Elementary School Students' Responses to Open-Ended Learning Materials Integrated with Regional Culture on Fractions, as Seen From the Cognitive Level

Atika Maulidina Hs[1]*, Wiryanto [2], Neni Mariana[3], M. Misbachul Huda[4], Maulana Paramaditya Ananta[5], Bambang[6]

[1]*, [4,5,6]Primary teacher education, STKIP Al Hikmah Surabaya, Jawa Timur, Indonesia

[2,3]Universitas Negeri Surabaya, Jawa Timur, Indonesia

Corresponding author: atika.22010@mhs.unesa.ac.id
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Abstract

This study aims to gain in-depth understanding of students' responses to the use of open-ended teaching materials integrated with local wisdom. This study used a descriptive qualitative approach, taking fourth-grade students of SDN Demangan 1 Bangkalan as subjects. Data were collected through student response questionnaires, interviews, observations, and documentation. The collected data were analyzed through data reduction, data presentation, and conclusion drawing stages, with data validity checked through technical triangulation. The results showed that, in general, students gave a very positive response with an average response score of 3.44 to the use of teaching materials. Positive responses were seen in increased student interest in mathematics learning, particularly through the integration of local wisdom content, increased enthusiasm for learning, self-confidence, and student involvement in discussions. Further analysis showed variations in responses based on students' cognitive levels, but all students, whether at high, medium, or low cognitive levels, showed positive attitudes toward the use of teaching materials. Thus, open-ended teaching materials based on local wisdom have the potential to be a relevant alternative to support meaningful mathematics learning in elementary schools.

1. Introduction

Elementary school is the initial stage of education that plays a crucial role in instilling concepts and developing children's cognitive abilities (Purnawanto, 2022; Wibowo et al., 2022). The success of the educational process at this level significantly impacts students' success at subsequent levels. Therefore, learning in elementary school must be designed in such a way as to foster strong thinking skills in students from an early age.

One of the compulsory subjects that plays a strategic role in developing students' thinking skills is mathematics. However, many students still consider mathematics a difficult subject (Fauzy & Nurfauziah, 2021; Permatasari, 2021). One topic often considered challenging by students is fractions. This difficulty is not only due to the abstract nature of mathematics but also due to the limited availability of teaching materials that are presented in a meaningful, contextual way and encourage students' active thinking. Although various mathematics learning resources are currently available that are packaged in a more conceptual and contextual manner, specific teaching materials on fractions with these characteristics are still relatively limited (Ardhiyah & Radia, 2020; Meilandari & Asril, 2022).

In addition to limited material availability, many teaching materials currently available are still dominated by routine and procedural practice problems. This pattern of problems encourages students to simply memorize and follow mechanical steps without developing a deep understanding of concepts. As a result, students' ability to think, connect concepts, and solve math problems independently is not optimally developed (Nourmaningtyas et al., 2020).

A similar problem was also found in fourth-grade mathematics lessons at SDN Demangan 1 Bangkalan. Based on preliminary studies, teachers were still using school-provided textbooks as the sole teaching materials. However, the analysis showed that these teaching materials were not fully developed based on the learning outcomes of the latest revised Merdeka curriculum. Furthermore, the practice problems tended to be routine and closed-ended, preventing students from exploring various possible correct answers and solving strategies. The

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ability to think through various possible solutions is a crucial indicator of critical reasoning. Therefore, this situation is one of the main contributing factors to students' low ability to solve non-routine and open-ended mathematics problems (Nurhasanah & Luritawati, 2021; Setiawan & Dores, 2019; Zebua et al., 2024).

One solution to address this problem is to use teaching materials based on an open-ended approach. Teaching materials are a component that significantly influences the quality of learning (Hayani & Sutama, 2022; Susanti et al., 2024). Teaching materials are not only a source of information but also a tool to guide students in thinking, processing, and interacting with the learning material (Hrahap et al., 2022; Hrp et al., 2022). Appropriately structured teaching materials help students develop a correct and more systematic understanding of concepts. Conversely, inappropriate teaching materials can lead students to simply memorize the material, limiting their ability to think more deeply about concepts. The open-ended approach to teaching materials allows students to consider a single correct answer and multiple solution strategies. This approach trains students to explore their thinking or reasoning independently (Jufri et al., 2023; Salsabila & Muqowim, 2024). This characteristic aligns open-ended teaching materials with the needs of learning that focuses on developing students' thinking skills..

However, the use of open-ended teaching materials in elementary schools also needs to be adapted to the characteristics and level of cognitive development of students. According to Piaget's theory, students aged 7-12 are in the concrete operational stage, where they can begin to understand certain concepts with the help of concrete and contextual materials. One concrete material that can be implemented is local wisdom (Purwanti et al., 2023). The use of local culture in mathematics learning is called ethnomathematics. By utilizing students' prior knowledge of local culture, it is hoped that students will more easily construct mathematical concepts. In addition to supporting the development of mathematical reasoning, this can also develop students' cultural literacy. Cultural literacy is one of the competencies expected to be developed in the Independent Curriculum.

Based on pre-research observations at SDN Demangan 1 Bangkalan, learning still focuses on teaching concepts and practicing math problems without linking them to the local cultural context. This not only results in less contextual mathematics learning but also reduces students' cultural literacy. Therefore, teaching materials will be used not only to train students' mathematical reasoning skills but also to support the development of their cultural literacy.

Various previous studies have shown that open-ended learning improves students' learning outcomes and cognitive abilities (Hardi et al., 2023; Marselina et al., 2024; Nurhidayah et al., 2022; Saragih et al., 2021). However, there is limited research specifically examining student responses to the use of open-ended teaching materials, particularly when linked to cognitive levels. Yet, student responses are a crucial indicator of the quality of teaching materials. Positive responses indicate that the teaching materials used are understandable, engaging, and appropriate to the characteristics and needs of students. Conversely, less positive responses can serve as evaluation material for improving teaching materials. Therefore, analyzing student responses is a crucial part of the process of developing quality and sustainable teaching materials.

Analysis of student responses will be more meaningful when viewed from the perspective of their cognitive level. This is because each cognitive level has different characteristics and levels of thinking, so student responses to the use of teaching materials can vary across levels (Susanto & Wulandari, 2024). By examining student responses at each cognitive level, researchers can obtain a more comprehensive picture of the extent to which open-ended teaching materials can facilitate students' thinking processes.

Based on this description, this study was conducted to further analyze student responses at SDN Demangan 1 Bangkalan to open-ended teaching materials based on their cognitive levels.

2. Method

This research is a descriptive qualitative study that aims to understand in depth the response to the use of open-ended teaching materials. The study was

conducted at SDN Demangan 1 Bangkalan with fourth-grade students as subjects. The subject selection was carried out using purposive learning techniques. The object of this research is student responses to open-ended teaching materials on fractions based on students' cognitive levels. Data were collected using questionnaires, interviews, observations, and documentation. The collected data were analyzed qualitatively descriptively with the stages of data reduction, data presentation, and conclusion drawing. Data validity was checked through triangulation techniques by comparing data from questionnaires, interviews, observations, and documentation.

3. Result and Discussion

Result

The following are the results of the student response questionnaire obtained:

Table 1. The results of the student response questionnaire

No	Indikator	Small Trial		Big Trial	
		Total Score	Average	Total Score	Average
1	This teaching material makes mathematics material easier to understand.	17	2,83	103	3,03
2	I am happy with the content of this teaching material, because I can learn about my local culture.	19	3,17	128	3,76
3	This teaching material makes mathematics less scary and difficult.	23	3,83	118	3,47
4	This teaching material allows me to connect mathematics with things I have seen, heard, and done in everyday life.	18	3	108	3,18
5	I am happy because this teaching material allows me to use mathematics to solve everyday problems in my area.	15	2,5	113	3,32
6	I don't find it difficult to work on the questions in the textbook materials.	22	3,67	115	3,38
7	I am happy because while studying using this book I can answer math questions freely and there are lots of correct answers.	19	3,17	102	3
8	I feel challenged and excited to follow the instructions and answer the example questions in the book.	18	3	115	3,38

No	Indikator	Small Trial		Big Trial	
		Total Score	Average	Total Score	Average
9	This teaching material makes me more enthusiastic about participating in mathematics learning.	22	3,67	129	3,79
10	This teaching material makes me no longer embarrassed to ask questions and express ideas during learning.	22	3,67	126	3,71
11	This teaching material allows me to have enjoyable discussions with my friends.	21	3,5	126	3,71
12	This teaching material makes me want to learn more about fractions.	21	3,5	120	3,53
13	After using this teaching material, I feel like I like mathematics more.	20	3,33	108	3,18
14	I am sure that after using teaching materials like this, my math skills will improve.	22	3,67	126	3,71
	Rata-Rata		3,32		3,44

Discussion

Student response to learning is a crucial factor to consider in achieving desired learning objectives (Ahmad et al., 2020; Mokodompit, 2020; Syifa & Julia, 2023). When students respond positively to learning, they are more engaged, focused, and enthusiastic about participating in each learning activity. This focus and enthusiasm for learning will optimize the learning outcomes and achieve learning objectives. Conversely, without positive student responses, no matter how creative and well-designed the learning design, it will still be difficult to achieve learning objectives. Therefore, when teachers design something new in their learning, student responses are crucial for measurement and in-depth analysis.

The use of open-ended teaching materials integrated with Bangkalan local wisdom is a learning innovation that has never been implemented before in class IVA at SDN Demangan 1 Bangkalan. This naturally elicits a variety of student responses. Each student's response may not all align with the teacher's and researcher's expectations. Therefore, this study will analyze student responses to learning using open-ended teaching materials integrated with Bangkalan local wisdom. Student response analysis was conducted in two trials, namely a small

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trial and a large trial. The small trial was conducted by taking a sample of 6 students, while the large trial took a sample of 34 fourth-grade students. Response data was collected using a response questionnaire instrument and interviews with students who have different cognitive levels. Student interviews were conducted involving 2 students with high, medium, and low cognitive levels. The selection of students at these cognitive levels was based on the direction of the class teacher. The response questionnaire was needed to determine the general student response to learning using the developed teaching materials, while interviews were conducted to determine the differences in student responses from various cognitive levels to learning..

In the small-scale trial, the student response questionnaire yielded an average score of 3.32, categorized as very positive. Some notes written by students included:

a. Problems that were initially difficult after studying together using the new math textbook turned out to be easier.

b. The problems in the textbook were more difficult than usual math problems.

c. The textbook was good because it could be used with a mobile phone.

Based on the notes above, it shows that responses varied among students, but overall, students responded positively to learning using the teaching materials. Therefore, learning using the products can be implemented in a larger trial.

In the large-scale trial, the student response questionnaire yielded an average score of 3.44, categorized as very positive. This indicates that learning using the teaching materials has generally elicited a positive response from students. More specifically, some of the items with the highest scores included questionnaire items 2, 9, 10, 11, and 14. For item 2, the positive student response was evident in the high average score of 3.76 for questionnaire item 2, indicating that most students enjoyed the integration of local wisdom into the teaching materials. This student interest in local wisdom content demonstrates the potential for cultural literacy skills, which most students already possess. This is because interest in learning about culture and local wisdom is one indicator used

to measure students' cultural literacy skills. This also demonstrates that the development of these teaching materials is an appropriate solution for students to develop these cultural literacy skills.

Student responses were also demonstrated in questionnaire item 9, with the highest average score of 3.79. This indicates that most students felt more enthusiastic about learning when using teaching materials. The ability of open-ended problems and local wisdom-based learning to foster students' enthusiasm for learning has been previously proven in research (Lestari et al., 2023), that open-ended learning based on ethnomathematics can improve the focus and enthusiasm for learning in fourth-grade elementary school students in mathematics. Open-ended learning itself has also been proven in research (Hanifat et al., 2019; Wulandari et al., 2022; Wanelly & Fauzan, 2020) to increase elementary school students' interest and enthusiasm for learning in mathematics. Similarly, local wisdom-based mathematics learning or ethnomathematics has also been proven in research (Mailani, 2021; Dinata et al., 2022; Pratama, 2023), that integrated mathematics learning with local wisdom content can stimulate students' interest and enthusiasm for learning.

In addition to fostering a passion for learning, the use of teaching materials can also boost student self-confidence. This is evidenced by the scores given by students on questionnaire response items 10, 11, and 14. For questionnaire item 10, the average score was 3.71, indicating that students felt comfortable asking questions and expressing ideas during learning. Furthermore, for item 11, the average score was 3.71, indicating that teaching materials increased students' interest in discussions with their peers. Meanwhile, for questionnaire item 14, the average score was 3.71, indicating that students felt confident that using these teaching materials would improve their math skills. Self-confidence plays a crucial role in one's progress and success in learning mathematics (Murni et al., 2022; Wiguna et al., 2022). Here are some of the impacts of self-confidence:

a. Improves the process of absorbing knowledge and skills

b. Increases student independence, activeness, and enthusiasm

c. Fosters motivation and a sense of enjoyment in learning

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d. Improving problem-solving skills and mathematics learning outcomes (Muawwanah et al., 2020; Rohmat & Lestari, 2019).

This increased student confidence will ultimately help them achieve their learning objectives. Another result of the questionnaire response analysis is that the teaching materials also make students' discussion experiences with their peers more enthusiastic and enjoyable. This is positive because discussion is one of the recommended methods for elementary school students (Holisoh, 2020; Hudah, 2019) and can provide many benefits, including:

a. Helping students make better decisions than making decisions alone.

b. Helping students escape from their own ways of thinking, which can sometimes be wrong, narrow, and full of prejudice.

c. Broadening horizons.

d. Increasing student motivation to think and follow the learning flow.

e. Developing critical and creative thinking skills.

f. Creating active, harmonious, and understanding relationships among students.

g. Fostering self-confidence and tolerance.

h. Minimizing tensions in the classroom (Abbas et al, 2022; Haq, 2019; Supriyati, 2020)

If learning using products generates positive student responses to classroom discussions and teachers can effectively manage the learning process, the benefits mentioned above can be achieved.

Some of the positive responses discussed above are the result of a classical analysis of student responses. However, not all students respond exactly the same. Interviews revealed differences in response levels between students with high, medium, and low levels of mathematical cognitive skills. Students with high cognitive skills tended to prefer learning using new learning materials. According to students with high cognitive skills, the material and math problems in the materials were easy to understand. However, the math problems initially seemed more difficult, but after rereading and reflecting, they turned out to be less challenging. In fact, one student with a high cognitive skill found some of the problems in the materials easier than those in the textbook. Furthermore, both

students with high cognitive skills found the questions in the materials more engaging and challenging than those in their previous textbooks. They stated that in addition to the greater variety of questions in the teaching materials, they were pleased that the questions allowed them to work in various ways and obtain correct answers. They were able to share these methods and answers with the researcher and their peers. Furthermore, they expressed their appreciation for the inclusion of several texts on local wisdom content. They mentioned that this was the first time they had been provided with mathematics teaching materials that included videos and interesting stories about the local wisdom of their region. Regarding the challenges they faced, students with a high cognitive level reported no significant obstacles during learning using the teaching materials.

Students with a medium cognitive level also tended to enjoy learning using the teaching materials. While students at a high cognitive level said their main preference was being able to work on the questions in various ways and obtain correct answers, those at a medium cognitive level preferred the inclusion of local wisdom content in the teaching materials and the broader opportunities for discussion. They found it particularly enjoyable when they and the researcher discussed Bangkalan's local wisdom. Furthermore, they also expressed their satisfaction with the discussion learning method and the discussion of answers within the group. They found this group discussion method made it easier for them to work through many of the problems in the teaching materials. They noted that sometimes their groupmates helped them better understand the problems so they could answer them. Students sometimes found it difficult to work through the math problems in the teaching materials on their own. However, when these problems were discussed, either in group discussions or with the researcher, they found it easy to understand and were willing to try other variations of the problems.

Students with low cognitive abilities also tended to enjoy learning using learning materials. Similar to those with medium cognitive abilities, they enjoyed the Bangkalan local wisdom content in the learning materials and the discussion sessions with their peers. Students at both cognitive levels were equally able to

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follow and understand the material well. However, students with low cognitive abilities tended to be more afraid to express their opinions during discussions or discussions with researchers. They believed that their peers were always quicker thinkers than they were, making them more passive and inclined to follow their peers' answers. Students with low cognitive abilities reported that they needed more time and more explanations to understand and answer questions. However, they still preferred learning using these learning materials compared to previous mathematics learning materials. Their main preference was the stories about Bangkalan local wisdom, which provided a brief "break" and prevented them from getting bored during math lessons. Based on the responses from the three cognitive levels above, it can be concluded that learning using teaching materials can increase students' interest and passion in mathematics. This is because the teaching materials use new concepts that have never been applied in previous teaching materials.

These teaching materials combine the advantages of open-ended learning with learning based on Bangkalan local wisdom. Providing space for students to explore various methods and correct answers tends to attract students with high cognitive levels. For students with medium and low cognitive levels, providing this opportunity also elicits a positive response and at least does not lead to despair, especially for students with low cognitive levels. This is still within reasonable and positive limits, because, as stated in Vygotsky's theory, when students are given material and assignments that are slightly above their developmental level but still within their reach, the learning process occurs. Students with high, medium, and low cognitive levels are all in this zone. This is evidenced by their statements that they are ultimately able to understand the material and provide solutions to the problems well. Even at the high cognitive level, they were more interested and challenged by these kinds of questions, although at the low cognitive level, they admitted they needed more time and more explanation to stimulate their thinking. Most importantly, however, the material and questions in the teaching materials didn't make students, from the high to the low cognitive levels, feel discouraged or reluctant to learn.

Their positive response to the discussion learning method indicates that learning using this teaching material can increase student interest and engagement. Furthermore, as mentioned in the previous paragraph, this discussion method offers several benefits for students. Another point is the interest of students, from high to low cognitive levels, in the content and reading texts and videos of local wisdom contained in the teaching material. This demonstrates that students have the potential for cultural literacy, and the development of this teaching material is the right solution to maximize this potential.

4. Conclusion

Based on the results of the research conducted, it can be concluded that the application of the Wordwall-assisted Problem-Based Learning model has a significant effect on improving the science learning outcomes of Grade IV students on the subject of 'Climate and Its Changes' at UPTD SDN Banyubunih 1. The application of this model is able to create a more active, interactive, and enjoyable learning process, making it easier for students to understand the concepts taught. The combination of a problem-based approach and the use of Wordwall digital media encourages students to think critically, collaborate, and be motivated in their learning activities. This is evident from the higher average learning outcome scores in the experimental class compared to the control class. Thus, the Wordwall-assisted Problem-Based Learning model can be used as an alternative innovative learning strategy to improve IPAS learning outcomes, especially for material that requires conceptual understanding and application in everyday life.

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