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Analysis of Students' Mathematical Literacy Skills after Participating in Differentiated Learning with the Outdoor Modeling Mathematics Model

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ABSTRACT

Students' mathematical literacy remains a persistent challenge across educational levels and continues to be a critical concern in mathematics education. This condition suggests that existing learning practices are largely dominated by conventional instructional approaches that do not adequately accommodate students' diverse learning needs and readiness levels. The study aimed to analyze the mathematical literacy abilities of Grade VII junior high school students after participating in differentiated outdoor mathematics learning on integer topics. A mixed-methods research design was employed. Quantitative data were collected from 25 students of Grade VII-B at SMP Negeri 17 Batanghari through the implementation of differentiated outdoor learning activities, supported by learning implementation observation sheets. Subsequently, qualitative data were gathered from six selected students to gain deeper insights into their mathematical literacy processes through analysis of test responses and semi-structured interviews. Mathematical literacy was assessed based on students' performance on literacy-oriented test items and interview data. The results indicated that overall student completion reached 44%, with 20% of students categorized as having high mathematical literacy, 52% moderate literacy, and 28% low literacy. Further analysis based on students' learning readiness showed that students with high readiness (S1KBT and S2KBT) achieved completion levels of 98.33% and 83.33%, respectively. Students with moderate readiness (S1KBS and S2KBS) attained 81.66% and 80%, while students with low readiness (S1KBR and S2KBR) reached 78.33% and 53.33%. These findings suggest that differentiated outdoor mathematics learning contributes to the development of students' mathematical literacy across varying levels of learning readiness.

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Introduction

In the world of mathematics education, there are various skills related to activities that require precision, logic, and analytical skills. All students must master these skills. Mathematics education involves various cognitive abilities that students must possess. According to Maulyda (2020) there are 5 basic mathematical abilities of NCTM including mathematical problem-solving ability, mathematical reasoning ability, mathematical communication ability, mathematical connection ability, and mathematical representation ability. In addition OECD (2023) conveyed that there are other mathematical abilities, namely mathematical literacy abilities, which are one of the mathematical abilities that all students must have. According to OECD (2023), several indicators of mathematical literacy abilities are: (1) Formulating problems mathematically; (2) Using mathematical concepts and procedures; (3) Interpreting and evaluating mathematical results, namely the individual's ability to interpret mathematical results into a real-world context and evaluate mathematical results.

Almost all mathematics materials require mathematical literacy skills, but the material taken for this initial mathematical ability test is integers. This material is one of the materials in Grade VII of Junior High School. Based on the results of observations conducted at SMP Negeri 17 Batanghari, in grade VII C there are still students who are lacking in mathematical literacy skills. It can be said that students' mathematical literacy skills are not yet good, this can be seen from the solution of story problems of comparison of value and inverse value in one of the students who have been tested.

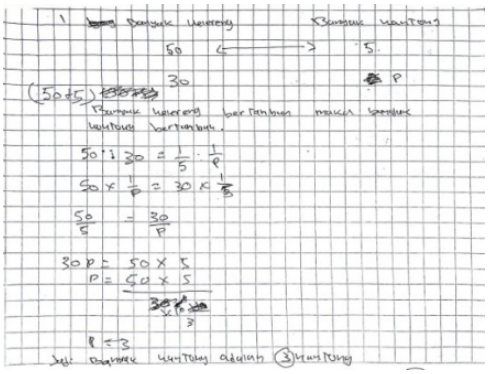

Figure1. Student Answer Results

Figure 1 shows that students' mathematical literacy skills are still classified as poor. This was observed in only 3.5% of students who completed the task. In this procedure, students first wrote down the concept of equivalent comparison. This was demonstrated by writing the formula for equivalent comparison. The students then connected the concept of equivalent comparison they knew to the information they had previously gathered, but they made a mistake in registering the information. As a result, the students obtained an inconsistent result.

The results of the initial ability test given by the researcher indicate that students' mathematical literacy skills need to be improved so they can solve mathematical problems with logical thinking. Students with low mathematical literacy skills often face difficulties when trying to solve mathematical problems. Several factors can influence students' low mathematical abilities, including the teacher, the students themselves, and the teaching methods applied. Based on the results of an interview with one of the 7th grade mathematics teachers at SMP Negeri 17 Batanghari, the school has implemented differentiated learning. However, there are still several shortcomings, one of which is the low mathematical literacy skills of students. The cause of students' still low mathematical literacy skills is a lack of understanding of

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formulating, applying, interpreting and solving mathematical problems related to prerequisite material, one of which is when operating equivalent comparisons and inverse values. When performing calculations in problem solving, there are still incorrect calculations so that the results obtained are not appropriate.

In line with the "Independent Learning" policy, which focuses on students, teachers must also consider the diverse characters and abilities of students in the classroom. To address this, one way to implement student-centered learning is through the implementation of differentiated learning. Differentiated learning is a series of learning efforts that address students' needs in terms of their learning readiness, learning profiles, and interests and talents (Aprima & Sari, 2022; Oktaviyanthi et al. 2021; Susilawati et al, 2020). This type of learning is expected to improve students' reasoning skills because they play an active role in constructing their own knowledge, thus also influencing the improvement of students' cognitive learning outcomes (Fitriani et al., 2023; Kristiani et al., 2021; Mariamah, et al., 2021). Based on the research results, the differentiated learning strategy used consists of content, process, product, and learning environment. The differentiation chosen in this study is based on the learning process and environment.

In this study, the differentiated learning used is based on learning readiness. Learning readiness needs to be considered in the learning process, because if students are ready to learn, their learning outcomes will be better. Furthermore, by understanding students' learning readiness in a class, teachers can provide varied learning and accommodate all students' needs (Rifqiyah & Nugraheni, 2023; Sofnidar et al, 2017). Differentiated learning based on readiness is learning tailored to the capacity to learn new material. A task that considers a student's level of readiness will take them out of their comfort zone (Hardani et al., 2020). However, with the right learning environment and adequate support, they can still master the new material. Understanding student readiness is a crucial concept in differentiated learning. For example, some students are ready to learn difficult material, while others require a long time to learn. If teachers have a good understanding of student readiness, they can link positive student thoughts about the new material to be taught and improve their potential in the learning process (Amin et al., 2023). Furthermore, if teachers understand students' readiness for a concept, they can introduce and implement the concept according to their needs, and create assignments that best suit their skills. To determine students' readiness for a concept, teachers need to conduct an assessment. Teachers can provide a brief pre-assessment to determine students' understanding of a topic and observe students completing a task or activity. Teachers can also ask about students' prior knowledge (Herwina, 2021).

One learning model that is suitable for differentiated learning in mathematics is Outdoor Modeling Mathematics. Outdoor Modeling Mathematics is a learning model that utilizes an environment outside the classroom (Taqwan, 2019; Utami et al, 2020). The use of this learning model aims to make students who are learning mathematics more interested and enthusiastic in learning mathematics, thereby improving learning outcomes. The uniqueness of the learning process using this method lies in its capability to be able to use various media found in the surrounding environment as demonstrations or means to acquire knowledge. This encourages students' ability to be more explorative and better able to improvise the knowledge they have previously acquired (Nafis & Zauri, 2021). The need for learning methods such as outdoor learning is a solution to monotonous learning that generally causes boredom in students (Zulfirman, 2022). The long learning process in the classroom with intense material reception, tends to be ineffective in increasing students' knowledge completely, at some point in the learning process, students will lose concentration and reduce their ability to focus on receiving the material. Outdoor learning prioritizes student creativity and initiative that hone students'

abilities independently, encouragement to think individually, will stimulate students' learning motivation evenly.

A common problem with indoor learning is the periodic boredom experienced by students, even when the material is well-delivered. If it isn't accompanied by icebreakers or moments to break the monotony, the effectiveness of the learning process becomes questionable. In outdoor learning, with the change in learning atmosphere, which is relaxed, flexible, and more inclined towards student creativity, the tendency for increased student enthusiasm is higher compared to learning methods that are entirely implemented in the classroom (Nurjanatin et al., 2017 ; Silitonga et al., 2022). The outdoor learning method is considered a creative and innovative learning method, and has the potential to be more effective than indoor learning, there are several advantages of this method. The advantages of the outdoor learning method are considered to support enthusiasm or in other words increase student motivation to be more active in the learning process. However, in the process, this learning method also has several disadvantages that have the potential to provide the opposite results from the expected positive potential. Excessive distractions from other students, or other objects and activities that can reduce student focus, to maximize learning outcomes using this method requires a good and comprehensive combination of media, and learning materials to be delivered, this will be more effective than only applying the outdoor learning method with the desire to change the learning atmosphere (Kurniawati et al., 2021). The importance of learning methods cannot ignore other aspects such as teaching materials, learning environments, and external factors on students and educators to achieve maximum results, but as an effort, learning methods are the first step in improving student learning outcomes.

Method

Types and Design of Research

This research uses a mixed methods approach. This mixed methods research is implemented by combining quantitative and qualitative research methods. The type of mixed research used in this study uses an explanatory sequential design strategy. The research procedure for this research design involves two steps: the researcher collects and analyzes quantitative data in the initial stage, followed by the collection and analysis of qualitative data in the second stage. This technique is used by the researcher because various forms of research complement and support each other, resulting in research results that are organized, in-depth, and factual.

Population and Sample

Quantitative research was conducted on 25 students of class VII B at SMP Negeri 17 Batanghari who had studied integers. This class was selected purposively based on the recommendation of the mathematics teacher at SMP Negeri 17 Batanghari, then continued with qualitative research to see the students' mathematical literacy abilities with 6 subjects, namely 2 students with high learning readiness, 2 students with medium learning readiness, and 2 students with low learning readiness.

Instrument

This study used instruments in the form of initial mathematical ability tests, observation sheets for the implementation of differentiated learning activities with the outdoor modeling

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mathematics model to see students' mathematical literacy abilities during the learning process by observing the subjects, mathematical literacy ability test questions in the form of descriptive questions with a learning environment that is close to the students' environment because it adapts to the learning model used, while the objects in this question are the school yard, school canteen and school garden. These questions are also adjusted to learning objectives and can measure students' mathematical literacy abilities and interview sheets that are in accordance with the indicators of mathematical literacy abilities. Before being used, the instrument was validated by an instrument expert first to obtain an instrument that is appropriate to the research needs. The results of the validation of the research instrument can be seen in Table 1 using the formula:

$$\frac{\text{total score obtained}}{\text{maximum score}} \times 100\%$$

Table1. Research Instrument Validation Results

Instrument	Total scores obtained	Maximum score	Validity percentage	Criteria
Initial mathematical ability test	57	60	95	Very valid
Observation sheet for the implementation of teacher activities	28	30	93.3	Very valid
Observation sheet for student activity implementation	28	30	93.3	Very valid
Mathematical literacy test questions	58	60	96.7	Very valid
Interview sheet	19	20	95	Very valid

The results of the mathematical literacy test are assessed based on mathematical literacy indicators. Both questions can be answered by applying the mathematical literacy indicators.

Table2. Mathematical Literacy Ability Indicators

No.	Mathematical Literacy Ability Indicators
1.	Formulate the problem mathematically
2.	Using mathematical concepts, facts, and procedures
3.	Interpreting and evaluating mathematical results

The mathematical literacy test was administered after conducting differentiated learning with the outdoor modeling mathematics model on integer material for seventh grade junior high school students. The aim was to determine students' mathematical literacy skills after the learning. Table 3 shows the grid for the students' mathematical literacy skills test.

Table3. Grid of Students' Mathematical Literacy Skills

Learning objectives	Mathematical Literacy Indicators	Question Number	Example of Instrument in the question
A.1. Reading and writing positive and negative integers	1	1a	1a. Write down what is known and what is asked in the problem mathematically! 1b. Arrange all temperatures from lowest to highest!
A.2. Comparing positive and negative integers	2 3	1b, 1c 1f	1c. Which part has the lowest temperature and which part has the highest! 1f. To keep frozen food fresh in the freezer, the temperature must be below -15 degrees Celsius. In the story problem above, does the freezer meet the required temperature? Explain! 1d. What is the total temperature inside the refrigerator? 1e. What is the difference between the temperature outside the refrigerator and the temperature in the freezer?
A.3. Using addition and subtraction operations of integers in everyday contexts	2	1d, 1e	2a. Budi is at point 0 on the number line, then Budi will make a jump, where one jump is 3 steps. If Budi faces left and makes 4 jumps, where is Budi's position now? 2b. Nida is at point 12 on the number line and wants to go back to point 0. If she faces left and jumps forward 4 times she will get to point 0 on the number line, with the same steps for each jump. How many steps does Nida take in one jump? Explain!
A.4. Using multiplication and division of integers in everyday contexts	1 2 3	2a, 2b	

Data collection

To determine students' mathematical literacy abilities after validating the instrument. First, students were given an initial mathematical ability test to identify student groupings based on learning readiness. Second, during the learning process, observations were made by observers to assess the implementation of teacher and student activities. Third, students were given mathematical literacy ability test questions in the form of essays for all class VII B students of SMP Negeri 17 Batanghari. Fourth, six students were interviewed, two representing each learning readiness group. After the data was collected, the validity of the data was checked using expert triangulation, source triangulation, technical triangulation, time triangulation, and using reference materials.

Data analysis

In this study, the data to be analyzed is a diagnostic test at the beginning before learning to group students based on their readiness in learning. And the results of this grouping are used for differentiated learning carried out based on student readiness, then carrying out treatment, namely differentiated learning with the outdoor modeling mathematics model after that, analyzing students' mathematical literacy abilities. Next, an interview sheet to see students'

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mathematical literacy abilities in the learning process will be supported by an observation sheet of the implementation of student activities in learning. The analytical approach applied in this research refers to credibility testing and through source triangulation techniques. The validity of information is maintained by compiling data from various sources that have different learning readiness characteristics, namely high, medium, and low. Next, technical triangulation is testing the credibility of the data with various data collection techniques, based on the results of the mathematical literacy ability test, observation sheets of the implementation of teacher and student activities, and interview sheets conducted with the subjects. Next, time triangulation is when there is a discrepancy in data from the test results and interviews then to find a credible answer, the implementation observation sheet is used to find a solution.

Research Findings

In the research to analyze and describe the Mathematical Literacy Abilities of Grade VII Junior High School Students after Participating in Differentiated Learning with the Outdoor Modeling Mathematics Model on Integer Material. In this case, to determine the mathematical literacy abilities of students can be seen from the analysis of the results of the answers to the questions given and strengthened by interviews with the subjects and observation sheets of the implementation of activities in the learning process. To facilitate the analysis process, the following is the coding of the 6 subjects:

Table 4. Coding of Research Subjects

Codes		Descriptions
S1KBT	:	Subject 1 in Differentiated Learning Based on High Learning Readiness
S2KBT	:	Subject 2 in Differentiated Learning Based on High Learning Readiness
S1KBS	:	Subject 1 in Differentiated Learning Based on Medium Learning Readiness
S2KBS	:	Subject 2 in Differentiated Learning Based on Medium Learning Readiness
S1KBR	:	Subject 1 in Differentiated Learning Based on Low Learning Readiness
S1KBR	:	Subject 2 in Differentiated Learning Based on Low Learning Readiness

The data obtained from the pre-test and post-test results are as follows:

Table 5. Pre-test Result Data

No.	Name	Question Number 1			Question Number 2			Question Number 3			Question Number 4			MARK
		KLM 1	KLM 2	KLM 3	KLM 1	KLM 2	KLM 3	KLM 1	KLM 2	KLM 3	KLM 1	KLM 2	KLM 3	
1.	ZKA	10	10	5	10	10	5	10	10	5	10	5	5	95
2.	CAA	10	10	5	10	5	5	5	5	5	5	10	5	80
3.	RA	10	5	5	10	5	5	10	5	5	5	5	5	75
4.	RA	10	5	5	10	5	5	10	5	5	5	5	5	75
5.	CSF	5	5	5	5	5	5	5	5	5	5	5	5	60
6.	CE	5	5	0	5	5	5	5	5	5	5	5	0	50

Table 6. Post-test Result Data

No	Name	Question Number 1										Question Number 2					MARK
		1.a	1.b	1.c	1.d		1.e		1.f			2.a			2.b		
		KLM 1	KLM 2	KLM 2	KLM 2	KLM 3	KLM 2	KLM 3	KLM 2	KLM 3	KLM 1	KLM 2	KLM 3	KLM 1	KLM 2	KLM 3	
1.	S1KBT	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	98
2.	S2KBT	4	3	4	4	4	4	0	4	3	4	4	0	4	4	4	83
3.	S1KBS	4	3	4	4	0	4	0	4	4	4	3	4	4	3	4	81
4.	S2KBS	4	4	4	4	4	4	4	4	4	0	4	0	0	4	4	80
5.	S1KBR	2	3	4	4	4	4	4	4	2	4	4	0	4	4	0	78
6.	S2KBR	2	3	4	3	0	4	0	4	4	0	4	0	0	4	0	53

Furthermore, data collection for this study was conducted at SMP Negeri 17 Batanghari during the odd semester of the 2025/2026 academic year. The research subjects were selected based on high, medium, and low learning readiness. The following is a breakdown of mathematical literacy skills based on students' learning readiness levels.

Students' mathematical literacy abilities after participating in differentiated learning with the outdoor modeling mathematics model based on high learning readiness.

In the mathematical literacy indicator, namely formulating problems mathematically, S1KBT is able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. Meanwhile, S2KBT is also able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. This can be seen from the following student answer sheets:

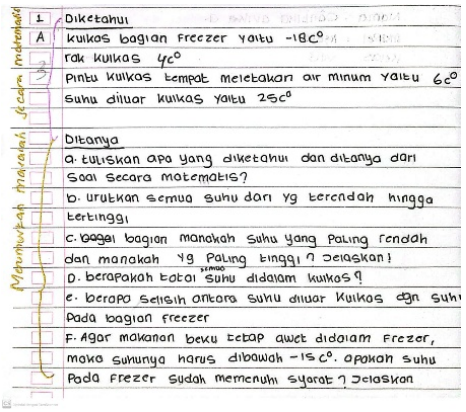

Figure2. High Ability Answer Sheet

So it can be concluded that by using the outdoor modeling mathematics model, the subject is able to have mathematical literacy skills in the indicator of formulating problems mathematically. In the indicator of using mathematical concepts and procedures, S1KBT is able to apply mathematical concepts and procedures to solve problems. Similarly, S2KBT is also able to apply mathematical concepts and procedures to solve problems.

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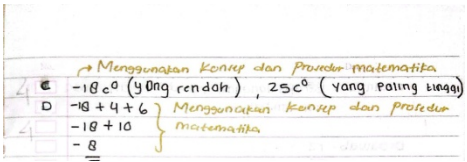

Figure3. High Ability Student Answer Sheet

So it can be concluded that by using the outdoor modeling mathematics model, the subjects are able to use mathematical concepts and procedures in the indicators of students' mathematical literacy abilities. In the indicator of interpreting and evaluating mathematical results, S1KBT and S2KBT are able to write conclusions from given problems. At this stage, S1KBT and S2KBT have fulfilled the mathematical literacy ability indicator, namely interpreting and evaluating mathematical results. This can be seen in the S1KBT and S2KBT answer sheets below:

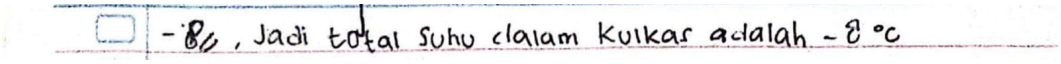

Figure 4. High Ability Student Answer Sheet

So it can be concluded that by using the outdoor modeling mathematics model, S1KBT and S2KBT are able to fulfill the indicators of mathematical literacy abilities, namely interpreting and evaluating mathematical results.

Students' mathematical literacy abilities after differentiated learning with the outdoor modeling mathematics model based on moderate learning readiness.

The subjects included in this mathematical literacy ability are S1KBS and S2KBS. The mathematical problem formulation indicator shows that S1KBS is able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. Similarly, S2KBS is able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. This can be seen in the answer sheets provided by the students below:

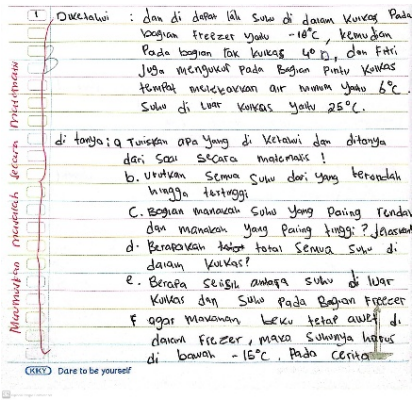

Figure 5. Answer Sheet for Medium Ability Students

So it can be concluded that by using the outdoor modeling mathematics model, S1KBS and S2KBS are able to improve mathematical literacy skills in the indicator of formulating problems mathematically. The indicator for using mathematical concepts and procedures shows that S1KBS is capable of using mathematical concepts and procedures. Likewise, S2KBS is

also capable of using mathematical concepts and procedures. As seen in the following student answer sheet:

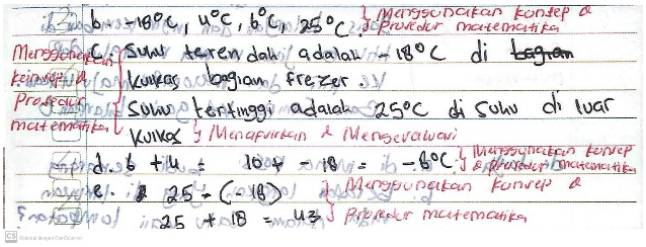

Figure 6. Answer Sheet for Medium Ability Students

So it can be concluded that by using the outdoor modeling mathematics model, S1KBS and S2KBS are able to improve mathematical literacy skills in the indicators of using mathematical concepts and procedures. In the indicator of interpreting and evaluating mathematical results, S1KBS and S2KBS students were not able to interpret and evaluate mathematical results properly and correctly from the given problems. This is because the S1KBS and S2KBS answer sheets do not include answers regarding interpreting and evaluating mathematical results from the problems. However, after interviews, S1KBS and S2KBS students were able to explain the conclusions of the problems in detail. The following is an excerpt from the interviews conducted with students:

Researcher: "What is the final conclusion from solving this problem?"
Student: "The conclusion is that Budi's position is at point -12 on the number line, sis."
Researcher: "How are the results of the problem useful or related to existing problems or real contexts?"
Student: "We can understand the operation of multiplying integers easily."

So it can be concluded that S1KBS and S2KBS fulfill the indicators of mathematical literacy skills, namely interpreting and evaluating mathematical results.

Students' mathematical literacy abilities after differentiated learning with the outdoor modeling mathematics model based on low learning readiness.

The subjects included in this mathematical literacy ability are S1KBR and S2KBR. In the mathematical problem formulation indicator, it is clear that S1KBR is able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. Likewise, S2KBR is able to provide information on what is known and what is being asked, and can simplify what is known based on the information in the problem. This can be seen in the answer sheets provided by the students below:

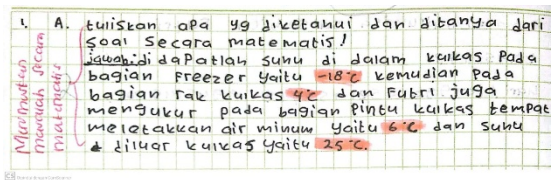

Figure 7. Low Ability Student Answer Sheet

So it can be concluded that by using the outdoor modeling mathematics model, S1KBR and S2KBR are able to improve their mathematical literacy skills in the indicator of formulating problems mathematically. The indicator for using mathematical concepts and procedures shows

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that S1KBR is capable of using mathematical concepts and procedures. Likewise, S2KBR is also capable of using mathematical concepts and procedures. As seen in the following student answer sheets:

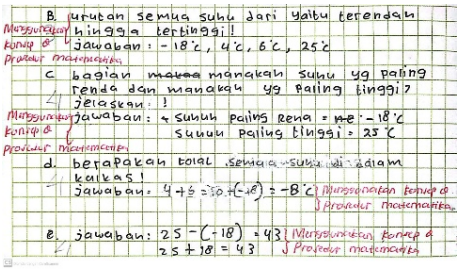

Figure 8. Low Ability Student Answer Sheet

So it can be concluded that by using the outdoor modeling mathematics model, S1KBR and S2KBR are able to improve their mathematical literacy skills in the indicators of using mathematical concepts and procedures. In the indicator of interpreting and evaluating mathematical results, S1KBR and S2KBR students were unable to interpret and evaluate mathematical results correctly from the given problems. This is because the S1KBR and S2KBR answer sheets did not include answers regarding interpreting and evaluating mathematical results from the problems. This can be seen in the following excerpt from interviews conducted with students:

Researcher: "What does the answer you got in this question mean?"
Student: "I don't know, because I don't understand."
Researcher: "What is the final conclusion from solving this problem?"
Student: "I don't know ma'am, I didn't draw any conclusions on that question."

Therefore, it can be concluded that S1KBR and S2KBR have not been able to fulfill the indicators of mathematical literacy skills, namely interpreting and evaluating mathematical results.

Discussion

The results of the study indicate that the mathematical literacy skills of seventh-grade junior high school students improved after participating in differentiated learning using the outdoor modeling mathematics model on integers. This improvement can be explained by the characteristics of differentiated learning, which provides space for students to learn according to their individual levels of readiness. This finding also aligns with previous research, which states that understanding student learning readiness is a concept in differentiated learning (Herwina, 2021; Ridzkiyah & Effendi, 2021). Readiness to learn is a condition in a person or student that enables them to learn. Readiness to learn enables students to learn effectively in class. Students will be more active in responding to the learning process if they are physically, mentally, and materially prepared. Student motivation to learn will also be affected if all aspects of the learning process are already prepared within the student (Harefa et al., 2023; Purba et al., 2021). Furthermore, the use of outdoor modeling mathematics has been proven to enrich students' learning experiences through contextual activities outside the classroom (Fazzilah et al., 2021). The concrete activity of measuring temperature and relating it to integer representations encourages students to develop mathematical literacy skills, particularly in the aspects of formulating, using, and interpreting mathematics in various contexts (Lestari & Effendi, 2022; Ismawati, & Yuliastuti, 2024). Thus, the results of this study confirm that

students' mathematical literacy can be improved through adaptive and contextual learning designs. The novelty of this study lies in the application of integration between differentiated learning and the outdoor modeling mathematics model on integer material at the junior high school level, something that has not been widely done in previous research. This integration results in learning that emphasizes not only conceptual understanding but also students' skills in applying mathematics to real-world contexts, while accommodating the diversity of student abilities within a class.

Conclusion

Based on the results of the research and discussion, it can be concluded that the mathematical literacy ability of seventh grade junior high school students after participating in differentiated learning with the outdoor modeling mathematics model of integer material with the number of students who completed the overall number of students is 44% and students who did not complete the overall is 56%, with 20% categorized as having high mathematical literacy abilities, 52% categorized as having moderate mathematical literacy abilities and 28% categorized as having low mathematical literacy abilities. The mathematical literacy ability of seventh grade junior high school students based on the level of ability after participating in differentiated learning, namely high learning readiness (S1KBT and S2KBT) on integer material as a whole obtained 98.33% and 83.33% were in the high category of mathematical literacy abilities. S1KBS and S2KBS on integer material as a whole obtained 81.66% and 80% were in the moderate mathematical literacy abilities. Overall, S1KBR and S2KBR obtained 78.33% and 53.33% marks for integers, respectively. This indicates that S1KBR and S2KBR have low mathematical literacy skills. Differentiated learning with outdoor mathematical modeling model based on learning readiness can improve the mathematical literacy ability on integer material. Differentiated learning with outdoor mathematical modeling model based on learning readiness on integer material can improve indicators of formulating problems mathematically, using mathematical concepts and procedures, interpreting and evaluating mathematical results. Differentiated learning with outdoor mathematical modeling model based on learning readiness can be used as a basis for developing more effective learning strategies in improving students' mathematical literacy ability on integer material.

Conflict of Interest

The author declares no conflict of interest.

Authors' Contributions

The main author, N.N.H., understood the concept of the research presented and was responsible for data collection, theory development, and actively participated in theory development, methodology, organization, and data analysis. The second author, S., actively participated in theory development, discussion of research results, approval of the final version of the work, data collection and data analysis. The third author, K.A., actively participated in theory development, discussion of research results, approval of the final version of the paper, data collection, and data analysis. All authors declare that the final version of this paper has been read and approved. The total percentage of contributions to the conceptualization, preparation, and correction of this paper is as follows: N.N.H.: 60%, S.: 20%, KA: 20%..

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Data Availability Statement

The authors declare that data sharing is not possible, as no new data was created or analyzed in this study.

References

Amin, NF, Garancang, S., & Abunawas, K. (2023). General concepts of population and sample in research. Pilar, 14(1), 15–31. https://doi.org/10.26618/whw41w62

Aprima, D., & Sari, S. (2022). Analysis of the Application of Differentiated Learning in the Implementation of the Independent Curriculum in Elementary School Mathematics Lessons. Cendikia: Media Scientific Journal of Education, 13 (1)(1), 95–101. http://dx.doi.org/10.17977/um009v32i12023p1-14

Dian Fitriani, Fatihatunnisa Ridha Rahman, Anti Dhamayanti Fauzi, Anisa Umu Salamah, & Asep Saefullah. (2023). Implementation of Differentiated Learning Based on Students' Learning Readiness Aspects in Senior High Schools. Genta Mulia Journal, 14(2), 1–12. https://doi.org/10.61290/gm.v14i2.358

Dwi Lestari, R., & Nia Sania Effendi, K. (2022). Analysis of Junior High School Students' Mathematical Literacy Skills on Plane Shapes. Biormatika: Scientific Journal of the Faculty of Teacher Training and Education, 8(1), 63–73. http://ejournal.unsub.ac.id/index.php/FKIP

Fazzilah, E., Effendi, KNS, & Marlina, R. (2020). Analysis of Student Errors in Solving PISA Problems with Uncertainty Content and Data. Jurnal Cendekia: Jurnal Pendidikan Matematika, 4(2), 1034–1043. https://doi.org/10.31004/cendekia.v4i2.306

Harahap, SS, Elindra, R., & Ardiana, N. (2021). Analysis of Students' Creative Thinking Skills in Solving Mathematics Problems for Class X TKJ Students of Harapan Private Vocational School. MathEdu Journal (Mathematic Education Journal), 4(3), 348–355. https://doi.org/10.37081/mathedu.v4i3.2552

Hardani, Helmina Andriani, JU, Utami, EF, Istiqomah, RR, Fardani, RA, Sukmana, DJ, & Auliya, NH (2020). Qualitative Research Methods Book. In Revista Brasileira de Linguística Aplicada (Vol. 5, Issue 1).

Harefa, A.D., Lase, S., & Zega, Y. (2023). The Relationship Between Mathematics Anxiety and Mathematical Literacy Ability and Student Learning Outcomes. Educativo: Journal of Education, 2(1), 144–151. https://doi.org/10.56248/educativo.v2i1.96

Herwina, W. (2021). Optimizing Student Needs and Learning Outcomes with Differentiated Learning. Perspectives on Educational Sciences, 35(2), 175–182. https://doi.org/10.21009/pip.352.10

Ismawati, & Yuliastuti, R. (2024). Analysis of Students' Ability to Solve Higher Order Thinking Skills (HOTS) Type Mathematics Problems. DEWANTARA Education Journal: Media for Communication, Creation, and Scientific Innovation in Education, 10(1), 18–22. https://doi.org/10.55933/jpd.v10i1.643

Kristiani, H., Susanti, E.I., Purnamasari, N., Purba, M., Saad, M.Y., & Anggaeni, A. (2021). Differentiated Learning Development Model. Center for Curriculum and Learning, Agency for Standards, Curriculum, and Educational Assessment, Ministry of Education, Culture, Research, and Technology. https://doi.org/10.26811/didaktika.v8i1.1301

Kurniawati, I., Purwati, & Mardiana, T. (2021). The Effect of Media-Assisted Outdoor Learning Methods. Borobudur Educational Review, 1(1), 30–41. https://doi.org/10.31603/bedr.4792

Mariamah, S., Yusri Bachtiar, M., & Indrawati. (2021). Implementation of Project-Based

Learning to Improve Collaborative Skills in Early Childhood. Educational Professions, 2(1), 125–130. https://ojs.unm.ac.id/JPK/article/view/27494

Maulyda, MA (2020). NCTM-Based Mathematics Learning Paradigm (Issue January).

Nafis, IA, & Zauri. (2023). Analysis of the Mathematical Literacy Ability of Grade X Students of Sman 1 Bantarkawung in Solving PISA-Oriented Problems Reviewed from Logical-Mathematical Intelligence and Cognitive Style. Journal of Research, Education, and Learning, 18(5), 1–13. https://jim.unisma.ac.id/index.php/jp3/article/view/19836/14787

Nurjanatin, I., Sugondo, G., & Manurung, MMH (2017). Analysis of Students' Errors in Solving Story Problems on the Surface Area of Cuboids in Class VIII–F Semester II of SMP Negeri 2 Jayapura. Scientific Journal of Mathematics and Its Learning, 2(1), 22–31. https://ejournal.uncen.ac.id/index.php/JIMP/article/view/252

OECD. (2023). PISA 2022 Assessment and Analytical Framework: Science, Reading, Mathematics and Global Competence. https://www.oecd.org/oecd/reports

Oktaviyanthi, R., Agus, RN, & Supriani, Y. (2017). PISA Mathematics Framework in Exploring Student Mathematical Literacy Skills. INA-Rxiv, November 2017, 77–85. https://doi.org/10.31227/osf.io/z2qsf

Purba, M., Purnamasari, N., Soetantyo, S., Suwarma, IR, & Susanti, EI (2021). Principles of Differentiated Instruction Development in a Flexible Curriculum as a Manifestation of Independent Learning. Jakarta: Agency for Educational Standards, Curriculum, and Assessment, Ministry of Education, Culture, Research, and Technology.

Ridzkiyah & Effendi. (2021). Nur Ridzkiyah 1), Kiki Nia Sania Effendi 2). Scientific Journal of Mathematics Education, 6(1), 1–13. https://doi.org/10.26877/jipmat.v6i1.8237

Rifqiyah, F., & Nugraheni, N. (2023). Analysis of Student Learning Readiness to Fulfill the Achievements of the Independent Curriculum with Differentiated Learning. Journal of Elementary Education Research (JRPD), 4(2), 145. https://doi.org/10.30595/jrpd.v4i2.16052

Silitonga, TAH, Purba, N., & Siahaan, TM (2022). The Effect of Outdoor Learning Methods on Students' Thematic Learning Outcomes in Subtheme 3 "Loving Plants" in Grade III of SD Negeri 122347 Pematangsiantar. Journal of Education and Counseling, 4(6), 1978–1988. https://journal.universitaspahlawan.ac.id/index.php/jpdk%0APengaruh

Sofnidar, Kamid, & Anwar, K. (2017). Syntax design of outdoor learning model based on modeling mathematics. Edumatica: Journal of Mathematics Education, 7(2), 1–10. https://doi.org/10.22437/edumatica.v7i02.4211

Susilawati, S., Pujiastuti, H., & Sukirwan, S. (2020). Analysis of Mathematical Creative Thinking Ability Reviewed from Students' Mathematical Self-Concept. Jurnal Cendekia: Jurnal Pendidikan Matematika, 4(2), 512–525. https://doi.org/10.31004/cendekia.v4i2.244

Taqwan, B. (2019). The Effect of Outdoor Learning on the Problem-Solving Skills of Grade VII Students of SMP Negeri 05 Seluma. Raflesia Journal of Mathematics Education, 4(1), 10–18. https://doi.org/10.33449/jpmr.v4i1.7524

Utami, N., Sukestiyarno, YL, & Hidayah, I. (2020). Literacy Skills in Solving Story Problems of Grade IX Students A. Prisma, Proceedings of the National Mathematics Seminar, 3, 626–633. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/37679

Zulfirman, R. (2022). Implementation of the outdoor learning method to improve student learning outcomes in Islamic Religion subjects at MAN 1 Medan. Journal of Research, Education and Teaching: JPPP, 3(2), 147–153. https://doi.org/10.30596/jppp.v3i2.11758

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