Physics science literacy profile using local wisdom-based instrument and profile of Pancasila students in particle dynamic

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Abstract
The science literacy profile of students in Banjarmasin City has not been fully identified. Therefore, the purpose of this study is to analyze the physics science literacy profile using local wisdom-based instruments and the Pancasila learner profile of high school students in Banjarmasin City. This type of research is quantitative research with purposive sampling technique with a total of 106 students in three high schools in Banjarmasin City. Data were obtained through surveys and analyzed descriptively using the Rasch model in the Winstep application. Based on the research, it was found that the science literacy of high school students in Banjarmasin City was categorized as sufficient due to low interest in reading, low analytical skills of students, low knowledge of educators about science literacy, and the lack of evaluation tools that develop science. So it is concluded that the profile of high school physics science literacy in Banjarmasin City is categorized as sufficient.

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1. Introduction

21st century learning currently focuses on schools to train students in science literacy skills (Hardinata et al., 2019; Irfandi et al., 2022; Sahyar et al., 2020; Snyder et al., 2024; Sutiani et al., 2021). It is useful so that future generations have qualities that are in accordance with the demands of the times (S. Andriani et al., 2023; Pagan et al., 2023; Rusilowati et al., 2016; Suwandi et al., 2024) and plays a role in fostering ways of thinking, attitudes and caring and responsible characters for themselves, society and nature (Fadlila et al., 2024; Iddy et al., 2024; Irfandi et al., 2022; Kemendikbud, 2020). The indicator of science literacy are identifying questions, providing scientific explanations, compiling new knowledge, concluding, and developing a mindset that can solve science-related problems (Bobrowsky, 2022; Bórquez-Sánchez, 2024; Garthwaite et al., 2014; Ploj Virtič, 2022).

Physics learning, where almost all physics studies make ideas and issues related to science literacy (Cronje et al., 2011; Istyadji & Sauqina, 2023; Kjærnsli & Lie, 2004; Misbah et al., 2024; Mustika et al., 2024; Rusmansyah et al., 2023). It can be a place for students to develop their ability to think (Wati et al., 2023; Zainuddin, 2021). Besides focusing on ideas and issues related to science, physics also discusses human life (Hidayati et al., 2022; Imanzha et al., 2024; Nurdiyanto et al., 2024). Teaching science literacy in physics also enables learners to build character and culturally relevant values of local communities in using technology to influence current and future decisions (Çalik & Wiyarsi, 2024; Lutfia et al., 2024; Martawijaya et al., 2024; Maulida & Sunarti, 2022; Sholahuddin et al., 2023; Syahmani, Kusasi, et al., 2021; Syahmani, Sauqina, et al., 2021).

In fulfilling the current 21st century skills, science literacy that involves the context of local wisdom and national values is important to be developed or improved (Rizki et al., 2022; Sholahuddin et al., 2021). It can help students to understand the science they learn with their lives (Asyafaah et al., 2024; Fitriah et al., 2021; Hamdanah et al., 2024; Irhasyuarna et al., 2022; Rahmia et al., 2021). Using local wisdom-based instruments to measure science literacy shows an effort to link education to the local cultural context(Rusmansyah et al., 2022; Sartika et al., 2024).

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Education in Indonesia has implemented a new curriculum to meet the challenges of the 21st century, the independent curriculum (Fitria et al., 2023; Hidayati et al., 2022; Mahtari et al., 2024). The independent curriculum focuses on 21st century skills that focus on character education known as the Pancasila learner profile (Jufriadi et al., 2022). The Pancasila learner profile is a lifelong learner who is globally competent and guided by the values of Pancasila, namely: noble character, global diversity, independence, mutual cooperation, critical reasoning, and creativity. Currently, the Ministry of Education and Culture formulates 21st century learning that requires learners to be open-minded to differences and provide benefits to others (Kemendikbud, 2022).

However, there may be shortcomings in the implementation of local wisdom in the existing curriculum, resulting in a lack of relevance of education for students. There is an urgent need to adapt and adjust the curriculum to reflect local wisdom and make it more relevant to students in various regions, especially in Indonesia which is rich in cultural diversity. Measuring students' science literacy with an instrument based on the Pancasila Student Profile is very important for several key reasons related to the development of scientific competence, character formation, and the relevance of education in the local and national context.

The level of science literacy of students is known based on the PISA (Programme for International Student Assessment) test conducted by the OECD every three years (N. Andriani et al., 2018). PISA is an ongoing programme that provides a view of the abilities and knowledge of 15-year-old students in various countries (Kemendikbud, 2022). Indonesia first joined PISA in 2000. One of the main reasons that made Indonesia participate was Indonesia's willingness to understand the achievements of students compared to other countries in facing the same difficulties (Mahtari et al., 2021). In the latest PISA acquisition, namely in 2022 by the OECD, it shows that Indonesian students have a reading score of 359 with an overall OECD score of 476. In the science category, Indonesia scored 383 out of an overall OECD score of 485, and the mathematics field scored 366 out of an average score of 472. This means that Indonesia's science literacy skills still do not meet the science literacy standards set by the OECD (Kemendikbud, 2022). The results of the PISA test show that Indonesian students' scientific literacy is still below international standards, so special attention is needed to improve the quality of science education.

In addition to the study conducted by PISA, in Indonesia, research by Mulyani et al (2020) found that high school students in Tasikmalaya had sufficient science literacy due to the lack of students' skills in working on comprehension and analysis questions. This was also revealed by Sutrisna (2021) who argued that the science literacy of Class X high school students in Sungai Penuh City was in the low category caused by low interest in reading, evaluation tools that did not develop science literacy and educators' understanding of science literacy was still minimal. In addition, Pratiwi's research (2023) found that the science literacy profile of high school students in South Kalimantan, especially in Banjarmasin City, was in the low category because learning activities did not focus on the science process.

Based on the previous research results (Wati & Dewantara, 2023) which developed a science literacy measurement instrument based on local wisdom and the developed Pancasila learner profile. This instrument shows potential as a measuring tool for the profile of scientific literacy in Banjarmasin City. This study introduces an instrument that is in accordance with the Merdeka curriculum, integrating aspects of local wisdom and the profile of Pancasila learners, which have not been applied in previous studies. In addition, previous studies were limited to one school in Banjarmasin City, so there needs to be a wider implementation to provide the right solution to the problem of scientific literacy in the field. Therefore, this study is entitled "Science Literacy Profile Using Local Wisdom-Based Instrument and Profile of Pancasila Students in Physics Learning " to fill the gaps in previous research and offer a more holistic approach. The local wisdom included is local wisdom in South Kalimantan along with tourism and the uniqueness of the area. The material raised is about particle dynamics. The purpose of this article is to describe the profile of high school physics science literacy using a science literacy instrument based on local wisdom and the profile of Pancasila students.

2. Method

This research is quantitative descriptive research through surveys and data collected through test instrument sheets. Quantitative research is research that makes populations or samples as a

medium of instrument data, statistical data analysis (Balaka, 2022). The research was conducted from November 2023 to April 2024 at 3 public high schools in Banjarmasin City. The sample selection was done through purposive sampling technique and calculated based on the slovin formula. The schools in this study were SMAN 7 Banjarmasin, SMAN 8 Banjarmasin, and SMAN 10 Banjarmasin. Students as samples in this study totalled 106 people.

In the previous research, the developedment assessment of high school physics science literacy based on Local Wisdom and Pancasila Student Profile has been proven to have good quality after conducting empirical quality tests and analyzed based on item response theory (IRT) using Rasch modeling. The developed science literacy assessment is declared valid because it fits the model based on the Outfit MNSQ value, Outfit ZSTD value, and Point Measure Correlation value. The assessment is declared reliable with a value of 0.92 and is able to group students into 5 groups. It has a level of difficulty that is not too difficult and not too easy with a measure logit value that is distributed proportionally. It has a discriminatory power with a respondent separation index of 0.73 and is able to differentiate students into two groups, namely groups with high ability and low ability. The final stage of the physics science literacy assessment consists of 16 multiple-choice questions with reasons that can be used as a student learning test (Dewantara, et al 2024).

This study was conducted to analyse the physics science literacy profile using local wisdom-based instruments and the Pancasila learner profile of public high school students in Banjarmasin City through the Rasch model approach with the help of Winstep software. The Rasch Model is an item response theory (IRT) model that focuses on building a unidimensional measurement scale that meets the logit probability principle. This model measures the probability of a person answering correctly or getting a score based on their ability level and the difficulty of the item. Rasch provides consistent interpretation of measurement results and allows for more detailed data modeling and more valid comparisons between individuals and items (Chan et al., 2013; Sumintono & Widhiarso, 2015).

The test results obtained were converted into scores based on the following formula.

$$Value = \frac{Total\ Score}{57} \times 100\% \quad (1)$$

The achievement of science literacy skills obtained was analysed based on the person measure in the rasch model output data from winstep. The following is a table of criteria for person measure in Table 1. Learner Ability Criteria.

Table 1. Learner Ability Criteria (Nugraha & Umam, 2023)

Logit Value of Learner's Ability	Ability Criteria
X ≥ (M + 1.5 Sdi)	Very High
$(M + 0.5\ Sdi) < X < (M + 1.5\ Sdi)$	High
$(M - 0.5\ Sdi) < X < (M + 0.5\ Sdi)$	Simply
$(M - 1.5\ Sdi) < X < (M - 0.5\ Sdi)$	Low
$X \leq (M - 1.5\ Sdi)$	Very Low

3. Results and Discussion

The material tested is about particle dynamics, which has learning outcomes, namely explaining the principles and concepts of linear and rotational motion dynamics through investigative activities to solve problems. The results of the evaluation of science literacy of grade XI students in 3 State Senior High Schools in Banjarmasin City are used as a benchmark to understand the profile of students' science literacy in the city in physics learning. The evaluation, which focuses on the aspect of physics education, provides insight into students' understanding and application of scientific principles. In this particle dynamics, students are expected to be able to explain the nature of the inertia of an object, apply Newton's Law equations in solving a problem, define force as a change in momentum over time in everyday problems, describe a diagram of the forces acting on an object, describe the equation of gravity, normal force and friction in everyday problems, describe the effect of air resistance on a free-falling object in a uniform gravitational field and apply the concept of the law of conservation of momentum to everyday phenomena.

Based on the scores obtained on the Table 2, the level of science literacy in physics learning is categorized using the average logit value and standard deviation from the Winstep application.

SUMMARY OF 106 MEASURED Person

	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	8.1	16.0	-1.59	.44	.92	-.04	1.05	.13
SEM	.5	.0	.07	.01	.04	.09	.06	.10
P.SD	4.7	.0	.70	.12	.45	.89	.66	.99
S.SD	4.7	.0	.71	.12	.45	.90	.66	.99
MAX.	26.0	16.0	.23	1.05	2.43	2.51	4.02	3.40
MIN.	1.0	16.0	-3.82	.27	.40	-1.59	.22	-1.43

REAL RMSE	.48	TRUE SD	.52	SEPARATION	1.08	Person RELIABILITY .54
MODEL RMSE	.45	TRUE SD	.54	SEPARATION	1.19	Person RELIABILITY .59

S.E. OF Person MEAN = .07

Figure 1. Summary of Measured Person

With a logit value of -1.59 and a standard deviation of 0.70, this metric reflects the criteria for high school students' science literacy abilities in physics learning in Banjarmasin City, as detailed in Table 2 below. These data highlight the effectiveness of current physics education strategies and identify areas that need to be improved in fostering stronger science literacy among students.

Table 2. Ability Criteria for Learners in Banjarmasin City

Logit Value of Learners' Ability	Ability Criteria
$X \geq -0.54$	Very High
$-1.24 < X < -0.54$	High
$-1.94 < X < -1.24$	Simply
$-2.64 < X < -1.94$	Low
$X \leq -2.64$	Very Low

The results of this data collection were analysed using winstep and then compared with Table 2, so that the results of the level of students' science literacy skills are presented in Table 3 below.

Table 3. Science literacy of students in Banjarmasin City

Category	Percentage
Very High	5.66%
High	25.47%
Simply	45.28%
Low	17.92%
Very Low	5.66%

The science literacy skills of students are divided into several categories, namely very high, high, sufficient, low, and very low. Table 3 shows students who have an average person measure score in the very high category with a percentage of 5.66%, in the high category with a percentage of 25.47%. While students with sufficient ability have a percentage of 45.28%, a low category with a percentage of 17.92%, and a very low category with a percentage of 5.66%. This means that science literacy in Banjarmasin City is dominant in the moderate category. The low achievement of students' science literacy is due to the lack of understanding and analysis of students. In a study by Mulyani et al (2020), it was suggested that students who were not trained in solving problems that demanded analysis were the main cause of the lack of science literacy skills. Questions that only focus on students' memory make students only memorise material so that students have difficulty in developing their thinking skills (Dwisetiarezi & Fitria, 2021).

The factors for the low science literacy of students are the lack of students' interest in reading and teachers' knowledge of science literacy. Sutrisna (2022) stated that students' low interest in reading makes students unable to relate their knowledge. Science literacy includes various sciences in various situations (Shihab, 2019). The lack of information about surrounding events results in students being very slow in science (Wahab et al., 2021). Research by Anggi et al (2019) revealed

that the factor of the lack of science literacy of students can be caused by the lack of knowledge of educators. Science literacy learning should contain facts, concepts, principles, and laws that can describe the function of technology in science for the surrounding and provide information on the negative effects caused (Muzijah et al., 2020).

The results of the achievement of science literacy competency aspects were analysed from the logit mean and standard deviation as follows.

3.1. Explaining Scientific Phenomena

In this indicator, the questions given are related to the demands of students to be able to exemplify the application of Newton's Law in everyday life. A discourse is given about local wisdom, namely about life in the Riam Kanan reservoir which is also combined with one aspect of the Pancasila student profile, namely mutual cooperation. Another case is when students are required to be able to analyze the direction of friction when the referee stands still in a game in South Kalimantan. Still in the same case, students are also required to exemplify the application of Newton's Second Law in everyday life. Another case in a discourse, students are required to be able to analyze the greatest acceleration of the ball correctly. The cases above are related to solving problems in particle dynamics, where the nuances of local wisdom are there, and the Pancasila student profile is emphasized in each question item. The average logit value obtained is -1.46 and a standard deviation of 0.90 which is then used to obtain the value of competence in explaining scientific phenomena in Banjarmasin City in Table 4.

Table 4. Achievement of competency aspects in explaining scientific phenomena in Banjarmasin City

Category	Percentage
Very High	4.72%
High	33.96%
Simply	29.25%
Low	30.19%
Very Low	1.89%

Based on Table 4, the results show that the achievement of competence in explaining scientific phenomena of high school students in Banjarmasin City with a total of 6 items obtained a percentage of 33.96% in the high category. This is because students have just been introduced to scientific phenomena. This aspect guides learners in recognising, conveying, and analysing various surrounding events and technology (Narut & Supardi, 2019). In PISA 2018, this aspect requires learners to use relevant scientific knowledge; identify, use knowledge, create an appropriate picture; create a basic picture; predict and propose hypotheses; explain the achievements of scientific knowledge that can be useful; and interpret the symptoms of future events (OECD, 2023). The high category in this aspect shows that learners have been able to predict and convey their arguments, but are still lacking in providing explanations from the analysis of the phenomena given. This is evidenced by the reasons for learners' answers to the questions about recognising and conveying arguments, but the reasons are less precise on the analysis question sheet.

3.2. Interpreting Scientific Data and Evidence

This indicator has the most questions in this instrument. Some of them are given a data table in a discourse about a traditional game, then students are required to be able to analyze the acceleration of the ball correctly. Also, When discussing tourism in South Kalimantan, then there is a case where the car breaks down and is given certain data, students are required to be able to determine the apparent weight of the car when it is at the top of the road. In the interpreting scientific data and evidence indicator, data is always provided in the form of a table, where students are asked to analyze the data according to the concept of particle dynamics. The aspect of competence in interpreting data and scientific evidence obtained a logit value and standard deviation of -2.06 and 0.99 respectively in Banjarmasin City in Table 5.

Table 5. Achievement of the competency aspect of interpreting data and scientific evidence in Banjarmasin City

Category	Percentage
Very High	5.66%
High	20.75%
Simply	55.66%
Low	0.00%
Very Low	17.92%

In this competency, it was found that the dominant learners were in the sufficient category with a percentage of 55.66%. In this aspect, learners must analyse and identify scientific data; make hypotheses and arguments; and make conclusions (Narut & Supardi, 2019). This competency requires learners to be able to process a picture; explain and predict data and draw conclusions; predict data, evidence, and scientific reasoning; divide arguments based on scientific findings and theories; and evaluate arguments and evidence from various sources (OECD, 2023). Skills in scientific evidence require learners to predict findings, provide evidence, and describe the relationship between evidence and conclusions (Antika & Marpaung, 2023).

In this competency, students are still in the sufficient category. This is because students do not make the right conclusions seen from the reasons for the wrong student answer sheets. Anggi et al (2019) also argue that low science literacy is caused by students not being able to predict data and information from the phenomena given. Nofiana and Julianto (2017) this is caused by students who are not trained with problem solving and conclusion drawing questions.

3.3. Evaluate and Design Scientific Enquiry

The case study given is closely related to the scientific data given in the question. Given a table in the discourse, students can analyze the acceleration of the ball correctly, so that they are able to evaluate the next action to be taken. This is for example in a traditional game, certain data is obtained. Then continued with the challenge of what the player must do in order to win. This calculation uses the concept of particle dynamics. The logit mean and standard deviation values obtained in the aspects of evaluating and designing scientific enquiry were -2.58 and 1.55, respectively. These values are used to measure learner achievement as shown in Table 6.

Table 6. Achievement of competency aspects of evaluating and designing scientific investigations in Banjarmasin City

Category	Percentage
Very High	5.66%
High	33.02%
Simply	29.25%
Low	17.92%
Very Low	14.15%

Based on Table 6, it is obtained that the ability of students in this competency is at a percentage of 33.02% which is in the high category. The ability to evaluate and make scientific investigations is used in describing and reviewing scientific investigations and providing steps for solving based on science (Narut & Supardi, 2019). PISA 2018 explains that this ability requires learners to process and distinguish scientific questions, suggest and evaluate questions, explain and evaluate data reliability, objectivity, and explanations that can represent the whole object (OECD, 2023). The achievement of this competency is in the high category. This can be seen from the correct reasoning on the learners' answer sheets.

The science literacy profile of students in Banjarmasin City using winstep was also analysed based on the Maps variable in Figure 2. The Maps variable in (Wright's Map) is a map that shows the subject's ability and the difficulty level of the item on the same scale, where on the right side is the distribution of student ability while the left side is the distribution of item difficulty (Untary, 2020). This map ranks from the highest category at the top to the low category at the bottom (Muthi'ah, 2022). Based on Figure 2, in general, the science literacy of high school students in Banjarmasin City is in the moderate category. This corresponds to Table 3. Science literacy of students in Banjarmasin City when viewed from the level of science literacy of students based on logit in the Person Measure

output which is then compared with the logit mean and standard deviation, the category that often appears is sufficient.

Variable Maps on the right show the ability/ability of students' science literacy which contains letters as the code of each school then followed by numbers from the sequence number of students (Purwana et al., 2020). Learners who have a very high ability category are shown at the top of the map. Based on Figure 2, it is obtained that students with very high abilities are occupied by 6 students indicated by the code A023, A024, A016, A025, C084, B036, A033, this shows that the questions given can be answered correctly by students (Ibnu et al., 2019). Figure 2 also shows students in the high category which is dominated by students with code A and code C and C. In this category there are 27 learners with high science literacy skills.

Based on Figure 2, the level of the sufficient category is the largest area occupied by students. This category is in the logit -2 to 0 which shows the literacy skills of students in the moderate category. Furthermore, the low category level can be seen in Figure 2 is an area occupied by 19 students, where the logit value is between below -2 to below -1. Furthermore, learners who are in the region with a very low category are 8 people with the codes B057, B058, B061, C074, A008, B040, B063, and B065. This category has a logit value below -2.

This map also shows the level of difficulty of the question items on the left. Each question is given a code, where G as explaining scientific phenomena, code H as interpreting scientific data and evidence, and code I as evaluating and designing scientific investigations. So, based on Figure 2, the overall level of science literacy skills of students in Banjarmasin City is categorised as sufficient where the question instruments used can almost be answered by all students. Learners who fall into the very high (A023) and high (C085) categories of science literacy are seen from the maps variable in questions with indicators explaining scientific phenomena totalling 6 questions obtaining 4 correct questions and 2 wrong questions for learners code A023, 2 correct questions and 4 wrong questions for learners code C085 accompanied by the right reasons on the answer sheet. This means that learners in this category are able to explain scientific phenomena well. Questions with indicators of interpreting data and scientific evidence totalling 6 questions by learner code A023 answered correctly as many as 1 question and 5 questions were wrong, while learner code C085 answered correctly 2 questions and 4 questions were wrong. In this indicator, very high category learners have been able to provide the right reasons but high category learners have not included reasons in their answers. In this case, the ability to interpret data and scientific evidence of students has not been fulfilled properly. Furthermore, the indicator of evaluating and designing scientific investigations totalling 4 questions was answered correctly by all learners A023, and answered 3 correctly with 1 wrong by C085. This indicator has not been fulfilled well by learners.

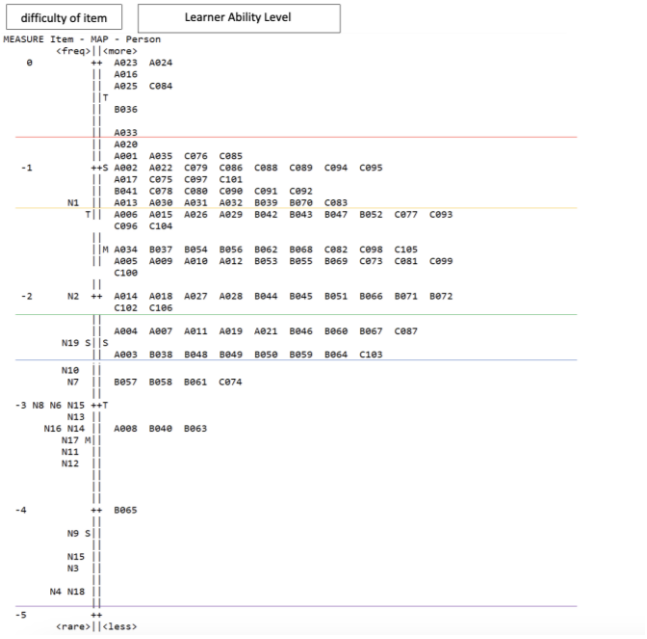

Figure 2. Variabel Maps

Based on the maps variable, learners categorized as moderate literacy skills (A027) and (B044) in the indicator questions explaining scientific phenomena, and indicators of interpreting scientific data and evidence both get 2 questions correct and 4 wrong questions that are not accompanied by reasons for choosing the answers given. This shows that the ability of students in this indicator has not been fulfilled. In the indicator of evaluating and designing scientific investigations, learners code A027 and B044 also answered 2 questions correctly and 2 questions incorrectly. Learners' ability in this indicator has not been fulfilled well by learners. Furthermore, low (B059) and very low (C074) science literacy skills from indicators of explaining scientific phenomena, interpreting scientific data and evidence, and evaluating and designing scientific investigations have not been fulfilled. This result was obtained from the answers that predominantly answered incorrectly and did not provide reasons for their answers. The overall level of science literacy profile of students in Banjarmasin City is in the sufficient category where 3 indicators of science literacy have not been fulfilled properly.

4. Conclusion

Based on the variable map shown, the level of physics scientific literacy of students in Banjarmasin City is generally in the sufficient category, with a number of students showing very high and high abilities. From the analysis, there are 6 students with very high abilities and 27 students in the high category, while the sufficient category is dominated by many students. However, the ability in the indicators of explaining scientific phenomena, interpreting data, and evaluating and designing scientific investigations has not been fully met, as seen from the many wrong answers and the lack of supporting reasons. Overall, although some students are able to answer well, there are still many aspects of scientific literacy that need to be improved to achieve better understanding among students.

Based on the conclusion about the level of physics science literacy of students in Banjarmasin City, it is recommended that schools and teachers take a more intensive approach in teaching science literacy. This can include providing more varied and challenging practice questions, as well as focusing on developing students' ability to provide appropriate reasons for their answers. In addition, training for teachers on interactive teaching methods can help increase student engagement. Additional tutoring programs for students in the low and very low categories are also important to improve their understanding. With joint efforts, it is hoped that students' science literacy can improve overall.

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