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STUDI PENDAHULUAN TERHADAP KEMAMPUAN LITERASI SAINS PADA PEMBELAJARAN FISIKA KELAS XI SMAN 4 PADANG

Preliminary Study on Scientific Literacy Skills in Physics Learning of Eleventh Grade Students at SMAN 4 Padang

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Abstract

This preliminary study aims to analyze the level of scientific literacy among students in physics learning in Grade XI at SMAN 4 Padang. Scientific literacy is one of the essential 21st-century competencies, reflecting students' ability to explain scientific phenomena, evaluate and design scientific knowledge, and interpret data and scientific evidence. A descriptive quantitative approach was employed, using a scientific literacy test instrument developed based on indicators from the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek). The research subjects consisted of 31 Grade XI students. The analysis results show that the average achievement in students' scientific literacy was only 38.96%, with the following breakdown: explaining scientific phenomena (36.88%), evaluating and designing scientific knowledge (38.75%), and interpreting data and scientific evidence (41.25%). These findings indicate that students' scientific literacy skills remain low and do not meet the expected

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standards. Therefore, the study highlights the urgent need for the development of innovative physics learning models that enhance active engagement, conceptual understanding, and scientific thinking skills.

Keywords: Scientific Literacy; Physics Learning; 21st-Century Competencies; Learning Evaluation; Scientific Ability

INTRODUCTION

21st century learning is a paradigm shift in education that requires students to act as learners who are active, creative, and able to apply scientific thinking in dealing with everyday life problems. In this learning context, the learning process depends not only on mastering knowledge, but also on developing skills (Ashari Hamzah *et al*., 2022). This change reflects a shift in the orientation of education from mere mastery of content to the development of higher-order thinking abilities and applicable life skills. Therefore, learners are expected not only to understand concepts, but also to be able to apply them in real situations. They need to collaborate in teams, solve complex problems, and communicate effectively. Education today emphasizes the importance of integration between cognitive and non-cognitive competencies. This includes critical thinking skills, creativity, collaboration, as well as science literacy. The learning process should make room for exploration, open discussion, problem-based projects and interdisciplinary learning. Thus, learners will be better prepared to face global challenges and the dynamics of life in the 21st century.

21st century skills have become a major focus in education today, especially in the context of physics learning. One of the skills that is very important to consider so that students can apply science appropriately is science literacy. Science literacy skills are essential competencies that must be possessed by every individual in this era (Situmorang, 2016). Science literacy is considered as one of the basic abilities that everyone must have (Aina & Hariyono, 2023). Science literacy focuses on developing learners' knowledge to use science concepts effectively, think critically, and make balanced decisions (Pratiwi *et al*., 2019). However, the main challenge in science literacy lies in the lack of familiarization with science literacy questions and learning models that train evidence-based argumentation. As a result, students often experience difficulties in analyzing scientific data (Amelia *et al*., 2021). This science literacy ability is not only important for those who have a career in science, but also for all citizens in living life in the modern era. Science literacy is not only an academic aspect,

but also an important provision to form a smart, rational, and responsible generation in the midst of advancing times.

Science literacy refers to the ability of individuals to apply their knowledge to identify questions, construct new knowledge, provide scientific explanations, and draw conclusions based on scientific evidence. In addition, science literacy also includes the ability to develop a reflective mindset, which allows individuals to participate in addressing issues and ideas related to science (OECD, 2017). The Organization for Economic Cooperation and Development (OECD) has released PISA (Programme for International Student Assessment) scores for Indonesia in 2022, covering literacy, mathematics and science. The purpose of PISA measurement is to evaluate the secondary education system, focusing on three main areas, namely math, science and literacy. Based on the latest PISA 2022 report published by the OECD, Indonesia's average science literacy score was recorded at 398 points, while the average global score reached 500 points. These results show that the science literacy achievement of students in Indonesia is still relatively low, although there is a slight increase compared to previous years. Indonesia ranks 71st out of 81 countries participating in PISA 2022 in the field of science literacy. This finding indicates that the majority of students in Indonesia still face difficulties in understanding basic scientific concepts, critical thinking, and problem solving.

Physics is a branch of natural science that studies natural phenomena and the relationship between variables in everyday life through observation, experimentation, and analysis. In the context of secondary education, physics is a very important subject because it can develop logical, critical, and analytical thinking skills, which are needed to face the challenges of the 21st century (Puling *et al.*, 2024). However, the reality of physics learning in the field shows the existence of various obstacles. These obstacles include low student interest in learning and learning approaches that are less contextualized. One of the main challenges is the abstract nature of physics material, which requires an understanding of mathematical concepts and high-level thinking skills (Rahmatiah *et al.*, 2016). In addition, the learning approach that is still centered on educators results in a lack of active involvement of students in the learning process (Setiawati *et al.*, 2018). Therefore, physics learning at the high school level needs to be developed, especially in the aspect of science literacy, through the application of innovative and contextual approaches.

In the context of physics learning, science literacy has a very important role. This subject teaches basic concepts that are the foundation for technological development and understanding of natural phenomena. However, in reality, physics learning in many schools is still theoretical and tends to emphasize memorization of formulas, instead of strengthening scientific reasoning and contextual thinking skills (Hasan, 2024). In addition, the lack of variety in physics teaching materials is also a significant problem (Emilya & Mufit, 2024). These conditions have the potential to cause low science literacy skills among students, especially in the aspects of data interpretation, understanding phenomena, and applying physics concepts in everyday life (Sari & Suryana, 2018). The low level of science literacy skills among students in Indonesia is caused by several factors. Factors that contribute to this low science literacy ability are related to Indonesia's PISA results, including: a) inappropriate selection of textbooks, b) misconceptions, c) non-contextual learning, d) low reading ability, and e) non-conducive learning environment and climate (Fuadi *et al.*, 2020).

Various studies show that the integration of learning models that support the development of science literacy is very important. Other studies also indicate that the application of learning models can improve science literacy. For example, the use of STEM-integrated teaching materials on impulse and momentum material has been proven to improve the scientific skills of students at the high school level (Widayoko *et al.*, 2020). The application of these models has proven effective in improving the quality of science learning and students' scientific literacy skills (Vibrianti *et al.*, 2023). In addition, training for educators is also very important to integrate science literacy into the learning process. This aims to enable educators to develop contextualized and meaningful learning activities (Yusmar & Fadilah, 2023). Therefore, an initial study of the condition of students' science literacy is needed as a basis for developing effective and relevant learning models.

Based on this background, this research aims to conduct a preliminary study of the level of science literacy of grade XI students in physics learning. In addition, this study also aims to identify aspects of literacy that still need to be improved. The results of this study are expected to be the basis for planning learning interventions that are more contextual and literative, as well as supporting the development of physics learning models in schools.

METHODS

This research applies a descriptive quantitative method, which aims to describe the phenomenon under study systematically, factually and accurately (Sugiyono, 2017). The quantitative approach was used to measure the level of students' initial science literacy skills, with data collected through a science literacy test instrument based on indicators set by Kemendikbudristek (2021). The research process involved descriptive data collection, which was then followed by in-depth analysis to find correlations between the variables studied. This research is also part of an effort to test the effectiveness of the generative learning model in improving the science literacy of grade XI students at the high school level. The initial data collection design used was as follows:

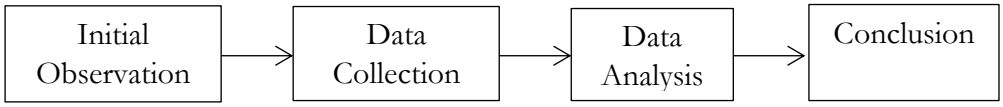


Figure 1. Research Steps

The population in this study included all students of class XI Phase F at SMAN 4 Padang. The research sample was taken using purposive sampling technique, by selecting class XI Phase F-9. This selection was based on the reason that students at this level showed readiness to engage in more active and interactive learning. The data collection technique used was a written test, which aims to measure students' science literacy related to physics material. This test consists of essay questions that have been prepared in accordance with the specified science literacy indicators. The data obtained were then analyzed using analytical descriptive method. Descriptive statistics are used to describe the results of students' initial science literacy in general.

RESULTS

The results of descriptive statistical analysis of the scores of science literacy questions from 31 students showed that the maximum value achieved was 65.71, while the minimum value was at 5.71. The average (mean) score obtained by students is 40.92, with a median value of 41.43. The median value which is slightly higher than the mean indicates that the data distribution tends to be negatively skewed, although the difference is relatively small. In addition, the standard deviation value of 9.64 indicates a moderate spread of data around the

mean. This means that most learners' scores are spread within a range of 9.64 points above and below the mean, indicating variation in science literacy among learners.

Table 1. Descriptive Analysis of Science Literacy

	N	Maxsimum Value	Minimum Value	Mean	Median	Standard Deviation
Learners's Science Literacy	31	65,71	25,71	40,92	41,43	9,64

Analysis of each indicator of students' science literacy showed that the overall average value of the three indicators was 38.96%. In detail, the indicator related to explaining scientific phenomena obtained the lowest achievement, which was 36.88%. The next indicator, evaluating and designing science knowledge, achieved a score of 38.75%. Meanwhile, the highest achievement was in the indicator of interpreting science data and evidence, which reached 41.25%. Overall, these values are still relatively low, as they have not reached the ideal threshold of 50% or more, which is required to show an adequate level of science literacy.

Table 2. Per-Indicator Science Literacy Result

Science Literacy Indicators	SMAN 4 Padang
Explanning science phenomena	36,88%
Evaluating and designing science knowledge	38,75%
Interpreting science data and evidence	41,25%
Average	38,96%

DISCUSSION

Based on the results of the science literacy test given to 31 students in grade XI SMA, the average score was 40.92. The distribution of scores shows that most students are in the low category, especially when compared to the international science literacy competency standards set by the Program for International Student Assessment (PISA). In this standard, the ideal science literacy score is in the range of 60 and above. This achievement also indicates that most learners have not been able to optimally utilize their science skills to understand, evaluate and make evidence-based decisions related to real-life problems.

The significant difference between the maximum and minimum scores indicates that there is considerable variation in science literacy skills among learners. This variation may be

influenced by factors such as differences in learning styles, access to learning resources, and teaching approaches applied by educators. The standard deviation value of 9.64 further corroborates the wide spread of scores, reflecting the unequal achievement of learning outcomes among learners. Thus, science literacy learning has not shown an equal distribution of competencies within groups of learners. From a curriculum point of view, these findings confirm that the implementation of science literacy-based learning in schools, especially in physics subjects, still needs improvement. Although the Merdeka Curriculum has accommodated the scientific approach and strengthened literacy, in practice, learning often focuses on conceptual aspects and places less emphasis on contextual problem solving or scientific evidence-based decision making.

Science literacy indicators consist of: 1) explaining science phenomena; 2) evaluating and designing science knowledge; and 3) interpreting science data and evidence (Mendikbutristekdikti, 2021). Based on the results of the analysis per science literacy indicator, the highest achievement was in the indicator of interpreting science data and evidence, which reached 41.25%. Meanwhile, the indicator of evaluating and designing scientific knowledge scored 38.75%, and the indicator of explaining scientific phenomena recorded the lowest score of 36.88%. Overall, the average value of the three indicators was 38.96%, which is still relatively low in the science literacy category.

When linked to the science literacy indicators set by the Minister of Education, Culture and Research, the low achievement in the first indicator shows that students still face difficulties in understanding and explaining scientific concepts that occur around them. This is likely due to learning approaches that emphasize memorization and formulas, without involving real contexts and daily experiences. The second indicator, which relates to the ability to evaluate and design scientific knowledge, also shows suboptimal achievement. This indicates that students' critical thinking and scientific experiment design skills need to be improved, especially in physics learning which should involve observation, hypothesis generation and testing. Meanwhile, the third indicator, interpreting scientific data and evidence, recorded the highest achievement although it is still relatively low. This achievement shows that students are starting to be able to read and interpret scientific data, although consistency in drawing valid evidence-based conclusions still needs to be improved.

This discussion supports the findings of previous research conducted by Pratiwi *et al.* (2019), which showed that science literacy has not been widely developed through

appropriate evaluation and has not been applied thoroughly in assessing students' abilities holistically. Therefore, systematic improvements are needed in the development of authentic and context-based evaluation instruments. In addition, training for learners in implementing learning models that have been proven effective in improving science literacy skills is also very important.

In the long run, improving science literacy will not only affect the cognitive achievement of students, but will also contribute to the formation of a generation that is critical, solutive, and able to adapt to the complexity of science-based global problems. Thus, the results of this study provide a significant foundation for designing learning models that are more innovative, interactive, and relevant to real-life contexts.

This research has an important role in understanding the initial results of students' science literacy. The initial picture serves as the basis for the next steps in developing the learning model. Thus, improving learners' literacy can be achieved effectively. This initial analysis becomes the main foundation in designing an efficient learning model. Therefore, this research is key in improving the quality of learning in the classroom.

CONCLUSION

Basic education has a very important role in shaping the foundation of students' knowledge, especially in learning Physics. The use of generative learning models is one solution to overcome the weaknesses of learning methods that still focus on educators. The generative learning model is designed to help learners build conceptual understanding actively. In this approach, learners not only passively receive information from educators, but are also involved in a series of activities that encourage them to associate prior knowledge with new concepts being learned. This model is proven to be very effective in learning physics. Therefore, the generative learning model not only improves mastery of the material, but also contributes to the improvement of learners' science literacy.

Based on the results of this preliminary study, it is recommended to carry out further research on generative learning models that use cognitive conflict strategies, with the aim of improving the science literacy of Phase F high school students. This further research is very important to evaluate more deeply the effectiveness of generative learning models in the context of science literacy of students. Therefore, the application of generative learning model is expected to provide significant benefits in improving students' science literacy.

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