Vol. XI No. 2 December 2025
DOI: https://doi.org/10.19109/bioilmi.v11i2.30138
E-ISSN: 2527-3760
Page: 81 - 92

Analysis of Science Literacy Abilities Through Authentic Assessment of High School Students

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ARTICLE INFO

***Article history*:**
Received: 07/07/2025
Revised: 23/12/2025
Accepted: 24/12/2025

***Keywords*:**
Authentic Assessment,
Biological Technology Innovation,
Factors Affecting,
Scientific Literacy

ABSTRACT

Indonesian students' scientific literacy skills from 2000 to 2022 remain low, as their scores are below the average PISA (Philosophy of Science and Technology) completion score. This study aims to analyze high school students' scientific literacy skills in the field of biological technology innovation through authentic assessment. This research is descriptive and quantitative. The study was conducted at SMAN 1 Medan. The population was all 432 tenth-grade students from 12 classes. The sample size was 72 students from two classes: class X1 and class X5. Simple random sampling was used as the sampling technique. Data collection used authentic assessment instruments, consisting of 10 essay questions and a 25-item questionnaire. The data were analyzed using a descriptive percentage formula. The results showed that students' scientific literacy skills were in the adequate category, with a percentage of 57%. A score of 57% reflects that most students have a basic understanding of scientific concepts, but are unable to fully master them or apply them optimally in real-life contexts. Internal factors influencing students' scientific literacy skills are categorized as good, with a percentage of 73%, and external factors are categorized as good, with a percentage of 75%. The research results show that students' scientific literacy skills are generally in the "adequate" category, although influencing factors, such as the availability of facilities and infrastructure, the quality of learning, and the role of teachers, are classified as "good." This indicates an imbalance between the potential of a supportive learning environment and suboptimal student learning outcomes.

INTRODUCTION

The development of technology and knowledge in the 21st century presents its own challenges, both in education and work, therefore, a generation is needed that has relevant skills to be able to keep up with the changing times. One of the important skills that students need to have to broaden their horizons and compete in this era is scientific literacy. Scientific literacy emphasizes the importance of thinking and acting skills, which include scientific thinking skills and approaches in understanding and responding to various social issues (Zuhri *et al*., 2023). Scientific literacy is a skill that every student must have, so that students can use science to solve their problem in life. Scientific literacy is characterized by competency indicators such as practical, conceptual, and procedural knowledge about biology and life, energy and change, Earth and space, the environment, technology, and society. Science is considered an integral part of life and is interconnected with other aspects of knowledge such as the environment, society, economics, and technology (Ryandi & Hasruddin, 2024).

The Programme for International Student Assessment (PISA) 2018 states that scientific literacy is divided into three main components, namely: (1) Science context; (2) Science knowledge; and (3) Science competence. PISA measures students' abilities in three main areas:

reading, mathematics, and science.This program is part of the Organization for Economic Cooperation and Development (OECD), an organization that focuses on economic cooperation and development. PISA involves 72 countries around the world and assesses 15-year-old students, who are generally in the 9th grade of junior high school or early high school, through basic tests in reading, mathematics, and science. Every three years, PISA emphasizes one of these areas in turn (Yusmar and Fadilah, 2023). This type of evaluation focuses on practical skills. It asks students to apply their knowledge to solve real problems or create something tangible, ensuring they can use what they learned in the classroom in the outside world. Authentic assessment requires educators to observe students' learning progress in real-world settings, and assessment is conducted using various methods. Assessment focuses on the student's task completion process (Sitorus et al., 2023).

Indonesia has been involved in the PISA study since 2000. Indonesia's scientific literacy rankings from 2000-2021 are: 2000, ranked 38th out of 41 countries with a score of 393; 2003, ranked 38th out of 40 countries with a score of 395; 2006, ranked 50th out of 56 countries with a score of 393; 2009, ranked 60th out of 65 countries with a score of 383; 2012, ranked 64th out of 65 countries with a score of 382; 2015, ranked 62nd out of 69 countries with a score of 403; 2018, ranked 71st out of 79 countries with a score of 396; 2022, ranked 67th out of 81 countries with a score of 383. Based on these data, it is known that the ability of Indonesian students for scientific literacy from 2000 to 2022 is still in the low category because the scores obtained are below the average PISA completion score (OECD, 2004: 2007: 2010: 2013: 2016: 2019: 2023). Indonesian students still struggle to grasp scientific ideas and often find it hard to use what they've learned in their daily activities (Sutrisna, 2021).

Measurement for these skills must use appropriate and good instruments, one of the instruments that can be used is Authentic Assessment. Authentic assessment is often referred to as Authentic Assessment which means a type of learning outcome assessment that requires students to demonstrate one achievement and learning skill. Authentic assessment as an instrument in assessing student learning outcomes is certainly constructed in the curriculum system by paying attention to aspects of adjustment to needs, especially student needs (Irawan, 2024). Authentic assessment encourages students to create original ideas and combine what they've learned to complete real-world tasks. It allows them to demonstrate the practical skills and knowledge they gained throughout the course (Mulyana *et al*., 2019). The results of authentic assessment can be used as material to improve the learning process that meets educational assessment standards.

Based on the results of direct observation in class X and interviews with one of the biology teachers at SMAN 1 Medan, it is known that the learning model applied is Problem Based Learning and the school implements the Independent Curriculum. In Problem-Based Learning (PBL), assessment is not limited to traditional written tests. The most appropriate method is authentic assessment, as it measures how students actually work and solve problems. Student work, both individual and group, can be effectively assessed using tools such as assessment rubrics, checklists, or rating scales. Performance assessment is particularly useful for measuring students' ability to solve assigned problems and assessing the quality of their teamwork. Learning at school is carried out face-to-face using media in the form of power points, infocus, and biology textbooks. However, students still have difficulty understanding biology material, especially on the topic of biological technology innovation. This can be seen from the difficulty of students in answering teacher questions, answering questions where they tend not to read the questions carefully and also the results of interviews with subject teachers, teachers have not fully implemented Authentic Assessment in measuring students' scientific literacy skills. So far, teachers have only asked students to read science-based narrative texts and work on practice questions. Research conducted by Zulanwari et al. (2023) found that the literacy skills of tenth-grade students at SMAN 1 Sakra, based on PISA questions, were classified as low, with an average scientific literacy percentage of 46.26%. Many students struggle with science because they don't fully grasp the core concepts or have the right mindset toward the subject. This often leads them to skim through their assignments without actually understanding the problems they are trying to solve. To address this, a study called

"Analysis of Science Literacy Abilities Through Authentic Assessment of High School Students" will examine how using real-world assessments can improve students' scientific literacy.

MATERIALS AND METHODS

1. Time and Place of Research

This study took place at SMAN 1 Medan, situated on Teuku Cik Ditiro Street in Medan Polonia, North Sumatra. The research was carried out over six months, from January to June 2025.

2. Research Method

The quantitative descriptive approach is a research method that aims to explain or interpret certain phenomena using data in the form of numbers or statistics.

3. Populations and Sample

The research population consisted of all 12 tenth-grade classes at SMA N 1 Medan, totaling 432 students. A simple random sampling technique was applied to select participants, giving every individual in the population a fair and equal opportunity to be included. Sugiyono (2011) Simple random sampling involves picking participants by chance, regardless of any specific groups within the population. For this research, the sample consisted of 72 students in total, divided equally between classes X_1 and X_5. So, the total sample is 72 students.

4. Research Procedure

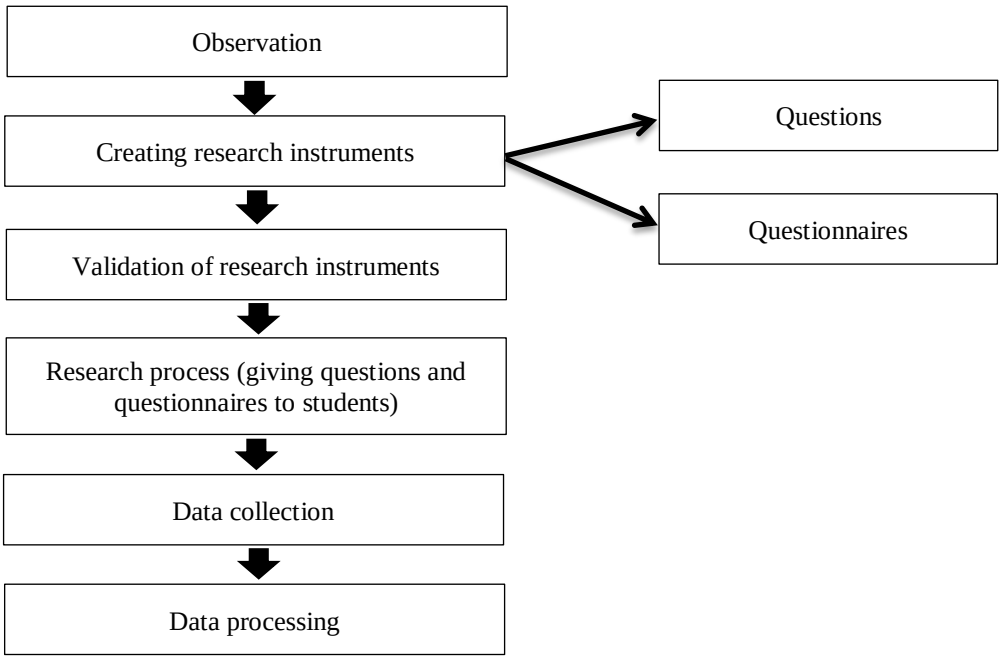

Figure 1. Stages of the research (Sugiyono (2011).

5. Data Collection

Data collection techniques using essay test instruments consisting of 10 questions that have been tested for validity and reliability to measure students' scientific literacy skills and using a questionnaire instrument with 25 statements for factors that influence scientific literacy skills. The questions used in this study contain material on conventional biotechnology and modern biotechnology. The statements in the questionnaire used in this study contain internal and external factors. Other instruments such as interviews during pre-research and documentation to support the research. Analysis of test result data is done by scoring.

6. Data Analysis

The test result data that has been scored is then converted into a value using the formula (Purwanto, 2013):

$$Scores = \frac{Score\ obtained}{Maximum\ score} \times 100\ \%$$

Table 1. Interpretation of Students' Scientific Literacy Levels

Score Interval	Categories
80-100	Very High
60-79	High
40-59	sufficient
20-39	Low
0-19	Very Low

The analysis of the questionnaire data was done by scoring. The questionnaire data that had been scored was then converted into a value using the Likert scale formula (Sugiyono, 2011):

$$Percentage(\%) = \frac{Total\ scores\ obtained}{Total\ Maximum\ score} \times 100\%$$

Table 2. Interpretation of Student Questionnaire Result Levels

Percentage Interval	Scores	Criteria
77-100%	80-100	Very Good
52-75%	61-79	Good
27-50%	51-60	sufficient
≤25%	≤50	Low

RESULTS AND DISCUSSION

Analysis of Science Literacy Skills

Based on research about how well 10th-grade students at SMAN 1 Medan understand science in learning the material of biological technology innovation, data were obtained from an essay test consisting of 10 questions. The number of respondents was 72 students. The data were obtained by calculating the scores of the results of the scientific literacy test for Class X students at SMAN 1 Medan are shown in Table 3. These results are broken down into three parts: context, knowledge, and competency.

Table 3. Data on the Results of Science Literacy of Grade X Students on Biotechnology Material

No	Classification	Score Interval	Frekuensi	Percentage
1	Very High	80-100	4	6%
2	High	60-79	26	36%
3	sufficient	40-59	35	49%
4	Low	20-39	7	10%
5	Very Low	0-19	0	0%
Students			72	
average score			**57%**	

Research shows how well students generally understand science ability is 57% and is included in the "Sufficent" category. The score of 57% reflects that most students have a basic understanding of science concepts, but have not been able to master them thoroughly or apply them

optimally in real-life contexts. This score reflects that students still have difficulty in developing critical thinking skills, solving problems based on scientific principles, and interpreting science-based data or information in depth. Scientific literacy encompasses not only theoretical understanding but also critical thinking skills, problem-solving abilities, and the use of scientific information in decision-making. Scientific literacy requires not only mastery of theory but also the ability to apply this knowledge logically and reflectively to everyday situations, which appears to remain a challenge for most students in this study (Mayasari, 2019). This is also supported by research (Takda *et al*., 2023), which found that only around 20% of students were able to answer questions correctly. This is because students lack the ability to develop conclusions, justify relationships in formulas, read graphs, design experiments, and identify variables. Students experience difficulty answering questions related to scientific investigations. One factor contributing to students' difficulty in determining variables is their lack of familiarity with identifying variables in experiments.

Improving students' learning abilities, speed, and effectiveness can also contribute to their ability to think creatively to solve various problems. Authentic assessment is often referred to as (Authentic assessment) measures a student's ability to use their skills in practical, everyday contexts rather than just on paper in the form of performance or learning outcomes. Authentic assessment includes both formal tests and other evaluation methods. One example of a testing-based approach is the performance assessment, project assessments, portfolio assessments, self-assessments and assessments using essay test instruments and questionnaires. Assessments using essay test questions and questionnaires are suitable for measuring students' scientific literacy skills and factors that influence students' scientific literacy skills (Hasruddin *et al*., 2018).

1. Contextual Aspect

The context of science refers to the situation or setting in which a scientific concept, principle, or phenomenon is applied or considered. It involves understanding how science interacts with everyday life, society, and technology. According to the OECD (2019), the "context" of science involves using scientific knowledge to understand personal, local, and international issues from both the past and present. The specific data regarding how students performed in this area can be found in Table 4.

Table 4. Data on the Results of Science Literacy Skills in the Context Aspect

Aspect	Item	Percentage	Average Score	Categories
Contectual	Personal	29%	29%	Low
	Local/Nasional	19%		
	Global	39%		

Scientific literacy involves applying science to real-life situations. However, a recent study found that only 29% of students were able to successfully use their scientific knowledge in these everyday contexts.This shows that grade X students of SMA N 1 Medan have not been able to engage with scientific issues related to students' personal, groups (local/national), and life around the world (global context) related to scientific knowledge. This indicates that students still have considerable difficulty in connecting science concepts with real-life situations. The context aspect in science literacy includes students' ability to understand, assess, and make decisions based on scientific issues that are relevant to everyday life (Mayasari, 2019). Scientific context is used in education to help students connect classroom lessons with their daily lives. It focuses on real-world situations where science is used, allowing students to better understand scientific concepts and how to apply them in practice (Rini *et al.,* 2021).

2. Knowledge Aspect

Scientific literacy involves more than just knowing facts; it includes understanding the natural world and technology (content knowledge), knowing the methods used to discover these facts (procedural knowledge), and understanding why those specific methods are trusted and

used (epistemic knowledge). This framework, based on OECD (2019) standards, is used to evaluate student performance in the "Knowledge" category, as shown in Table 5.

Table 5. Data on the Results of Scientific Literacy Skills in the Knowledge Aspect

Aspect	Item	Percentase	Average Score	Categories
Knowledge	Content	52%	40%	Sufficient
	Procedural	31%		
	Epistemik	34%		

The content of science involves the basic ideas we need to understand nature and how humans impact the world. Testing scientific literacy helps us see if students can use what they've learned in their daily lives. Research shows that 10th-grade students at SMA N 1 Medan scored 40% in this area, which is considered a "sufficient" level. This means these students have a basic grasp of scientific facts and theories, as well as an understanding of how those ideas are formed.

When viewed in each aspect of knowledge, content knowledge has a higher ability compared to procedural knowledge and epistemic knowledge. Students' science content knowledge has a percentage of 52% and is categorized as sufficient. A high percentage of science literacy content knowledge indicates that the individual has mastered the concept of a material. A student's content knowledge in the average category indicates a basic understanding of the subject matter, but not yet a complete or comprehensive grasp (Rahmayanti *et al*., 2021). At this level, students are generally able to recognize key concepts, recall important information, and answer straightforward or routine questions. However, when faced with questions that require higher-level reasoning, conceptual integration, or application in new contexts, students often struggle (Yusmar & Fadillah, 2023).

Research indicates that students struggle with procedural knowledge, scoring only 31%. This low performance stems from a tendency to focus strictly on scientific theories rather than practical application. According to Mellyzar *et al*., (2022), this gap exists because classroom instruction often prioritizes verbal lectures over hands-on learning, making it difficult for students to master the actual processes of science. Procedural knowledge encompasses the ability to know how to do something—for example, following the steps of an experiment, using a formula, operating a tool, or applying a problem-solving strategy. When students' average scores are low in this area, it indicates that they are unfamiliar with or do not fully understand the sequence and workings of a process (Rahmayanti *et al*., 2021). As a result, students can understand various scientific concepts only by rote so that when they are applied in real life, they cannot run properly. Questions about epistemic knowledge require students to understand not only how to find solutions to a problem, but also to consider whether this evidence can scientifically justify the conclusions of the statements given.

3. Competency Aspects

This set of science competencies treats science as a shared group of social and intellectual practices used across all scientific fields. Rather than just listing facts, these competencies focus on actions—showing exactly what a scientifically literate person knows and can actually do. The data regarding student performance in these specific areas is presented in Table 6.

Table 6. Data on the Results of Science Literacy Skills in the Competency Aspect

Aspect	Item	Percentage	Average Score	Categories
Competency	Explaining Scientific Phenomena	24%	19%	Very Low
	Evaluating and Designing	16%		

Aspect	Item	Percentage	Average Score	Categories
	Scientific Inquiry			
	Interpreting Data and Evidence Scientifically	18%		

Research indicates that students are struggling significantly with scientific literacy, scoring only 19% in overall competency. This "very low" performance suggests that most students find it difficult to handle the basics of science. Specifically, they have trouble forming scientific questions, planning experiments, and making sense of data to reach logical conclusions. Ultimately, these results show that many students are not yet able to use a structured, scientific approach to thinking in their schoolwork or practical activities. This is certainly a big challenge in preparing students to face real problems that require science-based analysis and problem-solving skills (Mellyzar *et al*., 2022). A low average score in students' science competencies indicates that most students have not yet mastered the basic skills needed to fully understand and apply science. Science competencies encompass three main aspects: conceptual (cognitive) knowledge, science process skills, and scientific attitudes. A low average score indicates that students have difficulty understanding scientific concepts, are not skilled in conducting scientific activities such as observation, experimentation, or data analysis, and have not yet demonstrated good scientific attitudes such as curiosity, critical thinking, and responsibility in learning. Students of SMAN 1 Medan are less proficient in the competency of evaluating and designing scientific investigations. The competency of evaluating and designing scientific investigations has a percentage of 16%. This is because the competency of evaluating and designing scientific investigations requires high analytical skills, so that seriousness and accuracy are needed in answering questions. (Mellyzar *et al*., 2022).

The competency category evaluates how a person thinks through scientific problems. It focuses on the ability to recognize relevant evidence, interpret data, and draw logical conclusions. This includes understanding the limits of science, identifying what data is required for an experiment, and ensuring that final results are backed by facts. These three aspects of scientific competence are interrelated and form the foundation of comprehensive scientific literacy. Effective science learning should develop these three aspects in a balanced manner so that students not only master theory but also become skilled in practice and develop attitudes consistent with the scientific spirit (Irsan, 2021).

Factors Affecting Scientific Literacy Skills

Tenth-grade students at SMA N 1 Medan showed average science literacy skills in their recent tests. Their scores fall into the "sufficient" category, which is shaped by a mix of personal traits and outside influences. Internal factors that exist within or are inherent in students and external factors that occur directly so that they can be felt by students. Based on the data from the questionnaire on factors that influence students' science literacy abilities, the following data was obtained:

1. Internal Factors

Several internal factors, such as a student's interests, motivation, and study habits, play a key role in shaping their scientific literacy. These personal elements directly impact how well a student understands science. The specific data collected from the questionnaires regarding these internal influences is presented in Table 7.

Table 7. Internal Factors Affecting Students' Science Literacy Skills

Indicator	Sub-indicator	Percentage	Average Percentage	Categories
Interest	Enjoyment of Learning	76%	73%	Good
Study Habits	Readiness to learn	67%		
Motivation	Passionate about learning	78%		

Students' interest in biology directly impacts their scientific literacy. Survey data shows a 76% interest level among students, which is considered a "good" rating. Essentially, a strong interest in the subject leads to better academic performance because interested students are more focused and motivated to work hard. Conversely, without this curiosity, achieving high-quality learning outcomes becomes much more difficult. As expressed by Jufrida *et al*., (2019) Students who are truly interested in learning will finish their assignments even if they are very hard. This passion acts as a powerful motivation to get things done. Interest is an inner drive within students that makes them interested, happy, and motivated to learn a subject, including science. When students have a strong interest in science, they will be more active in participating in learning, seeking additional information, and more diligent in understanding scientific concepts. This interest also encourages students to engage in scientific activities such as experiments, discussions, or science projects, ultimately strengthening their scientific literacy skills (Fuadi *et al*., 2021).

Student motivation in learning can also affect students' scientific literacy skills. Based on the results of the student motivation questionnaire, it showed a percentage of 78%. Similar to interest, good motivation will show good results. Learning without motivation in a person will be difficult for him to succeed. As expressed by Retariandalas, (2017) Students with strong motivation usually perform better academically, while those who lack drive often see poorer results. Additionally, a student's daily study habits play a major role in how well they understand scientific concepts. When students are highly motivated to learn, whether due to personal interest, curiosity, or a drive to achieve, they will be more active and persistent in understanding science material. Motivated students tend to actively ask questions, explore, and persist when faced with difficulties. This encourages them to read, research, and apply scientific concepts in real life—all of which are essential components of scientific literacy. Conversely, students with low motivation typically show weak interest in learning, get bored easily, and tend to be passive during lessons. They are less encouraged to understand concepts deeply or engage in science-based learning activities such as experiments, discussions, or problem-solving. This directly impacts low scientific literacy skills, as students are not accustomed to using knowledge critically and functionally. Therefore, it is important for teachers and learning environments to build student motivation through relevant approaches, providing positive feedback, reinforcing achievement, and creating challenging yet enjoyable learning. When motivation is high, students will be more prepared and enthusiastic about developing their scientific literacy (Jufrida *et al*., 2019; Supriwardi *et al*., 2021).

Based on the results of the study, students' learning habits obtained a percentage of 67%. Students are said to have good learning habits if they can choose good learning methods so that a pleasant learning atmosphere is created and this situation can support and help students in learning (Hanafi et al., 2019). Regular, diligent, and strong learning habits will have balanced results, but poor or irregular learning habits will also produce poor results. Good study habits include regular study habits, effective time management, the use of appropriate study strategies (such as summarizing, practicing exercises, or engaging in discussions), and an active approach to seeking and understanding information. Students with consistent study habits tend to be better prepared for science lessons, understand concepts more easily, and are better able to apply knowledge in various contexts. This supports the development of scientific literacy, as scientific literacy is not just about memorizing information, but also about understanding, analyzing, and communicating scientific ideas critically and logically (Fuadi *et al*., 2021).

2. External Factors

Student success is often shaped by outside influences, such as how a teacher conducts a class, the quality of school equipment, and the level of encouragement from parents. In particular, the specific teaching techniques used in the classroom play a major role in how well students understand science. You can find the survey results regarding these external factors in Table 8.

Table 8. External Factors Influencing Students' Science Literacy Skills

Indicator	Sub-indicator	Percentage	Average Percentage	Categories
Learning methods	Implementation of learning strategies	78%	75%	Good
Facilities and infrastructure	Availability of school facilities and infrastructure	77%		
Parental Support for Education	Parental Attention	71%		

How a teacher chooses to teach directly impacts how well students understand science. According to survey data, this teaching style has a 78% influence on student outcomes. To reach their goals and get the best results, teachers must carefully select the most effective methods for their classrooms. This is in line with the opinion of Prihatini (2017) in her research entitled The Influence of Learning and Learning Interest on Science Learning Outcomes which states that the learning method is one of the supporters and supporters of an effective learning process so that it can increase interest and make it easier for students to receive learning so that they will get satisfactory results. Learning methods play a crucial role in influencing students' scientific literacy skills. The methods teachers use to deliver material will determine the extent to which students can understand, process, and apply scientific concepts in everyday life. Active and participatory learning methods—such as inquiry, experiments, group discussions, problem-based learning, or project-based learning—can help students build a deeper understanding of concepts, develop critical thinking skills, and improve their ability to read and interpret scientific information. All of these are part of scientific literacy (Hasruddin *et al*., 2018).

The facilities and infrastructure in the school also support students' scientific literacy skills. Learning requires media, information technology and other facilities that can support learning and make students feel comfortable so that students can directly relate science materials according to real-life contexts. Based on the results of the questionnaire obtained, the facilities and infrastructure showed a percentage of 77%. This shows that the school has provided good facilities, the school also has a biology laboratory that can help students improve their scientific literacy skills. School facilities and infrastructure significantly influence students' scientific literacy skills. These include all equipment and tools used in the learning process, such as textbooks, teaching aids, microscopes, laboratory materials, and educational technology like computers and projectors. Having complete and adequate facilities and infrastructure will support a more interactive, contextual, and hands-on science learning process, ultimately enhancing students' understanding of scientific concepts and developing their scientific skills (Jufri, 2017; Gani *et al*., 2020).

Research shows that 71% of students benefit from parental involvement, which significantly boosts their scientific literacy. Because the home is a child's primary place of learning, parents play a vital role in guiding their education. By providing this support, parents help children overcome academic challenges and succeed in their studies. Parental support plays a crucial role in improving students' scientific literacy skills (Miski, 2015; Marshanda *et al*., 2025). Parents who are actively involved in their children's learning can create a home environment that encourages curiosity, disciplined learning, and reading habits. For example, parents who provide science books, help children understand scientific concepts, or discuss everyday natural phenomena can help children develop a stronger understanding of science. This support also includes providing motivation, monitoring study time, and rewarding children for their efforts and achievements in science (Palupi *et al*., 2021; Mulwandani *et al*,. 2024).

The research results show that students' scientific literacy skills are generally in the "adequate" category, although influencing factors, such as the availability of facilities and infrastructure, the quality of learning, and the role of teachers, are classified as "good." This

indicates an imbalance between the potential of a supportive learning environment and suboptimal student learning outcomes. Despite adequate learning environments and processes, students' ability to understand, apply, and reflect on scientific knowledge remains limited. This is likely due to the suboptimal utilization of these supporting factors in learning activities that truly foster active, critical, and contextual scientific literacy. The difference between student learning outcomes and the quality of supporting factors indicates a gap between potential and realization. This means that even though students receive good support from teachers and learning facilities, this has not yet significantly improved their scientific literacy skills. This could be due to the suboptimal utilization of these factors in the teaching and learning process. For example, teachers may possess good competencies but have not yet implemented methods that truly encourage students to think critically and actively explore scientific concepts. This lack of contextual and active learning methods is also evident. Even if the teacher's skills are good, the approach they use may still be lecture- or memorization-centered (Prihatini, 2017). Scientific literacy requires students not only to understand the material but also to be able to apply it in real-life situations, such as understanding natural phenomena, interpreting data, and making scientific decisions (Hanafi et al., 2019).

CONCLUSION

Based on the research conducted with Grade X students at SMAN 1 Medan during the 2024/2025 academic year, the findings are as follows: Overall Performance: Students demonstrated a "moderate" level of scientific literacy regarding biological technology innovations, achieving an average score of 57%. Influencing Factors: The study identified two main drivers of these literacy skills: Internal Factors: Elements such as student motivation and prior knowledge scored 73%, falling into the "good" category. External Factors: Environmental and educational influences also performed well, reaching a score of 75%.

ACKNOWLEDGMENTS

The author would like to thank the students of class X and teacher at SMAN 1 Medan who have contributed to the process of collecting data and writing this article. Thank you to the supervisor who has helped in the process of writing this article so that it can be completed well and correctly.

REFERENCES

Fuadi, Husnul, Annisa. Z. R., Jamaluddin, & Abdul. W. J. (2020). Analisis Faktor Penyebab Rendahnya Kemampuan Literasi Sains Peserta Didik. *Jurnal Ilmiah Profesi Pendidikan*, 5(2): 108–116.

Gani, A. R. F., Zaimah, U., & Wulandari, S. R. (2020). Studi Literatur Upaya Meningkatkan Literasi Informasi Siswa Pada Mata Pelajaran Biologi Selama Belajar Daring Efek Covid-19. *Bioilmi: Jurnal Pendidikan*, *6*(2), 129-136.

Hanafi, M. (2019). The Effect Of Learning Habits And Teachers ' Role In Learning, *Jurnal Kajian Pendidikan Akuntansi Indonesia*. 5(1): 1–15.

Hasruddin, Harahap, F., & Mahmud. (2018). Penyusunan Instrumen Keterampilan Proses Sains Berbasis Inkuri Kontekstual pada Perkuliahan Mikrobiologi. *Konferensi Pendidikan Biologi Prosiding*, 15(01): 627–634.

Irawan, A. (2024). Model Penilaian Otentik Arah Kurikulum. *Al-Mujaddid: Jurnal Ilmu Agama*, 6 (1): 09-20.

Jufri, A. W., (2017). *Belajar dan Pembelajaran Sains: Model Dasar Menjadi Guru Profesional*. Bandung: Pustaka Reka Cipta.

Jufrida, F. R., Basuki, M. D. P., & Nugroho, A. D. P. (2019). Analisis Faktor Yang Mempengaruhi Hasil Belajar IPA Dan Literasi Sains Di SMP Negeri 1 Muaro Jambi. *Jurnal Pendidikan Fisik*, 4(2): 32-40.

Marshanda, F. L., Destiansari, E., & Meilinda. (2025). Application of Problem Based Learning Based E-LKPD on Digital Literacy and Critical Thinking Skills of High School Class X Students. *Bioilmi: Jurnal Pendidikan*, *11*(1), 1-12.

Mayasari, T. (2019). Analisis Kemampuan Literasi Sains Siswa Kelas XI SMAN Dikota Yogyakarta Mata Pelajaran Biologi Ditinjau Dari Kefavoritan Sekolah. *Jurnal Edukasi Biologi*, 8(1): 86-92.

Mellyzar, M., Zahara, S. R., & Alvina, S. (2022). Literasi sains dalam pembelajaran sains siswa SMP. *Pendekar: Jurnal Pendidikan Berkarakter*, 5(2): 119-124.

Miski, R. (2015). Pengaruh Sarana Dan Prasarana Terhadap Hasil Belajar Siswa. Tadbir Muwahhid, 4(2): 69–73.

Mulwandani, Z., Fajrina, S., Lufri, & Fadilah, M. (2024). Enhancing Students Sustainability Literacy through a Green Economy-Based Project-Based Learning Model. *Bioilmi: Jurnal Pendidikan*, *10*(2), 99-104.

Mulyana, A., Khoirunnisaa, A., Darma, C., Uthartianty, R., Suwanto, S., & Gianjar, G. (2019). *Model Penilaian Autentik pada Pendidikan Kesetaraa Program Paket C dalam Jaringan*. Bandung: PP-Paud dan Dikmas.Nasution, L. M. (2017). Statistik Deskriptif. *Hikmah*, 14(1): 49-55.

Organization for Economic Cooperation and Development (OECD). (2004). *PISA 2003*. Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2007). *PISA 2006*. Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2010). *PISA 2009*. Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2013). *PISA 2012 Results in Focus* . Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2016). *PISA 2015 Results in Focus. Paris*: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2019*). PISA 2018 Assesment and Analytical Framework*. Paris: OECD Publishing.

Organization for Economic Cooperation and Development (OECD). (2023). *PISA 2022 Assesment and Analytical Framework*. Paris: OECD Publishing.

Pakpahan, N. A., & Hasruddin, H. (2021). Kemampuan Literasi Materi Sistem Gerak Siswa SMA pada Masa Pandemi Covid-19. *Jurnal Review Pendidikan Dan Pengajaran (JRPP)*, 4(1): 162-172.

Palupi, D., Ngatman, & Susiani, S., T. (2021). Pengaruh Bimbingan Belajar Orang Tua Terhadap Hasil Belajar Ipa Siswa Kelas Iv Sdn Sekecamatan Puring Tahun Ajaran 2020/2021. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, 9(3): 60-73.

Prihatini, E. (2017). Pengaruh Metode Pembelajaran Dan Minat. *Formatif : Jurnal Ilmiah Pendidikan MIPA*, 7(2): 171–179.

Purwanto. (2013). *Prinsip-prinsip dan Teknik Evaluasi Pengajaran*. Bandung: Remaja Rosda Karya.

Rahmayanti, S. P., Andayani, Y., & Al Idrus, S. W. (2021). Studi Kemampuan Literasi Sains Mahasiswa Pendidikan Kimia Terkait Etnosains Bau Nyale. *Jurnal Pijar Mipa*, 16(3): 326–332.

Retariandalas. (2017). Pengaruh Minat Membaca Dan Motivasi Belajar Terhadap Prestasi Belajar IPA Siswa. *Formatif: Jurnal Ilmiah Pendidikan MIPA*, 7(2): 190–197.

Sugiyono. (2011). *Metode Penelitian Kuantitatif Kualitatif dan R & D*. Bandung: Alfabate.

Supriwardi, L., Zulyusri, Z., & Lufri, L. (2021). Meta-Analisis : Pengaruh Model Problem Based Learning Terhadap Kemampuan Literasi Sains Peserta Didik. *Bioilmi: Jurnal Pendidikan*, *7*(2), 120-128.

Sutrisna, N. (2021). Analisis Kemampuan Literasi Sains Peserta Didik SMA di Kota Sungai Penuh. *Jurnal inovasi penelitian*, 1(12): 2683-2694.

Takda, A., Arifin, K., Tahang, L. (2023). Profil Kemampuan Literasi Sains Peserta Didik SMA Berdasarkan Nature Of Science Literacy Test (NoSLiT). *Jurnal Penelitian Pendidikan Fisika*, 8(1): 19-27.

Yusmar, F., & Fadilah, R. E. (2023). Analisis Rendahnya Literasi Sains Peserta Didik Indonesia: Hasil PISA dan Faktor Penyebab. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, 13(1): 11-19.

Zuhri, M. M., Adnan, A., & Saparuddin, S. (2023). Analisis Kemampuan Literasi Sains Peserta Didik SMA Kelas X IPA di Kota Makassar dalam Menyelesaikan Soal PISA. *Bioscientist: Jurnal Ilmiah Biologi*, 11(2): 1892-1902.