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Increasing Science Literacy through Make a Match Learning Media on Human Growth Materials in Class V of Elementary School

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Abstract: This study aims to evaluate the influence of the Make a Match learning method on the science literacy ability of grade V elementary school students. This method is compared to conventional learning approaches in improving students' understanding of science materials. The research method used is an experiment using the Rasch Model to analyze the difficulty level of pretest and posttest questions. The results showed that there was a significant improvement in the science literacy ability of students in the experimental class who used the Make a Match method compared to the control class. However, there are several questions that are still considered difficult by students in both groups. This finding highlights the need to adjust learning strategies to overcome these difficulties to improve students' understanding of science literacy.

Keywords: Conventional learning; Elementary school; Make a match method; Rasch model; Science literacy

Introduction

Education is a fundamental element in the formation of a person's character and knowledge, and plays an important role in preparing the young generation to face future challenges (Carl et al., 2016; Hagermoser-Sanetti & Collier-Meek, 2019). At the elementary school level, education has a very important role because it is in this phase that the basics of knowledge and skills are formed. One of the important aspects of basic education is the development of science literacy, which includes an understanding of scientific concepts, critical thinking skills, and the application of science in daily life. In this era of globalization, the development of science and technology is getting more rapid, so that science literacy skills are becoming more and more crucial. Science literacy is not only the ability to understand scientific concepts, but also includes the ability to think critically, solve problems, and make decisions based on accurate information. Therefore, science education in elementary schools must be designed in such a way as to equip students with these abilities. However, various studies show that student science literacy in Indonesia is still relatively low. Data from the Programme for International Student Assessment (PISA) shows that the science literacy of Indonesian students is still below the average of OECD countries (OECD, 2018). This shows that there needs to be efforts to improve the quality of science learning in elementary schools. One of the efforts that can be made is to use innovative and interactive learning media.

Learning media is one of the important components in the teaching and learning process. The use of appropriate learning media can help students understand abstract concepts to be more concrete, increase interest in learning, and make it easier to achieve learning goals. One of the learning media that can be used is the Make a Match method. Make a Match is one of the cooperative learning methods that involves matching cards that contain questions and answers (Aranzabal et al., 2022; Lee et al., 2015; Sukmawati et al., 2021b).

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This method is designed to increase student involvement in the learning process, facilitate cooperation between students, and develop critical thinking and problem-solving skills. Make a Match can also make the learning process more fun and challenging, so that it can increase students' motivation to learn. In the context of science learning in elementary schools, especially in human growth materials, the use of the Make a Match method is expected to help students understand the basic concepts of human growth better. Human growth is one of the important topics in the elementary school science curriculum that covers various aspects, such as physical and mental changes during growth, factors that affect growth, as well as the importance of maintaining health. Through the activity of matching cards containing information about human growth, students are expected to develop their science literacy skills. They not only learn to identify and understand scientific concepts, but also learn how to connect the information and apply it in the context of daily life (Fauziah et al., 2023; Sukmawati et al., 2021). This study aims to evaluate the effectiveness of the use of Make a Match learning media on human growth materials on the improvement of science literacy of grade V elementary school students. In particular, this study aims to answer questions related to the influence of the use of the Make a Match method on the understanding of the concept of human growth.

Method

This study uses a quasi-experimental design with a quantitative approach, aiming to evaluate the effectiveness of Make a Match learning media on human growth materials on improving science literacy of grade V elementary school students. The subject of the study was 120 grade V students from four elementary schools in the city of Jakarta who were randomly selected. The students were divided into two groups: the experimental group and the control group, each consisting of 30 students. The research procedure begins with the preparation of a learning plan that uses the Make a Match method for the experimental group and the conventional learning plan for the control group. Research instruments in the form of science literacy tests and learning motivation questionnaires were also prepared. Furthermore, learning was carried out during two meetings for each group. The experimental group used the Make a Match method, while the control group used the conventional method. Data were collected through science literacy tests and learning motivation questionnaires given before and after treatment. The research instruments include a science literacy test consisting of 30 multiple-choice questions, measuring science literacy skills.

The data obtained was analyzed using the Rasch, Stacking, and Racking Models. The Rasch model is used to evaluate the validity and reliability of science literacy test instruments, estimate the parameters of student ability and item difficulty, and check the suitability of the items. The analysis is performed with software such as Winsteps or the Rasch Unidimensional Measurement Model (Aisyah et al., 2023; Ramadhani, 2022; Sukmawati, 2020). Stacking, as a statistical analysis technique to obtain a more accurate estimate of the influence of the Make a Match method on science literacy. Racking is used to evaluate the effectiveness of the instrument by measuring the level of success of the questions worked on before and after learning in the experimental and control classes. The data analysis process begins with initial data processing to check the completeness and consistency of the data, as well as statistical descriptive to provide an overview of the data distribution. Furthermore, Rasch analysis was carried out to estimate the parameters of students' abilities and item difficulties and check the suitability of the model (Laliyo et al., 2022; Sumintono, 2018). The results of this data analysis are expected to provide comprehensive information about the effectiveness of the Make a Match method in improving students' science literacy. In particular, this study is expected to show a significant improvement in the science literacy ability of students who use the Make a Match method compared to the conventional method. See figure 1.

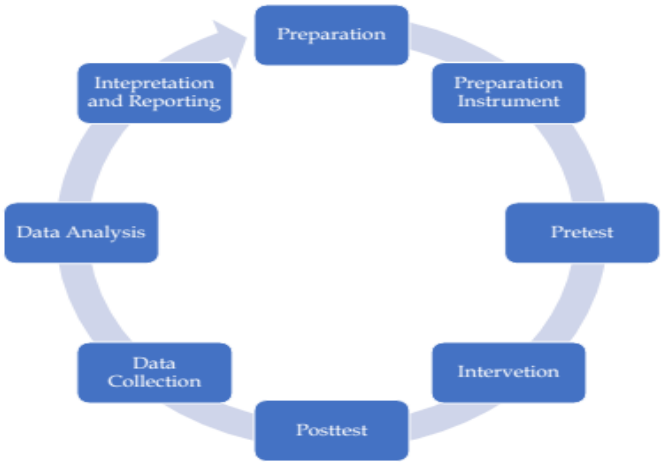

Figure 1. Research procedure

Result and Discussion

This study aims to evaluate the effectiveness of Make a Match learning media on human growth materials on the improvement of science literacy of grade V elementary school students. For this reason, data from the control group and the experimental group were analyzed. The following are the results of data analysis from both groups based on pretest and posttest,

which were measured using the Rasch Model. Data from the control group showed that the average pretest score was 1.112 with a standard deviation of 0.7789069, while the average posttest score increased to 1.667 with a standard deviation of 0.6025166. In the control group, some students showed a significant improvement in their scores after being given conventional treatment, but the improvement was uneven among all students. For example, subject 6 showed an increase from 2.1 on the pretest to 2.78 on the posttest with a standard error of 0.53 and 0.65, respectively, which showed a significant improvement in his science literacy. However, there were also subjects who showed a lower improvement or even a decrease in scores, such as 19 subjects who showed an increase from -0.3 in the pretest to 0.97 in the posttest. On the other hand, data from the experimental group showed a more consistent and significant improvement. The average pretest score in the experimental group was 1.057 with a standard deviation of 0.7434431, while the average posttest score increased to 2.073 with a standard deviation of 0.6876554. These results show that the use of the Make a Match method is more effective in improving students' science literacy (Ifdaniyah et al., 2024; Istiqomah et al., 2023; Sukmawati, 2023). Subject 12, for example, showed a very significant improvement from 2.22 on the pretest to 3.82 on the posttest with a standard error of 0.57 and 1.04 respectively. A similar increase was also observed in 23 subjects, which increased from 2.58 in the pretest to 3.82 in the posttest. In comparison, the experimental group showed a higher and consistent improvement in science literacy compared to the control group. The average increase in scores from pretest to posttest in the experimental group was 1.0166667, higher than the increase in the control group which was only 0.5553333. In addition, the standard deviation in the posttest in the experimental group (0.6876554) was lower compared to the control group (0.6025166), which showed that the improvement of science literacy was more evenly distributed in the experimental group.

Table 1. Stacking of Control Classes

Subject	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	0.24	0.42	0.97	0.44
2	0.42	0.42	0.97	0.44
3	1.17	0.45	1.37	0.46
4	0.79	0.43	1.17	0.45
5	0.6	0.43	1.83	0.5
6	2.1	0.53	2.78	0.65
7	0.97	0.44	1.59	0.48
8	-0.11	0.43	1.37	0.46
9	-0.11	0.43	0.6	0.43
10	1.83	0.5	2.41	0.58
11	0.24	0.42	0.97	0.44
12	1.83	0.5	2.41	0.58
13	1.17	0.45	1.59	0.48
14	2.1	0.53	2.1	0.53
15	0.97	0.44	1.37	0.46
16	0.6	0.43	1.83	0.5
17	1.59	0.48	2.1	0.53
18	0.97	0.44	1.37	0.46
19	-0.3	0.43	0.97	0.44
20	2.41	0.58	2.78	0.65
21	1.17	0.45	1.59	0.48
22	0.97	0.44	1.17	0.45
23	1.17	0.45	1.59	0.48
24	0.6	0.43	1.59	0.48
25	0.97	0.44	1.59	0.48
26	2.41	0.58	2.41	0.58
27	1.17	0.45	1.37	0.46
28	0.6	0.43	0.97	0.44
29	2.41	0.58	2.78	0.65
30	2.41	0.58	2.41	0.58
Mean	1.112		1.6673333	
S.D.	0.7789069		0.6025166	

Table 2. Stacking of Experimental Classes

Person	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	1.45	0.47	2.22	0.57
2	-0.14	0.41	1.04	0.43
3	0.69	0.42	1.93	0.52
4	0.02	0.4	1.04	0.43
5	1.24	0.45	1.67	0.49
6	1.67	0.49	2.58	0.64
7	-0.47	0.41	1.67	0.49
8	1.04	0.43	2.22	0.57
9	0.52	0.41	1.24	0.45
10	1.24	0.45	1.67	0.49
11	2.58	0.64	3.06	0.76
12	2.22	0.57	3.82	1.04
13	1.45	0.47	2.22	0.57
14	1.04	0.43	1.93	0.52
15	0.52	0.41	2.22	0.57
16	1.45	0.47	1.67	0.49
17	0.52	0.41	1.93	0.52
18	0.86	0.42	1.93	0.52
19	1.04	0.43	1.67	0.49
20	0.52	0.41	1.24	0.45
21	1.45	0.47	2.58	0.64
22	0.86	0.42	1.45	0.47
23	2.58	0.64	3.82	1.04
24	0.19	0.4	1.93	0.52
25	1.45	0.47	2.22	0.57
26	1.93	0.52	3.06	0.76
27	-0.14	0.41	1.45	0.47
28	1.24	0.45	2.58	0.64
29	1.24	0.45	2.22	0.57
30	1.45	0.47	1.93	0.52
Mean	1.057		2.0736667	
S.D.	0.7434431		0.6876554	

The significant increase in the experimental group can be explained by the use of the Make a Match method which is designed to increase student engagement and interaction in the learning process. This method allows students to actively participate in matching cards containing questions and answers about human growth material, thereby improving their conceptual understanding and critical thinking skills. This active and interactive engagement is likely to contribute to a more significant increase in science literacy compared to the conventional methods used in the control group. It is also important to note that data analysis using the Rasch Model provides advantages in evaluating the validity and reliability of measurement instruments. With the Rasch Model, we can measure students' abilities and item difficulties independently, which helps in understanding how well the test instrument measures students' science literacy (Kusnadi et al., 2023; Mulyanti et al., 2022). In this study, the Rasch Model helps in identifying the improvement of students' science literacy skills from pretest to posttest more accurately. Data show that the Make a Match method is effective in improving the science literacy of grade V elementary school students. A significant improvement in the experimental group compared to the control group indicates that the use of interactive learning methods and actively engaging students can provide better results in science learning. Therefore, it is recommended that the Make a Match method be applied more widely in science learning in elementary schools to improve the quality of education and student science literacy. With these results, research makes an important contribution to the world of education, especially in the development of more effective and fun learning methods. Increasing students' science literacy through the Make a Match method not only has an impact on better learning outcomes, but also increases students' motivation and interest in learning about science, which ultimately supports the achievement of national education goals. For more clarity, see figures 2.

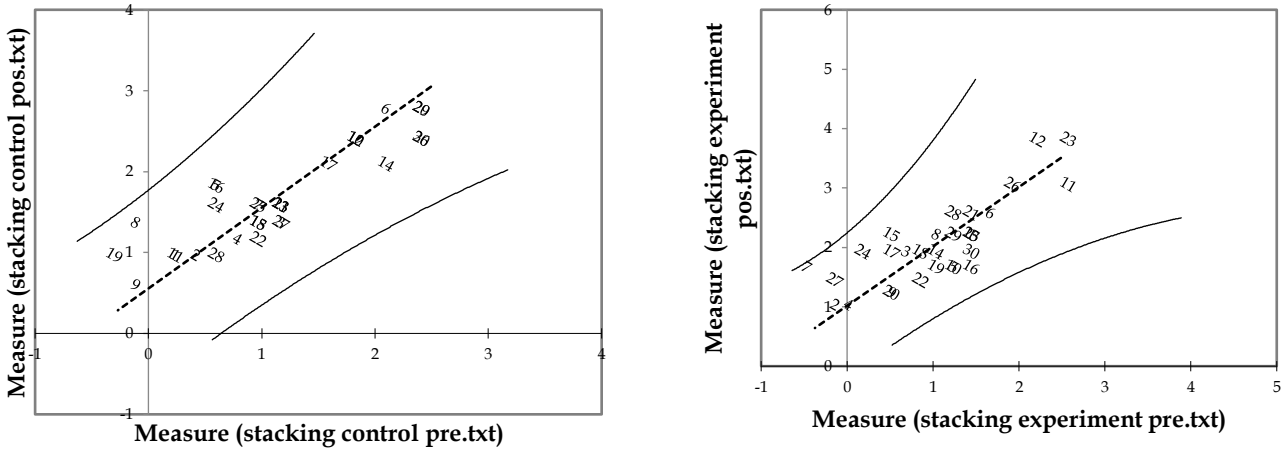

Figure 2. Changes in science literacy ability of experimental and control class students

Based on the data obtained from figure 2, the average increase in science literacy skills in the experimental class using the Make a Match learning method was 1.067, while the control class using the conventional learning method only experienced an average increase of 0.56. This shows that the use of the Make a Match method has a significant and positive influence on improving students' science literacy. The Make a Match method is designed to increase students' active involvement in the learning process through interactive and fun activities. In this method, students are given cards that must be matched between a question and an answer or related concepts. This active involvement not only improves conceptual understanding, but also critical thinking skills and problem-solving abilities, which are important components in science literacy. The higher improvement in the experimental class compared to the control class can be attributed to several factors. First, the Make a Match method makes learning more interesting and fun, so that students are more motivated to learn and easier to understand the material being taught. Second, interaction between students in card matching activities can increase collaboration and discussion, which helps deepen students' understanding of science materials. Third, this method also allows teachers to more easily identify students' learning difficulties and provide more timely feedback (Apriliana et al., 2021; Sukmawati et al., 2023). In addition, the data showed that the standard deviation of science literacy improvement in the experimental class was lower compared to the control class, which indicated that the increase in science literacy was more evenly among students in the experimental class. This shows that the Make a Match method is

effective not only for students with high ability, but also for students with various levels of ability. In other words, this method is able to improve science literacy holistically, covering all groups of students. For more clarity, you can see in figure 3.

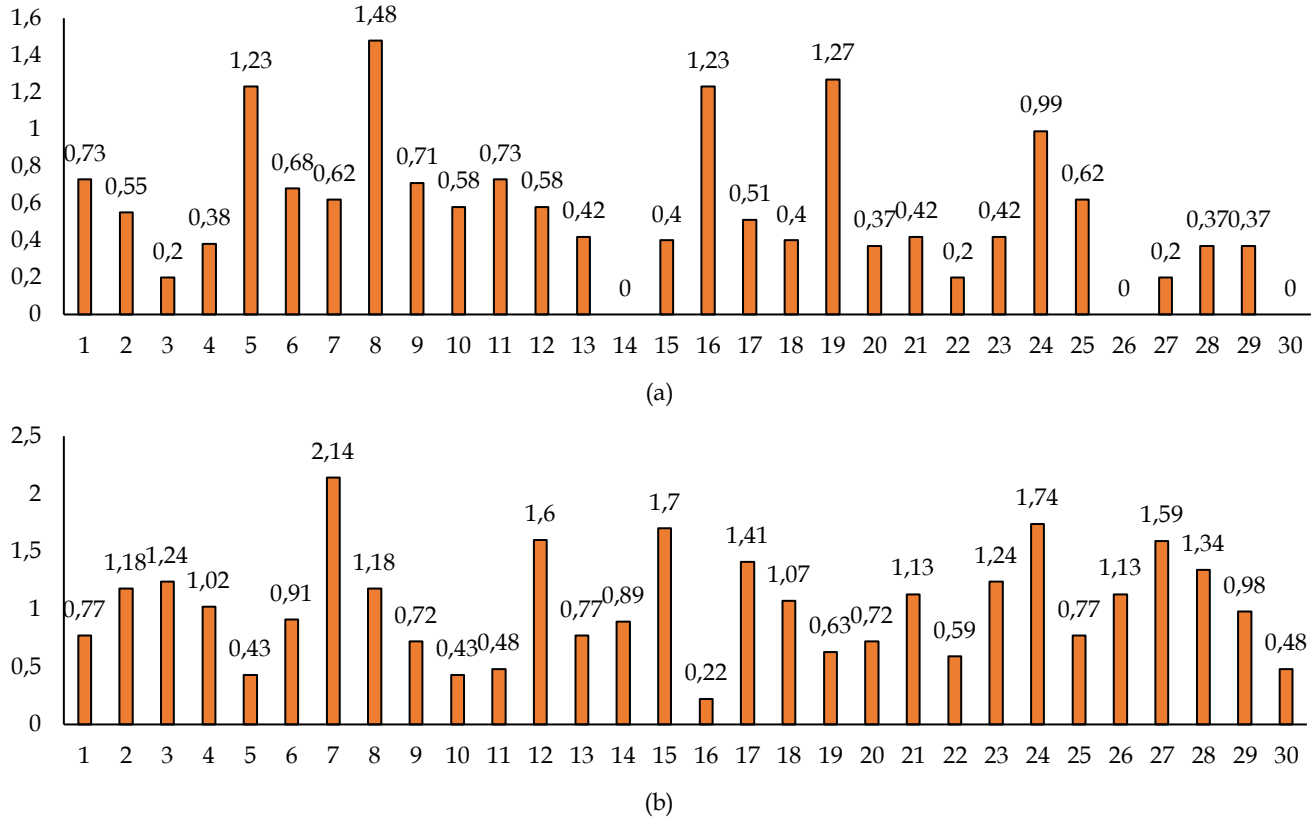

Figure 3. Changes in students' science literacy skills, (a) Control class, and (b) Experimental class

Based on the data obtained, both the experimental class and the control class showed an improvement in science literacy skills, albeit at different levels. The increase in science literacy in these two groups can be explained by several common factors in the learning process. First, all students experience exposure to science learning materials during the research, which naturally improves their understanding (Glew et al., 2019; Mehrvarz et al., 2021; Nadrah et al., 2017; Sopandi, 2017). Second, science literacy tests given before and after treatment can motivate students to be more serious in studying the material because they realize that their results will be evaluated. In addition, factors such as interaction with teachers and peers, as well as home-based learning support, can also contribute to improved science literacy (Fikriyah et al., 2022; Sukmawati & Wijiastuti, 2021). In the control class, even though the learning methods used are conventional, sustainability and consistency in teaching still have a positive impact on student understanding. Meanwhile, in the experimental class, the interactive and fun Make a Match method provides additional stimulation that is more powerful, resulting in a more significant increase. Overall, the learning process that is structured and supported by a conducive learning environment contributes to the improvement of students' science literacy in both groups.

Table 3. Control Class Racking

Items	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	-1.56	0.74	-1.56	0.74
2	0.82	0.39	0.97	0.39
3	1.57	0.39	1.72	0.39
4	-0.04	0.45	-0.04	0.45
5	1.72	0.39	0.97	0.39
6	-3.5	1.81	-2.3	1.03
7	-0.04	0.45	-0.04	0.45
8	-0.48	0.5	-1.1	0.62
9	-2.3	1.03	-2.3	1.03
10	0.82	0.39	0.33	0.42
11	1.27	0.39	1.27	0.39
12	0.66	0.4	0.5	0.41
13	-1.56	0.74	-1.56	0.74
14	-2.3	1.03	-3.5	1.81
15	-2.3	1.03	-3.5	1.81
16	3.05	0.51	2.4	0.43
17	0.97	0.39	-0.25	0.47
18	-0.76	0.55	0.5	0.41
19	-0.25	0.47	0.16	0.43

Items	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
20	-0.76	0.55	-0.04	0.45
21	-0.76	0.55	-1.56	0.74
22	0.97	0.39	0.5	0.41
23	-1.1	0.62	-2.3	1.03
24	2.21	0.42	-0.25	0.47
25	0.82	0.39	-0.25	0.47
26	0.66	0.4	0.16	0.43
27	1.88	0.4	-0.25	0.47
28	2.4	0.43	-0.04	0.45
29	0.82	0.39	-1.1	0.62
30	-0.75	0.55	-1.56	0.74
Mean	0.0726667		-0.4673333	
S.D.	1.5555276		1.4065559	

Table 4. Experimental Class Racking

Items	Pretest		Posttest	
	Measure	S.E.	Measure	S.E.
1	0.18	0.45	-0.26	0.5
2	1.33	0.39	0.55	0.41
3	1.18	0.39	0.72	0.4
4	-0.03	0.47	-0.54	0.55
5	0.18	0.45	-0.26	0.5
6	-1.33	0.74	-1.33	0.74
7	0.72	0.4	0.18	0.45
8	0.55	0.41	-0.26	0.5
9	-0.54	0.55	-2.08	1.02
10	0.18	0.45	-0.88	0.62
11	1.18	0.39	-0.88	0.62
12	0.18	0.45	-1.33	0.74
13	-3.27	1.8	-2.08	1.02
14	-1.33	0.74	-2.08	1.02
15	-0.03	0.47	-0.03	0.47
16	3.25	0.51	1.18	0.39
17	1.78	0.39	-0.54	0.55
18	0.88	0.4	-0.03	0.47
19	0.18	0.45	-0.88	0.62
20	0.72	0.4	-0.26	0.5
21	-0.88	0.62	-1.33	0.74
22	-0.88	0.62	-1.33	0.74
23	-0.88	0.62	-1.33	0.74
24	2.79	0.45	-0.03	0.47
25	1.33	0.39	0.72	0.4
26	1.93	0.39	-0.26	0.5
27	0.55	0.41	-0.54	0.55
28	0.37	0.43	-0.88	0.62
29	1.63	0.39	1.18	0.39
30	-0.03	0.47	-0.26	0.5
Mean	0.3963333		-0.505	
S.D.	1.2789357		0.8700603	

Based on the results of data analysis from Table 3 and Table 4. we can evaluate the difficulty level of the questions in the pretest and posttest for the control class and the experimental class. The difficulty level of the problem is measured through the "Measure" value generated from the analysis of the Rasch Model. In general, a higher "Measure" score indicates an easier question, while a lower score indicates a more difficult question. In the control class, the average pretest score was 0.0727 with a standard deviation of 1.5555, while the average posttest score decreased to -0.4673 with a standard deviation of 1.4066. This decrease in average indicates that some questions may be found more difficult by students after learning. Specific examples can be seen in items 1 and 8 that have a "Measure" value that remains the same or decreases, indicating consistency or increased difficulty perceived by students. In addition, items such as item 6 and item 14 showed very low "Measure" scores on the pretest and posttest, indicating that the questions remained difficult for most students throughout the test (Sukmawati et al., 2018; Wanningrum et al., 2023). This level of difficulty can be caused by the complexity of the material or the way the questions are presented that may not be fully understood by students.

In contrast, in the experimental class, the average pretest score was 0.3963 with a standard deviation of 1.2789, while the posttest score decreased to -0.505 with a standard deviation of 0.8701. This decrease also suggests that some questions may be more difficult after learning with the Make a Match method, although students in the experimental class experienced significant improvements in overall science literacy (Elmer & Stadtfeld, 2020; Jamaluddin et al., 2019; Sujana et al., 2021). Item 1, for example, shows a decrease from 0.18 on the pretest to -0.26 on the posttest, indicating an increase in the difficulty of the questions for students after learning. Similarly, items 6 and 14 show very low "Measure" scores on the pretest and posttest, indicating ongoing difficulty in understanding the questions.

In further analysis, we can see that some items such as item 16 in the control class and the experimental class have high "Measure" values, namely 3.05 and 3.25 in the pretest, but decrease in the posttest to 2.4 and 1.18. This suggests that the item is relatively easy for students at first, but the difficulty may increase or students become more critical in answering after learning, which indicates a change in their understanding and approach to the question. The difference in the difficulty level of the questions experienced by the control class and the experimental class can also reflect the difference in learning methods. Conventional methods in the control classroom may not provide enough variety in learning approaches, so some questions remain difficult for students to understand (Sukmawati, 2022; Wahjusaputri et al., 2022). In contrast, the Make a Match method in the experimental classroom, which encourages active student interaction and engagement, may make students more critical in answering the questions, so they are more aware of the real difficulties of the questions. In addition, the lower standard deviation in the posttest in the experimental class compared to the

control class showed that the difficulty level of the questions was felt more evenly by students in the experimental class. This means that the Make a Match method helps to reduce variation in student understanding, so that all students have a more uniform and comprehensive learning experience. Analysis of the difficulty data showed that despite the improvement in science literacy, some questions remained difficult for students in both the control and experimental classes. However, the Make a Match method seems to be more effective in helping students identify and overcome difficulties in answering challenging questions, as well as providing a more equitable and holistic learning experience. Further evaluation of question design and teaching methods can help improve students' understanding and lower the difficulty level of questions in future science learning. For more clarity, see figure 4.

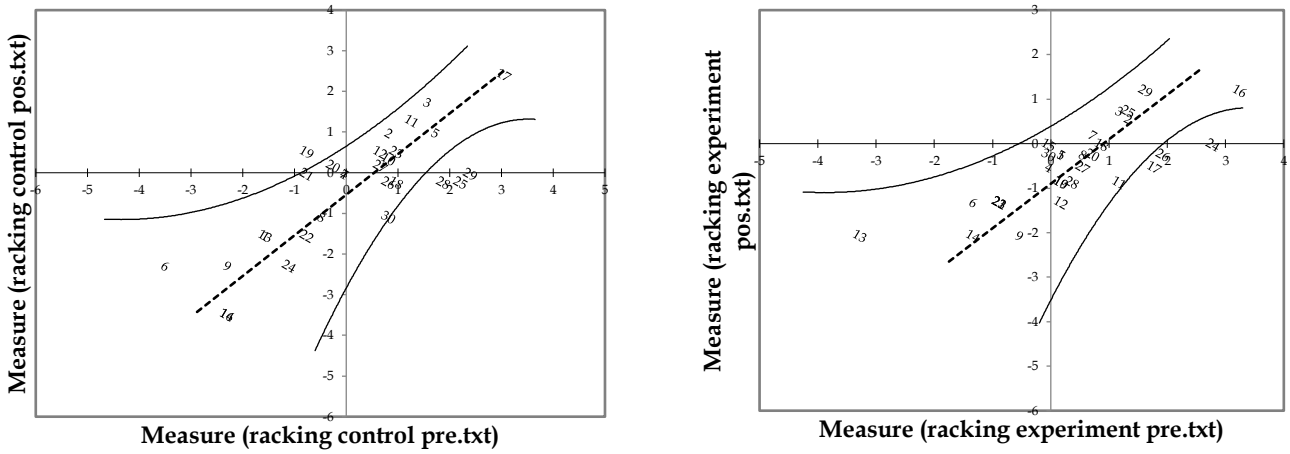

Figure 4. Changes in difficulty level of experimental and control class questions

Based on the problem difficulty data, the average decrease in the difficulty level of the questions in the experimental class was 0.90, while in the control class it was 0.54. A more significant decrease in the experimental class showed that the Make a Match learning method was more effective in helping students understand the material and reducing the difficulty in answering questions. The interactive and collaborative Make a Match method facilitates a deeper understanding of concepts, so that students are better prepared and able to answer questions better. In addition, interaction and discussion between students in this method allows them to share knowledge and strategies in answering questions, which contributes to the improvement of science literacy skills. On the other hand, in the control class that uses the conventional method, although there is an improvement, it is not as effective as the Make a Match method in reducing the difficulty level of the questions. This can be due to a lack of variation in learning approaches and active student engagement (Sukmawati et al., 2021a; Wanningrum & Sukmawati, 2023). Therefore, these results show that the Make a Match method not only improves students' understanding of the material but also reduces the difficulty in dealing with the problem, resulting in a more substantial improvement compared to the conventional method. For more clarity, see figures 7 and 8.

Based on the data of figures 5, d espite the general improvement in science literacy, the control class students still faced a number of problems that were considered difficult. In this case, there are six questions in the pretest and posttest that still show a significant level of difficulty, namely questions number 2, 3, 6, 18, 19, and 20. Meanwhile, in the experimental class, only one question was considered difficult, namely question number 13. The cause of this difference can be analyzed through several factors (Aslan, 2021; Ismail et al., 2018; Yew & Goh, 2016). First, the learning methods used in both groups can affect students' perception of the difficulty of the questions. In a control classroom, where conventional learning methods are applied, the possibility of a more linear and less interactive learning approach can make some concepts difficult for some students to understand (Sukmawati & Wahjusaputri, 2024; Wahjusaputri et al., 2024). This can cause difficulties in answering questions related to the concept. In contrast, in an experimental classroom, the Make a Match method that is interactive and actively engages students can help them understand the concept more deeply, thereby reducing the number of questions that are considered difficult (Wahjusaputri et al., 2022).

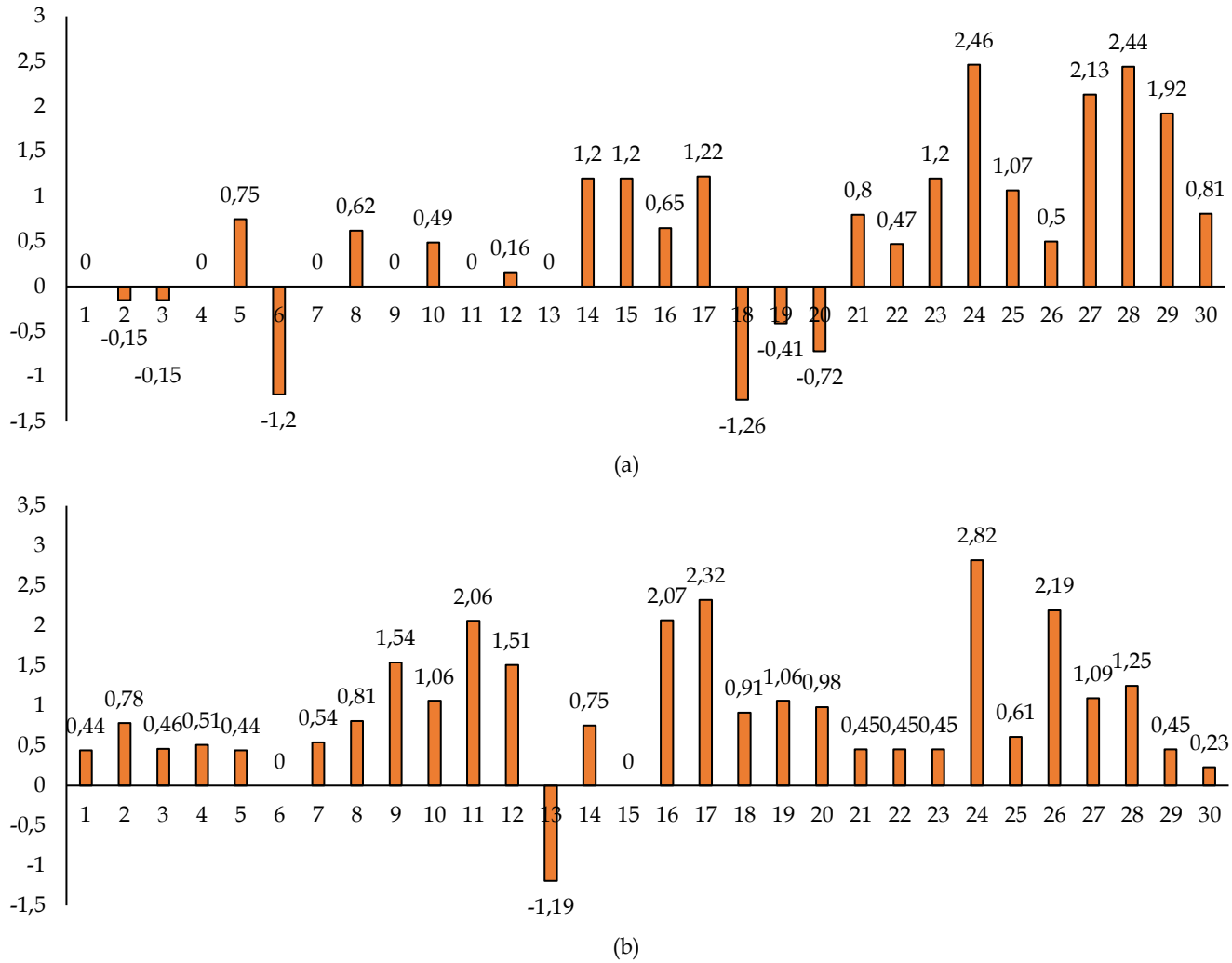

Figure 5. Changes in the level of difficulty of questions, (a) Control class, and (b) Experimental class

Figure 6. Learning with make a match

Second, individual factors such as students' prior knowledge background and cognitive abilities can also affect their perception of the difficulty of the question (Ifdaniyah & Sukmawati, 2024; Kusnadi & Sukmawati, 2023; Muthi'ah & Sukmawati, 2023). Students with a stronger knowledge background or higher cognitive abilities may have an easier time coping with problems that are considered difficult. However, for students who have limitations in this regard, problems that are considered difficult remain a significant challenge (Sukmawati et al., 2022). In addition, the design of questions and the presentation of learning materials can also affect students' perception of the difficulty of the questions. Some questions may be designed with a higher level of difficulty or use language that is less familiar to students, causing difficulties in understanding and answering them. From a teaching point of view, these results highlight the importance of paying attention to individual students' differences in material understanding and problem-solving skills. Teachers need to consider various learning strategies that can help students overcome difficulties in learning, including providing additional explanations, further exercises, or using more interactive and actively engaged learning methods such as the Make a Match method. Thus, it can be expected that the difficulty level of the questions can be minimized, and all students can achieve a better understanding of science literacy.

Conclusion

This study investigates the influence of the Make a Match learning method on the science literacy ability of grade V elementary school students compared to conventional learning methods. Through an experimental approach and analysis using the Rasch Model, it was found that the use of the Make a Match method significantly improved students' science literacy skills compared to conventional methods. This method, which emphasizes student interaction and active involvement, provides better results in understanding science concepts and science literacy skills. However, there are still some questions that are considered difficult by students in both groups, highlighting the need for more appropriate adjustment of learning strategies and question designs to strengthen students' understanding of science literacy. This conclusion emphasizes the importance of applying innovative and student-involvement-oriented learning methods in improving the quality of science education at the elementary level.

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The authors declare no conflict of interest.

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