JPPIPA 11(3) (2025)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Analysis of Scientific Literacy Capability in Aspects Attitude of Students in Yogyakarta

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Received: December 8, 2024
Revised: February 7, 2025
Accepted: March 25, 2025
Published: March 31, 2025

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DOI: 10.29303/jppipa.v11i3.6453

Abstract: One of the important qualities that students must possess is the ability to read and understand scientific texts. The ability and attitude of high school students' science literacy in Yogyakarta will be tested in this study. To provide a scientific explanation of what happens during data collection, this research uses a quantitative descriptive methodology. As many as sixty-six high school students from Yogyakarta were used as the research sample. The science literacy attitude aspect questionnaire was used as a direct data collection tool. Analysis, collecting literature, making instruments, presenting and reducing data, conclusion are some components of the data analysis method. In terms of the components of scientific literacy attitudes, the research found that high school students in Yogyakarta have a "enough" level of ability. Students' attitudes towards each component of scientific literacy skills are divided into three categories: "low" for honesty and critical thinking, "enough" for feeling of enthusiasm and collaborating, or "good" for perseverance and responsibility. Research findings indicate that high school students in Yogyakarta need to improve their scientific literacy skills, particularly in the attitude component. Ideas for better materials, appropriate learning media, and teaching models aligned with physics concepts are some of the efforts made to improve students' scientific literacy skills, which are still lacking in terms of attitude.

Keywords: Attitude aspects; Physics; Scientific literacy; Students; Yogyakarta

Introduction

To ensure that science knowledge encompasses both theory and practice, science education helps students build the capacity to understand how to effectively apply what they have learned in a real-world context. Nature and the forces that shape it are the focus of physics, a scientific discipline. According to Etkina (2017), the purpose of studying physics is to develop traits such as honesty, self-discipline, and critical thinking skills. Therefore, it is reasonable to say that physics education helps students become more science literate.

According to Acut (2024) and Pakpahan (2022) science literate students can apply what they have learned in the classroom to face real-world challenges. In order for students to not only understand scientific ideas but also apply science literacy skills in solving problems and making decisions based on scientific reasoning, they need to acquire scientific knowledge, develop a positive attitude towards science, and understand the basic principles of science (Lieskovský et al., 2022; Nasor et al., 2023; Yohamintin et al., 2023). Science literate students are better equipped to do a variety of things, including asking and answering questions about scientific phenomena, understanding the relationship between science and technology, and more.

According to PISA, science literacy includes four aspects: context, knowledge, competence and attitude (OECD, 2021). In the first aspect, "context", students should be able to identify real-world scenarios involving science and technology. The second aspect is knowledge-students should have a solid understanding of scientific facts and concepts, both in general and within the scientific community. The third aspect is

How to Cite:
Nurmarwaa, S., Jumadi, & Kuswanto, H. (2025). Analysis of Scientific Literacy Capability in Aspects Attitude of Students in Yogyakarta. *Jurnal Penelitian Pendidikan IPA*, *11*(3), 997–1002. https://doi.org/10.29303/jppipa.v11i3.6453

competence, where students are expected to apply the scientific method by demonstrating knowledge, understanding and ability to interpret and apply scientific facts and evidence. Finally, attitude is very important. Students must demonstrate an interest in science and a sense of responsibility for protecting the environment and natural resources. A positive attitude encourages learners to engage actively with scientific issues in their daily lives and to make informed decisions based on evidence (Julianto et al., 2022; Mehmood et al., 2023; Roza et al., 2023). It also fosters a sense of curiosity, openness to new ideas, and a willingness to collaborate in solving real-world problems (Aritonang et al., 2021; Sargioti et al., 2020). When students develop strong attitudes toward science, they are more likely to value the role of science in society and contribute to sustainable development.

The Partnership for 21st Century Skills states that in the face of advances in science and technology, education should aim to improve students' scientific literacy. However, in reality, the science literacy skills of students in Indonesia are still relatively low. This can be seen from the 2018 Program for International Student Assessment (PISA) results, where Indonesia ranked 64th out of 65 countries with a science literacy score of 382. According to Aritonang et al. (2021), Sargioti et al. (2020), and Sugrah et al. (2023), students' scientific attitudes are often neglected in the classroom because science education tends to focus more on memorizing facts and data. Research conducted by Rakhmawan et al. (2015) supports this statement. Their findings showed that among the four dimensions of science literacy-context (49.91%), process (48.93%), and content (56.19%)-the attitude dimension scored the lowest, only 14.83%. Students' inability to solve real-world problems is reflected in their low performance in the attitudinal dimension of science literacy (Candia et al., 2024). This suggests that many students still lack the necessary skills to address contemporary challenges.

Therefore, this study needs to be conducted to look at the science literacy skills of high school students in Yogyakarta, especially on the attitude element in physics learning. This research is important because scientific attitudes are the basis for developing scientific characters - such as critical thinking, environmental care, and responsibility - in facing real-life challenges. The purpose of this study is to determine the extent to which students' attitudinal aspects of science literacy have been developed through physics education and to identify factors that contribute to the low performance in this dimension. The findings are expected to serve as a basis for designing more effective learning strategies that can comprehensively strengthen science literacy.

Method

Research Design

This study uses a quantitative descriptive approach that aims to describe students' scientific literacy skills in the aspect of attitudes in physics learning at the high school level. This design was chosen to gain a clear understanding of how students' scientific attitudes are reflected in the learning process and its relationship to learning outcomes (Fadhila et al., 2020; Ningsi et al., 2019). This study does not provide treatment, or changes to the independent variables, but explains the conditions of the data in the field. The design flow in this study adopts (Miles et al., 1994) as follows:

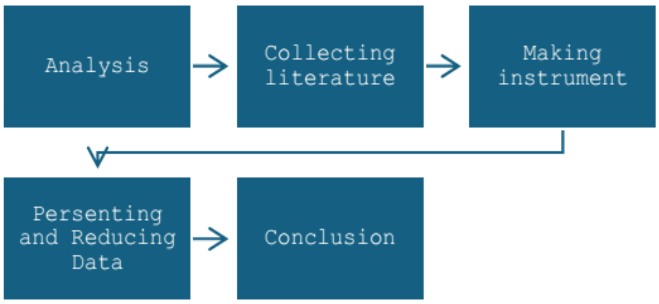

Figure 1. Design flow

Research Participants

The subjects of this study were 10th grade students at a public senior high school in Yogyakarta City. The number of participants was 66 students who were selected purposively by considering that the class had received relevant physics learning materials and the implementation of learning was carried out with an approach that allowed the development of students' scientific literacy. The selected students were also considered to have a representation of the general characteristics of high school students in Yogyakarta so that the research findings could be used as a basis for limited generalization.

Research Instruments and Data Collection Procedures

The main instrument in this study is a questionnaire on scientific literacy skills in the aspect of attitudes, which is structured based on scientific attitude indicators according to the PISA science literacy framework and developed in accordance with the context of physics learning. The questionnaire consists of five main indicators, namely: (1) enthusiasm for science, (2) honesty in the scientific process, (3) ability to cooperate, (4) perseverance in completing scientific tasks, (5) ability to think critically in data-based decision-making, and (6) ability to take responsibility for every decision. Each indicator is assessed through a number of attitude statements using a four-point Likert scale, ranging from "strongly disagree" to "strongly agree." In addition to the questionnaire, semi-structured interviews were also

conducted with several randomly selected students to delve deeper into their perceptions of the assessed attitude indicators. The research instrument grid and the distribution of questions on the aspect of science literacy attitude in this study are listed in the table 1.

Table 1. Instrument Grid and Question Distribution

Aspect of science literacy attitude	Indicator	Item Number
Feeling of enthusiasm	Actively asking questions and seeking information	1, 2, 3
Honesty	Answering based on facts	4, 5, 6
Collaborating	Collaborating, accepting, and appreciating others' opinions	7, 8, 9, 10, 11
Perseverance	Meticulous, not careless	12, 13, 14, 15
Critical thinking	Not easily accepting opinions without clear evidence	16, 17, 18
Responsible	Being responsible, punctual	19, 20

Data Analysis

The data obtained were analyzed descriptively and quantitatively. The results of the questionnaire were analyzed by calculating the percentage achievement of each attitude indicator using the equation:

$$Percentage\ Score = \frac{C_a}{N} \times 100\ \% \quad (1)$$

Description:
C_a : total questions answered correctly
N : total students

The percentage of achievement in the science literacy aspect of attitude descriptively based on the standard criteria listed in the table 2.

Table 2. Standard Criteria (Herlena S et al., 2024)

Percentage Interval (%)	Criteria
$86 \leq 100$	Very Good
$72 \leq 85$	Good
$58 \leq 71$	Enough
$43 \leq 57$	Low
$N \leq 43$	Very Low

Result and Discussion

This research aims to analyze the science literacy skills in the aspect of scientific attitudes of high school students in Yogyakarta. Scientific attitudes are one of the important domains of science literacy as defined by AlAli et al. (2024), Lam et al. (2024), and OECD (2019), which include attitudes towards science as a way of understanding the world, awareness of science and technology issues, and personal values such as honesty, responsibility, and cooperation.

Data collection was conducted by distributing questionnaires to 66 eleventh-grade students from several schools in Yogyakarta. This questionnaire was developed based on scientific attitude indicators according to Roberts (2000), and Yore et al. (2007), namely: (1) enthusiasm for science, (2) honesty in the scientific process, (3) ability to cooperate, (4) perseverance in completing scientific tasks, (5) critical thinking in decision-making, and (6) ability to take responsibility. The average percentage results of science literacy skills in the attitude aspect can be seen in Table 3.

Based on the data processing results from the questionnaire distributed to students in Table, it was found that the average percentage achievement of scientific attitude indicators is 65.08%, which falls into the sufficient category. These results reflect that, in general, students have demonstrated a moderate or developing scientific attitude, but there are still certain aspects that need improvement.

Table 3. Average Percentage Science Literacy Skills Aspect of Attitude

Aspect of science literacy attitude	Percentage (%)	Criteria
Feeling of enthusiasm	71	Enough
Honesty	53	Low
Collaborating	62.5	Enough
Perseverance	82	Good
Critical thinking	49.5	Low
Responsible	72.5	Good
Average	65.08	Enough

Of the six analyzed scientific attitude indicators, the perseverance indicator occupies the highest position with an achievement of 82% and falls into the good category. This indicates that students are quite diligent and consistent in completing scientific tasks, such as experiments or project-based learning activities. These findings are in line with the opinion of (Kurbanoğlu et al. (2023), and Rahmatiah et al. (2023), who state that perseverance is one of the important indicators in the formation of students' scientific attitudes and is greatly influenced by interest and teacher support in learning.

The responsibility indicator also shows a good achievement, at 72.5%, which means that students have a sense of responsibility in carrying out tasks and following the rules that apply during science lessons. Meanwhile, the enthusiasm indicator for science reached 71% and fell into the sufficient category, indicating that most students showed interest and curiosity towards science materials, but there is still room for improvement, especially in terms of learning motivation and active involvement in scientific activities.

On the other hand, the cooperation indicator received a score of 62.5%, still in the sufficient category, indicating that students' ability to collaborate during scientific activities has developed, but is not yet fully optimal. Group-based learning activities such as discussions or practical should be more focused on improving students' communication and teamwork skills.

The indicators that received the lowest scores are honesty with a score of 53%, and critical thinking with a score of 49.5%, both of which fall into the low category. The low honesty indicator indicates that there are still students who are not honest in reporting experimental data or in the process of completing assignments. This is an important concern because honesty is the main foundation of scientific ethics. Similarly, with critical thinking, students still seem to struggle with evaluating information in depth and making decisions based on scientific evidence. However, critical thinking skills are very important in the science learning process because they are directly related to problem-solving abilities and scientific decision-making (Alberida, 2020; Hayati et al., 2023; Karimi et al., 2024; Muhibbuddin et al., 2019; Verawati et al., 2023).

Overall, the results of this study indicate that although some scientific attitudes such as perseverance and responsibility have developed well, more intensive efforts are still needed to cultivate students' honesty and critical thinking. The application of the Problem-Based Learning model and inquiry approach can be an effective strategy to more comprehensively cultivate scientific attitudes. These findings support previous research by Mulyono et al. (2024) and Sjöström (2024), which demonstrate the importance of integrating learning that fosters scientific attitudes in real-life contexts to enhance overall science literacy.

Conclusion

Based on the research conducted on students' science literacy skills in the attitude aspect in Yogyakarta, it was found that the average achievement of students' scientific attitude indicators falls into the sufficient category, with an average score of 65.08%. From the six indicators analyzed, the indicators of perseverance and responsibility showed the highest achievement and fell into the good category, reflecting that students have commitment and consistency in science learning activities. However, the indicators of honesty and critical thinking received the lowest percentages and fell into the low category, indicating that students still need to be encouraged to be more honest in presenting scientific data and to be able to evaluate information in a deep and logical manner. Meanwhile, the indicators of enthusiasm for science and cooperation fall into the adequate category, indicating that although interest and collaboration in learning are present, they still need to be improved. Therefore, a more active, participatory, and problem-based (Problem-Based Learning) or inquiry-based learning approach is needed to more evenly develop and strengthen students' scientific attitudes. These findings have important implications for educators and curriculum developers to not only focus on knowledge aspects but also emphasize the development of scientific attitudes as an integral part of comprehensive science literacy.

Acknowledgements
The authors would like to thank the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia with DRTPM and "Beasiswa Unggulan 2023" which has provided funding support and opportunities.

Author Contributions
"Conceptualization, Syarifa Nurmarwaa; Methodology, Jumadi; Software, X.X.; Validation, Heru Kuswanto; Formal Analysis, Jumadi; Investigation, Syarifa Nurmarwaa; Resources, Heru Kuswanto; Data Curation, Syarifa Nurmarwaa; Writing–Original Draft Preparation, Syarifa Nurmarwaa; Writing–Review & Editing, Jumadi.; Visualization, Syarifa Nurmarwaa.; Supervision, Jumadi, Heru Kuswanto; Project Administration, Syarifa Nurmarwaa; Funding Acquisition, Jumadi, Heru Kuswanto".

Funding
This research was funded by the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia through DRTPM and "Beasiswa Unggulan 2023".

Conflicts of Interest
The author(s) declare no conflict of interest.

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