyzed using content analysis based on conceptual analysis and relational analysis between what students wrote in the form of artifacts and the results of interviews conducted (Yin, 2015). Thus, the presentation of the data in the results of this study describes the results of students' work on the given mathematical literacy questions and interview excerpts.

RESULT AND DISCUSSION

Result

In this study, the research subjects involved were given 3 questions related to numeracy literacy. The topics raised in this research are the School Canteen and New School Year Discounts, where the second theme contains 2 questions. The numerical literacy test questions used in this study are as follows.

Problem 1 School Shop



The principal of MTsN 1 Polewali Mandar will renovate a school shop. The work of the shop requires 5 workers in 15 days. For the work on the shop to be completed within 5 days, the workers needed are...

Problem 2 New School Year Discount

Ahead of the new school year, some stores are giving big discounts. The following table shows a list of prices and discounts at some stores. All these shops sell the same goods.

Store Name	Discount		Unit price	
	Slippers	Shoes	Slippers	Shoes
Adi	15%	30%	Rp. 45.000,00	Rp. 70.000,00
Ina	20%	25%	Rp. 45.000,00	Rp. 70.000,00
Ana	25%	20%	Rp. 45.000,00	Rp. 70.000,00
Ali	30%	15%	Rp. 45.000,00	Rp. 70.000,00

Based on the text above, determine whether the following statements are true or false!

Statements	True	False
The most expensive unit price for sandals is at Adi's store		
The difference in the unit price of shoes at Ali and Ana's shop is Rp. 5,000.00		

Problem 3 Based on the discount table above!

Zea has Rp. 100,000.00 and want to buy one sandal and one shoe. To get the most of the remaining money, in which stores should Zea shop?

- A. Adi and Ina
- B. Adi and Ana
- C. Ali and Ina
- D. Ali and Adi

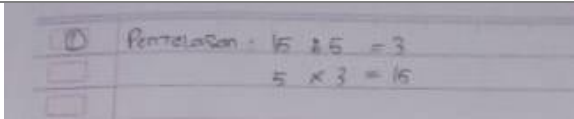
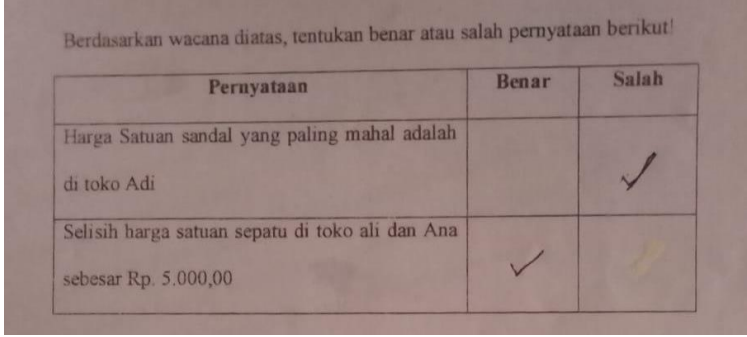
Of the three questions given to the subjects in this study, their responses are described as follows.

Table 1. The First subject's Answer and Interview Excerpts

Subject	Item Number	Student Response
1	1	<p>$15 : 5 = 5 : x$ $x = \frac{15 \times 5}{5} = 15$</p>
	Argumentation	<i>S1: yes, so from the question it's 15 days for 5 workers then asked how many workers in 5 days? Here we use a value comparison if I'm not mistaken, so that's the way to determine how many people if 5 days work. and the result is 15.</i>
1	2	
	Argumentation	<p>S1: because judging from the discount I: why the discount, can you explain? S1: Adi's discount is the least, which is 15%, so Adi who has a small discount means Adi is the most expensive, I think so I: If the second one, can you explain why you chose the wrong one? S1: because I was looking for Ali and Ana's discount, then after deducting the discount at Ali and Ana's shop it became 3500 instead of 5000, so I checked wrong.</p>
1	3	
	Argumentation	<i>S1: So what I got was the price of shoes at Adi's shop was 490,000 and it was the cheapest shoes among other stores, then if Ina the price of sandals was 36,000 that was also the cheapest I got</i>

I: try to re-check the price of the shoes, the period is more expensive after the discount because the normal price is 70,000
 S1: I counted myself later because there were so many zeros I might have miscalculated
 I: try to count again
 S1: sorry not 490,000 but 49,000. So, sandals at Ali's shop are the cheapest because the price is 33,650 then the price of shoes at Adi's shop is the cheapest because the price is 49,000
 I: means the answer?
 S1: D, Ali, and Adi

Table 2. The Second subject's Answer and Interview Excerpts

Subject	Item Number	Student Response
2	1	
Argumentation		<p>I: Pay attention to number 1 and provide the information contained in question number 1? S2: The information for Masters is that the principal wants to renovate the canteen which requires 5 people in 15 days I: what is asked? S2: how many people are needed if it takes 5 days I: Can you explain question number 1? S2: The master's degree requires 5 workers in 15 days so 15 days is divided by 5 people into 3, so that the canteen work can be completed in 5 days so 5 days multiplied by 3 equals 15 then the work required is 15 people</p>
2	2	
Argumentation		<p>Q: Can you explain how to answer number 2? S2: didn't know because I immediately worked on number 3, because it was so noisy that I couldn't focus. Q: so how to answer number 2? S2: just ticked S2 I: oh so. Even though if you know how to do number 3 it's easy to determine the answer to number 2, try to pay attention to question number 2 again S2: yes, the first is the price of the most expensive sandal unit at Adi's shop I: After answering number 3, right, we get all discounts from all stores, so the correct answer is that statement? S2: means that here the most expensive price is correct at the Adi store because the discount is only 6750 while the others are 9000, 11250, 13,500 meaning that the second statement is wrong because the difference must be 3500</p>

		I: already understand, it means you have to focus more on reading the problem
2	3	<p>3. Berdasarkan tabel diskon diatas!</p> <p>Zea memiliki uang sebanyak Rp. 100.000,00 dan ingin membeli satu sandal dan satu sepatu. Agar sisa uangnya paling banyak, ditoko mana saja zea harus berbelanja?</p> <p>A. Adi dan Ina B. Adi dan Ana C. Ali dan Ina <input checked="" type="checkbox"/> D. Ali dan Adi</p>
Argumentation	<p>Q: Can you explain what was the first thing you thought after reading question number 3? S2: mean? Q: After reading question number 3, how do you answer the question? S2: oh how, look for the cheapest shop Q: What is the reason for choosing D? S2: Because the store with the most discounts is Ali and Adi's shop from other stores Q: Can you explain the answer you got? S2: so here the discounted price for sandals at Adi's shop is 6750, Ina's shop is 9000, Ana's shop is 11.250, Ali's shop is 13.500 which means the most discounted is Ali's shop, while the price of sandals is cut at Adi's shop 21,000, Ina's shop 17.500, Ana's shop 14,000, Ali's shop 10,500 so the most discount is Adi's shop. So the cheapest one has the most pieces, which means D is the answer</p>	

Table 3. The Third subject's Answer and Interview Excerpts

Subject	Item Number	Student Response
3	1	
Argumentation	<p>I: try to see what question number 1 can be obtained after reading the question? S3: here the principal will renovate the canteen. The canteen is done by 5 people in 15 days I: So can you explain how to answer question number 1? S3: so it was asked by the person who can work within 5 days so I did it like this then multiplied and divided, so I got 15 (show answer paper)</p>	

3 2

Pernyataan	Benar	Salah
Harga Satuan sandal yang paling mahal adalah di toko Adi	✓	
Selisih harga satuan sepatu di toko ali dan Ana sebesar Rp. 5.000,00	✓	

Argumentation

I : from question number 2 what information did you get?
 S3: Approaching the new year, some stores give big discounts and then there are prices for sandals and shoes
 I : look again at the answer, why do you think that the price of sandals is the most expensive at Adi's shop?
 S3: I'm just guessing, because I only read the problem, I'm not looking for the answer
 I : oh yes, after reading how do you get that answer?
 S3: has the least discount on Adi's shop, so I think it's the most expensive shop
 I : If the second one, can you explain why we choose right?
 S3: doesn't know how, only Ali and Ana's discount is reduced and the difference is 5%, so I think the difference is 5000

3 3

3. Berdasarkan tabel diskon diatas!

Zea memiliki uang sebanyak Rp. 100.000,00 dan ingin membeli satu sandal dan satu sepatu. Agar sisa uangnya paling banyak, ditoko mana saja zea harus berbelanja?

A. Adi dan Ina
 B. Adi dan Ana
 C. Ali dan Ina
 D. Ali dan Adi

Argumentation

I : Pay attention to question number 3, can you explain what was the first thing you thought after reading question number 3?
 S3: What does S3 mean?
 I : After reading the problem, you will think about how to solve this problem
 S3: I don't understand
 I : What is the reason for choosing C?
 S3: I just chose S3 because I know Adi is the most expensive, so I choose the one without Adi's name
 I : why do you think Adi is the most expensive?
 S3: Because the discount at Adi's shop is 15% at least
 P: oh yeah

Discussion

From the results of the research obtained stated above, the 3 numbers of mathematical literacy questions given received different responses based on their understanding of mathematical concepts.



For question number 1, the three subjects given the question target that the number of workers needed is 15 people. The first subject stated that the concept used was to use value comparisons, while the second and third subjects described how the concepts of multiplication and division were involved in solving the given problem. Although subjects 1 and 3 started their solution by using the same form of a mathematical expression, the execution process was not in line with that mathematical form. This is what often happens in students' understanding, known as misconceptions about mathematical concepts. It is stated that it is not uncommon for students to make mistakes and misconceptions because of the multiple meanings of a mathematical concept (Ni & Zhou, 2005). Mulbar & Nasrullah (2014) suggest that this misconception can be corrected with clear instructions in directing students' understanding. As with the third student's answer to question number 1, the special attention given is to provide an opportunity to improve the form of mathematical expression that is built because the next execution is correct. In other words, students must carefully and well understand the instructions given by the teacher (Walshaw, 2012).

Question number 2 received different responses from the three subjects in this study. For the first student, the responses given were interesting because they did not experience external or internal constraints in constructing the solution to the problem. In contrast to the second subject who thought he didn't know because the class conditions were not conducive or noisy. This condition is a challenge in the learning environment where students are involved to be active in learning activities (Kahl, 2013). As for the third subject, relying more on predictions than tracing answers mathematically. Therefore, teachers need to provide intervention to students who experience this as a target for improving learning outcomes.

If explored further, the second student is given the opportunity to understand well the questions given. As a result, he is able to construct his argument logically to show what the correct answer looks like. In contrast to the third student, for the first part of the second question, the argument put forward is correct so that the opportunity given by the teacher can lead students to think again and construct the correct answer. Even so, the answer to the second part of this question is still not correct. In other words, these students need opportunity to learn to raise their level of thinking. In line with that, Hwang & Ham (2021) emphasize that opportunity to learn that can be provided in the form of procedural tasks can improve mathematical literacy.

For the third question, the second subject shows an interesting thinking structure, interrelated arguments, and performs an appropriate evaluation. This thinking structure begins with determining the problem keyword, namely the cheapest store is marked with the most discount discounts. Therefore, in the evaluation, the intended price discount is stated, and then concludes the store that provides the largest discount. In contrast to the first subject who experienced inaccuracy, although after that the teacher gave the opportunity to re-examine the answer. The response from these opportunities has an impact on the improvements made so that the real answer can be found. Compared to the two subjects, this third subject really needs to get special intervention in helping himself to build understanding through mathematical literacy knowledge.

Of all the answers put forward by students, there are several important lessons that both teachers and other practitioners need to know. Forms of opportunity to learn need to be prepared and should vary based on the level of ability of students. For learning mathematics, it is seen that not all of them are successful in completing the given mathematical literacy questions. Constraints faced by students can be sourced internally and externally. Internal constraints can be in the form of misconceptions, inaccuracy, lack of knowledge and learning experience, and lack of initiative. In addition, external factors are in the form of a conducive learning environment because not all students like the noisy atmosphere in the classroom.

CONCLUSIONS AND SUGGESTIONS

Overall, this research shows that opportunity to learn need to be given to students, especially context-based mathematics learning to support the improvement of mathematical literacy skills. Opportunity to learn can be prepared in the form of context-based math problems. By giving such questions, students experience a learning process that significantly supports their mathematical literacy skills. Significant

changes can be seen in the students' ability to use their knowledge and reasoning by utilizing mathematical concepts to solve the given problems.

Of the 3 students involved in this study, the learning activities given to students need to be prepared by taking into account the different abilities of students. Not all students can achieve the best level in learning mathematics. This is influenced by two factors, both internally and externally. Internal constraints can be in the form of misconceptions, inaccuracy, lack of knowledge and learning experience, and lack of initiative. Meanwhile, external constraints can be in the form of a conducive learning environment.

In the future, it is necessary for education practitioners in learning mathematics to review the extent to which students can be free from the misconceptions experienced if given a series of opportunity to learn (Nasrullah & Baharman, 2018). Likewise, the inaccuracy where various opportunity to learn allow can change such affective constraints. And whether students are able to build their knowledge and learning experiences well if context-based opportunity to learn are provided in a structured, systematic manner, and pay attention to students' abilities (Miller et al., 2020). Until the importance of preparing a conducive learning environment has become a special concern for teachers (König et al., 2017), in carrying out learning activities in the classroom.

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