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Analysis of Students' Scientific Literacy Abilities on Phase E Global Warming Materials

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ABSTRACT

In the modern era, education provides graduates with diverse skills, including the ability to understand and apply scientific concepts. Scientific literacy entails utilizing scientific knowledge, recognizing inquiries, making informed conclusions supported by evidence, comprehending the environment and its human-induced alterations, and making informed choices. In assessing scientific literacy abilities, there are four aspects, namely content, context, abilities and attitudes. The aim of this capability is to provide a strong scientific foundation in discussing global issues. This research aims to analyze students' scientific literacy abilities in learning physics material on Global Warming Phase E. This type of research uses a quantitative descriptive approach with a survey method in the form of questions as an instrument for collecting data. The results of the data obtained and after analyzing the four aspects of scientific literacy, students experienced literacy misconceptions. The percentage obtained for the misconception category is very high in the range of 78 – 82%, while for the literacy understanding category the percentage is low compared to the other two categories although there is no significant difference with the not understanding literacy category. The cause of students experiencing misconceptions about the questions given is caused by several factors. The influence of misconceptions on students' scientific literacy abilities is quite large. Overall, it can be said that the scientific literacy abilities of students at SMAN 5 Pariaman who understand literacy are in the very low category.

Keywords : Analysis; Scientific Literacy; Global Warming.

I. INTRODUCTION

The development of information technology in the world of education is increasingly rapid and its impact cannot be avoided. Globalization has created a trend in the world of education that is moving away from traditional face-to-face meetings to more open education [1]. Technological developments are a new challenge for education in the industrial era 4.0, especially in the 21st century. Education in the 21st century aims to create the nation's next generation who are independent, sustainable and able to compete in an increasingly competitive era and ever-growing technological demands [2]. Many technological developments in this era have made learning media increasingly developed [3]. With the current development of information technology, it is hoped that it will be able to continue to improve the learning process in line with increasingly sophisticated developments. The 21st century learning process is about equipping graduates with complex skills [4].

The World Economic Forum (WEF) has also identified 16 skills needed in the 21st century, and scientific literacy is one of them. Scientific literacy involves utilizing scientific knowledge, posing questions, making conclusions backed by evidence, comprehending the environment and its human-made alterations, and making informed decisions [5]. Scientific literacy is also related to social problems. This ability allows a person to apply scientific principles and processes to make decisions that affect social life [6]. In assessing scientific literacy abilities, there are four aspects, namely content, context, abilities and attitudes. Scientific literacy views the

importance of the ability to think and act in order to master thinking and use scientific literacy to identify and respond to social problems [7]. Scientific literacy helps students develop knowledge, skills and attitudes towards science and technology in everyday life.

The OECD defines scientific literacy as human scientific knowledge used to identify questions and explain scientific phenomena [8]. According to PISA, students are considered to have good basic science skills if they are able to evaluate and plan scientific research, explain phenomena scientifically, and interpret data and evidence scientifically [9]. The aim of this capability is to provide a strong scientific foundation in discussing global issues [10]. A good understanding of real-world concepts and procedures indicates that students are fully demonstrating their scientific literacy. That way, students are able to link the problems and activities they carry out daily with the learning process related to global issues. One of the keys to success in improving students' ability to adapt to changing times and enter the world of technology is to develop skills in the field of physics [11].

Physics is a branch of natural science, which studies various natural phenomena. In the physics learning process based on the Independent Curriculum, students are trained to carry out simple investigations about natural phenomena [12]. Apart from that, physics is one of the natural science subjects which has an important role in improving the quality of human resources [13]. Physics learning must be concrete, meaning it must be interesting for students, increase understanding, eliminate boredom, convey clear messages, and improve student performance and knowledge [14]. In general, the aim of physics learning in secondary schools is to convey physics knowledge, process skills, to increase students' creativity, literacy skills and other skills [15].

Students' scientific literacy abilities in physics subjects can be said to be quite low. This is proven by several preliminary studies that have been carried out by previous researchers in measuring the level of students' scientific literacy abilities. Based on research conducted by Tulaiya (2020), the scientific literacy abilities of SMA/MA students in Sumenep Regency are still relatively low as evidenced by the average percentage obtained being only 27.50% [16]. Research conducted by Ngadimin, et al (2023) also agrees with Tulaiya that the level of scientific literacy skills of students in Indonesia is still low, one of which is the students of SMAN 3 Banda Aceh [17]. Apart from that, further research by Sutrisna (2021) said that the average scientific literacy score for Class X SMA Sungai Penuh students in high school was 31.58 in the low category [18]. The low level of students' scientific literacy skills is influenced by several factors, namely low interest in reading, evaluation tools that have not yet led to the development of scientific literacy, and teachers' lack of knowledge about scientific literacy.

Based on research conducted by previous researchers regarding the level of students' scientific literacy abilities in Indonesia, it can be said to be in the quite low category. According to Fuadi, et al (2020), several factors cause low scientific literacy skills, namely the choice of textbooks, misconceptions, learning out of context, low interest in reading, and an environment and climate that is not conducive to learning [19]. This is caused by several factors, such as the learning process carried out by teachers is still not integrated with scientific literacy, both in terms of models, media, methods and teaching materials used. Efforts that can be made by teachers and schools are by providing and using learning processes that are integrated with scientific literacy, supported by facilities and infrastructure. Therefore, high school students' scientific literacy abilities need to be analyzed further to determine developments.

Based on the problems that arise regarding the scientific literacy abilities of high school students, it is known that information on the scientific literacy data of SMAN 5 Pariaman students is not yet known. This is because no research has been conducted at the school in question. Information about students' literacy ability data needs to be known so that the problems that cause it can be overcome and solutions provided so as to improve students' scientific literacy abilities at the school. Therefore, researchers want to conduct research that aims to analyze students' scientific literacy skills in learning physics material on Global Warming Phase E. The results of the research conducted were analyzed quantitatively and descriptively.

II. METHOD

This kind of research employs a quantitative descriptive approach utilizing a survey method to gather data through a series of questions [20]. This research aims to analyze students' initial knowledge in supporting the improvement of scientific literacy skills in Phase E Global Warming material at SMAN 5 Pariaman. The following are the procedures or stages in the research which can be seen below.

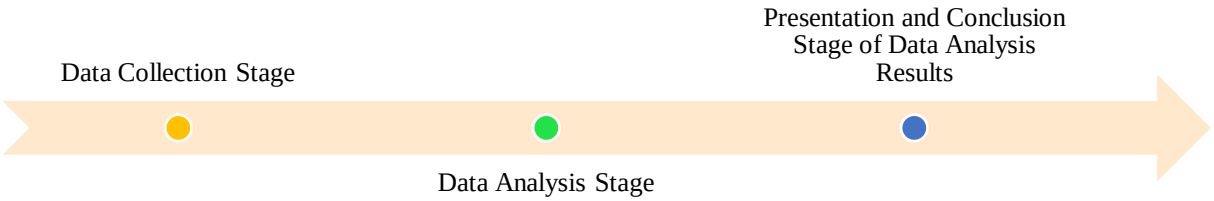

Fig. 1. Research Procedure

This research consists of 3 stages, namely the data collection stage, the data analysis stage, and the presentation and conclusion stage of the data analysis results. In the first stage, data collection was carried out by collecting data on the results of scientific literacy skills with a test in the form of Global Warming material questions as a research instrument. The test instrument given consists of 10 four-tier multiple choice questions. The questions used were sourced from research by Usie Puspitasari (2022) which had been tested for the level of validity and reliability. These questions are created based on 4 aspects of scientific literacy, namely context, content, competency and attitude. Each aspect also consists of several indicators of scientific literacy [21].

In the second stage, data analysis was carried out from the results in the field in the form of testing scientific literacy questions for students. The analysis begins with grouping each student's categories per question. This category consists of understanding literacy, misconceptions about literacy, and not understanding literacy. The results of student completion on scientific literacy questions are calculated from the number of correct and incorrect answers to each question item. Scoring is done by giving a value of 1 for the correct answer choice or reason choice and a value of 0 for the wrong answer choice or reason choice. Interpretation of diagnostic test results in four stages is used to classify students based on criteria such as literacy misconceptions, literacy understanding, and not literacy understanding. The interpretation results are presented in a table format containing columns for answers, answer confidence, reasons, and reason beliefs. Guidelines for interpreting the diagnostic tests used come from research by Fariyani. There are 16 possible student criteria, as listed in Table 1 below [22].

Table 1. Interpretation of Four-Tier Diagnostic Results

Answer	Confidence in the Answer	Reason	Reason Belief	Criteria
Correct	High	Correct	High	Understand
Correct	Low	Correct	Low	Do Not Understand
Correct	High	Correct	Low	
Correct	Low	Correct	High	
Correct	Low	Incorrect	Low	
Incorrect	Low	Correct	Low	
Incorrect	Low	Incorrect	Low	
Correct	High	Incorrect	Low	
Incorrect	Low	Correct	High	
Correct	Low	Incorrect	High	Misconception
Correct	High	Incorrect	High	
Incorrect	High	Correct	Low	
Incorrect	High	Correct	High	

Incorrect	High	Incorrect	Low
Incorrect	Low	Incorrect	High
Incorrect	High	Incorrect	High

(Source: Ref [22])

The results of the scoring process and grouping of students' answers based on the criteria of literacy misconceptions, understanding literacy or not understanding literacy are then presented using a percentage technique. The scores obtained by students are calculated using the following Equation (1).

$$P = \frac{f}{n} \times 100\% \quad (1)$$

Explanation:

P = Percentage figures (% group)

f = Number of students in each group/aspect

n = The total number of students who were used as research subjects

III. RESULTS AND DISCUSSION

The test instrument given to high school students consists of 10 four-tier multiple choice questions with material on Global Warming integrated with scientific literacy which is quite relevant to problems in everyday life. These questions are equipped with supporting statements or images. At the first level, there are answer choices for the questions given, consisting of 5 answer choices (a, b, c, d, e). At this level, students are asked to choose one answer that they think is appropriate and correct. Next, at the second level, there is the level of confidence in choosing the answer, which consists of 2 options, namely sure and not sure. Meanwhile, at the third level, it is the reason why the student chose the previous answer option which is answered in the form of an essay or an answer in the form of a statement consisting of several sentences. Finally, the fourth level is the level of confidence in the reasons as well as the confidence in the answers.

The questions used contain 4 aspects of scientific literacy, namely content, context, competence and attitudes reviewed from the cognitive domain of learning in accordance with the OECD [23]. The results of the research carried out are divided into 4 parts which are reviewed from the aspect of scientific literacy. In the first step, each student was grouped per question based on the categories of understanding literacy, not understanding literacy, and misconceptions about literacy. After grouping, an analysis of the percentage per question of each scientific literacy indicator was carried out using Equation (1) above. Furthermore, a percentage analysis was also carried out per aspect of scientific literacy with the aim of reducing the scope of the final results analyzed and drawing conclusions about the scientific literacy abilities of students at the school. To get the final result, the average percentage value per indicator for each aspect is determined so that the final percentage is obtained.

Overall, from the four aspects of scientific literacy contained in these questions, it can be said that students' scientific literacy abilities at SMAN 5 Pariaman are in the low category and tend to experience misconceptions in understanding the questions given. This is because these students are still not used to working on questions that are integrated with scientific literacy. The following is a diagram of the results of the analysis of all aspects of scientific literacy, including those who understand literacy, do not understand literacy, and have misconceptions about literacy. The diagram is listed in Figure 2 below.

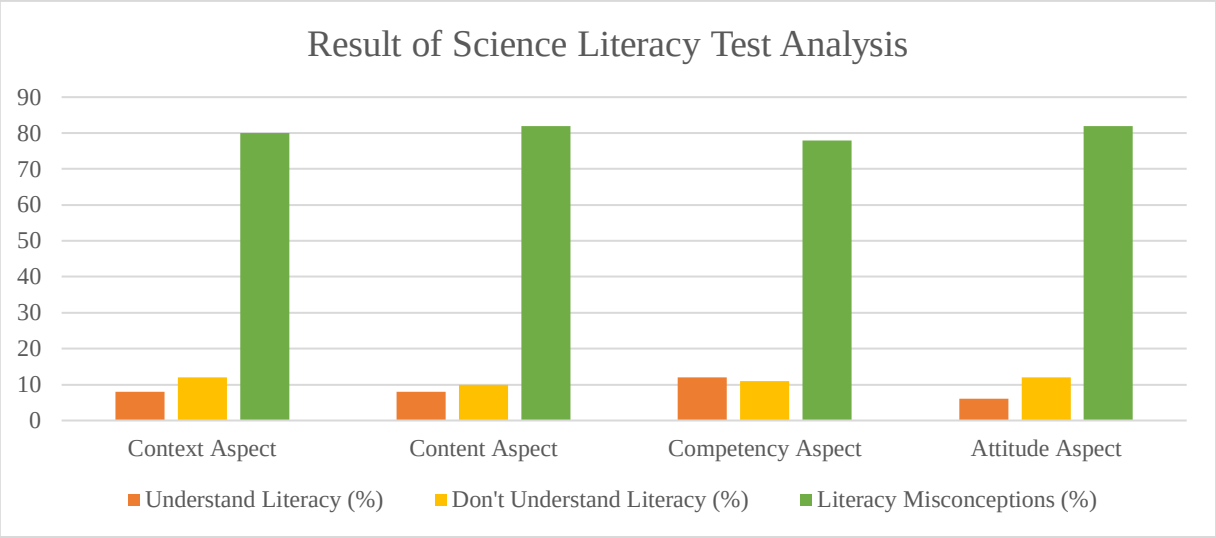

Fig. 2. Diagram of Scientific Literacy Test Analysis Results

According to the diagram shown in Figure 2 above, it is evident that students have misconceptions about scientific literacy after analyzing the data collected from the four aspects. The percentage obtained for the misconception category is very high in the range of 78 – 82%, while for the literacy understanding category the percentage is low compared to the other two categories although there is no significant difference with the not understanding literacy category. Students experiencing misconceptions are usually caused by several factors, both internal and external. Internal factors include the ability of students who find it difficult to understand material or questions that are integrated with scientific literacy and the students' lack of interest in learning, while external factors include the facilities and infrastructure in schools which are still inadequate and the learning process provided by teachers is also still not integrated. scientific literacy, both in terms of the use of models, media, learning methods. This is supported by research carried out by Entino, et al (2022) which states that the factors that cause student misconceptions include student abilities, low interest in learning, and how to teach in class [24].

The following are the results and a more detailed discussion of each aspect of scientific literacy from the research that has been conducted. The data from the analysis based on the diagram in Figure 2 above is divided into 4 parts, namely as follows.

Aspects of Scientific Literacy: Context

The context aspect of scientific literacy focuses on the application of science in everyday life and solving real world problems. This aspect consists of several indicators, such as personal, social and global. Students are expected to understand the importance of the value of science for individuals and society in improving the quality of life and developing public policy [25]. In the test instrument provided, the questions only use personal and global indicators for this aspect. The following is data on test results on aspects of the scientific literacy context that have been carried out, which can be seen in Table 2 below.

Table 2. Scientific Literacy Test Results Data on Context Aspects

Indicator	Question Number	Percentage (%)		
		Understand Literacy	Don't Understand Literacy	Literacy Misconceptions
Global	1, 2, 3, 4, 5, 7, 8, 9, 10	10	12	79
Personal	6	6	12	82
Average		**8**	**12**	**80**

Based on the data in Table 2 above, it shows that in the context aspect the average percentage results were obtained, namely the literacy understanding category was 8%; do not understand literacy 12%; literacy misconceptions 80%. Students tend to experience misconceptions due to the suitability of the answers or reasons

with the belief that the answers and reasons are not in sync with one another. The percentage in the category of understanding and not understanding literacy is very small, namely in the range of 6 – 12%. As a result, it can be inferred that students' scientific literacy abilities in the context aspect are in the low category and tend to have misconceptions. Apart from that, this research uses 2 indicators on the context aspect, namely as listed in the table above.

Aspects of Scientific Literacy: Content

The content aspect of scientific literacy refers to important scientific concepts needed to understand natural phenomena and changes caused by nature through human activities. This aspect consists of several indicators, such as physical systems, living systems, earth and space systems, technological systems, and earth systems. Criteria for selecting scientific content in scientific literacy, relevant to real situations (facts) and representing important knowledge and long-term use [25]. The following is the test results data on the scientific literacy content aspect that has been carried out, which can be seen in Table 3 below.

Table 3. Scientific Literacy Test Results Data on Content Aspects

Indicator	Question Number	Percentage (%)		
		Understand Literacy	Don't Understand Literacy	Literacy Misconceptions
Earth System and Space	1, 2, 3, 5, 7, 8, 9, 10	10	13	78
Living System	4	9	6	85
Earth System	6	6	12	82
Average		**8**	**10**	**82**

Based on the data in Table 2 above, it shows that in the content aspect the average percentage results were obtained, namely the literacy understanding category was 8%; do not understand literacy 10%; literacy misconceptions 82%. Students tend to experience misconceptions due to the suitability of the answers or reasons with the belief that the answers and reasons are not in sync with each other. The percentage in the category of understanding and not understanding literacy is very small, namely in the range 6 – 13%. Hence, it can be inferred that students' grasp of scientific literacy in terms of context is below average and often includes misconceptions. Apart from that, this research uses 3 indicators in the content aspect, namely as listed in the table above.

Aspects of Scientific Literacy: Competence

The competency aspect of scientific literacy refers to the mental processes involved in answering questions and solving problems, such as recognizing and interpreting evidence and explaining conclusions. The competency aspect, also called the scientific process, is one aspect of scientific ability. The process by which someone answers questions or solves scientific problems and builds students' scientific skills based on logic, reasoning, critical and creative analysis [25]. This aspect consists of several indicators, namely identifying scientific problems, explaining phenomena scientifically, evaluating and designing scientific investigations, interpreting scientific evidence and data, and analyzing and interpreting data to draw appropriate conclusions. The following is data on test results on aspects of scientific literacy competency that have been carried out, which can be seen in Table 4 below.

Table 4. Science Literacy Test Results Data on Competency Aspects

Indicator	Question Number	Percentage (%)		
		Understand Literacy	Don't Understand Literacy	Literacy Misconceptions

Explaining Phenomena Scientifically	1, 5, 7, 10	8	13	80
Evaluate and Design Investigation Scientific	2	3	15	82
Interpreting Scientific Evidence and Data	3	29	13	68
Explain Data in Order to Make Accurate Conclusions.	4, 8, 9	7	13	80
Average		**12**	**11**	**78**

According to the data presented in Table 4, it is evident that the average percentage results were achieved in the competency aspect, namely the literacy understanding category was 12%; do not understand literacy 11%; literacy misconceptions 78%. Students tend to experience misconceptions due to the suitability of the answers or reasons with the belief that the answers and reasons are not in sync with one another. The percentage in the category of understanding and not understanding literacy is very small, namely in the range 3 – 29%. Therefore, it can be concluded that students' scientific literacy abilities in the context aspect are in the low category and tend to have misconceptions. Apart from that, this research uses 4 indicators in the competency aspect, namely as listed in the table above.

Aspects of Scientific Literacy: Attitude

The attitudinal aspect of being scientifically literate involve enhancing one's understanding of science, building self-assurance, fostering curiosity in scientific matters, and developing a commitment to caring for resources and the environment. One goal of science education is for students to develop attitudes that predispose them to pay attention to scientific issues and then acquire and apply scientific and technological knowledge for personal, social, and global benefit. Therefore, one of PISA's views on scientific ability is an individual's attitude towards science. Elements of a scientific competence attitude include curiosity, practical skills, scientific and critical thinking skills, independence, and the development of a caring and responsible attitude towards the natural and social environment [25]. The following is data on test results on aspects of scientific literacy competency that have been carried out, which can be seen in Table 5 below.

Table 5. Scientific Literacy Test Results Data on Attitude Aspects

Indicator	**Question Number**	**Percentage (%)**		
		Understand Literacy	**Don't Understand Literacy**	**Literacy Misconceptions**
Interest in Issues Science	6	6	12	82
Average		**6**	**12**	**82**

Based on the data in Table 5 above, it shows that in the attitude aspect the average percentage results were obtained, namely the literacy understanding category was 6%; do not understand literacy 12%; literacy misconceptions 82%. Students tend to experience misconceptions due to the suitability of the answers or reasons with the belief that the answers and reasons are not in sync with each other. The percentage in the category of understanding and not understanding literacy is very small, namely in the range of 6 – 12%. In the attitude aspect, there is only 1 question from the test instrument given, namely number 6. Apart from that, this research only uses 1 indicator in the attitude aspect, namely the indicator of interest in science issues. Therefore, it can be concluded that students' scientific literacy abilities in the context aspect are in the low category and tend to have misconceptions.

Based on surveys conducted by researchers, supporting factors in improving students' scientific literacy skills are still inadequate. For example, these supporting factors are found in the learning resources or teaching materials used which are not yet based on or integrated with aspects of scientific literacy. Full mastery of scientific literacy can help solve problems. The implementation of a learning process that places less emphasis on the context of

everyday problems is the cause of the decline in scientific literacy. Presentation of physics learning material that takes scientific aspects into account is still rarely used in the classroom. Therefore, educators need to understand more about the importance of improving students' scientific literacy abilities.

Scientific literacy has a fairly close relationship with students' misconceptions in the learning process, especially in physics learning. This is because students' misconceptions trigger a low or high percentage of scientific literacy abilities. This ability requires students to be able to understand concepts and theories related to everyday life [26]. Teachers have a very big role in implementing scientific literacy to their students. As educators, we should change the way we think about the physics learning process in schools in order to improve students' scientific literacy skills [27]. To overcome these challenges, PISA and TIMSS adopted policies by establishing various efforts to improve students' science skills [28].

Efforts and solutions that can be implemented to improve students' scientific literacy skills can be divided into several parts, namely solutions from the school, teachers, and from the students themselves. On the school side, by providing learning resources that are integrated with scientific literacy, increasing teacher competency, carrying out School Literacy Movements, and holding Minimum Competency Assessments [29]. Meanwhile for teachers by carrying out an interesting learning process that is integrated with scientific literacy and for students by introducing and providing education about the importance of scientific literacy in schools. Apart from that, another way to improve students' scientific literacy skills is to examine students' internal and external factors, find students' obstacles to learning, and improve students' scientific abilities [30].

IV. CONCLUSION

According to the findings of a study on students' scientific literacy abilities in Phase E of the Global Warming material, percentage results were obtained for each aspect, namely, Context Aspect: Literacy Understanding = 8%; Don't Understand Literacy = 12%; Literacy Misconceptions = 80%, Content Aspects: Literacy Understanding = 8%; Don't Understand Literacy = 10%; Literacy Misconceptions = 82%, Competency Aspects: Understanding Literacy = 12%; Don't Understand Literacy = 11%; Literacy Misconceptions = 78%, and Attitude Aspects: Literacy Understanding = 6%; Don't Understand Literacy = 12%; Literacy Misconceptions = 82%. Of these four aspects, the percentage of literacy in the attitude aspect is lower than the other aspects, namely 6%. The cause of students experiencing misconceptions about the questions given is caused by several factors, namely internal factors and external factors. The influence of misconceptions on students' scientific literacy abilities is quite large. Overall, from the results of the analysis that has been carried out, it can be said that the scientific literacy abilities of students at SMAN 5 Pariaman who understand literacy are in the very low category.

This research still has limitations, namely the data obtained still comes from one school in Pariaman City. Apart from that, the questions used are still not evenly distributed for each aspect, for example in the attitude aspect there is only 1 question from the instrument provided by the researcher. Additional data is needed for future researchers to analyze students' scientific literacy abilities in order to compare this literacy ability between one school and another. Apart from that, an even distribution of questions that will be tested on students is also needed so that students' literacy results on Global Warming material can be evenly known. Prospective researchers must then prepare the latest innovations to overcome the limitations that exist in this research so that data results that are quite complex are obtained.

REFERENCES

[1] W. Wati and H. Istiqomah, "Game Edukasi Fisika Berbasis Smartphone Android Sebagai Media Pembeajaran Fisika," *Indonesian Journal of Science and Mathematics Education*, vol. 2, no. 2, Art. no. 2, Jul. 2019, doi: 10.24042/ijsme.v2i2.4341.

[2] A. P. Penginan, L. Sukariasih, L. Tahang, and A. Abdin, "Pengembangan Media Pembelajaran Game Edukasi Berbasis Android Pada Materi Fluida Statis Kelas XI," *Indonesian Journal of Physics and its Applications*, vol. 2, no. 1, Art. no. 1, Aug. 2022, Accessed: Jan. 06, 2024. [Online]. Available: http://ojs.uho.ac.id/index.php/IJPiA/article/view/25806

[3] D. Muliyati, F. Bakri, and D. Ambarwulan, "Aplikasi Android Modul Digital Fisika Berbasis Discovery Learning," *WaPFi (Wahana Pendidikan Fisika)*, vol. 3, no. 1, Art. no. 1, Feb. 2018, doi: 10.17509/wapfi.v3i1.10944.

[4] M. Dhanil and F. Mufit, "Preliminary Analysis of Scientific Literacy in Fluids at SHS 6 Padang," *Jurnal Penelitian Pendidikan IPA*, vol. 9, no. 11, Art. no. 11, Nov. 2023, doi: 10.29303/jppipa.v9i11.4320.

[5] E. A. Usman, A. Asrizal, and Z. Kamus, "Pengembangan LKS IPA Terpadu Mengintegrasikan Literasi Saintifik Pada Materi Gerak Dalam Kehidupan Untuk Siswa Kelas VIII SMP," *Pillar Of Physics Education*, vol. 9, no. 1, Art. no. 1, 2017, doi: 10.24036/2512171074.
[6] B. R. Sativa and D. Eliza, "Pengembangan E-Modul Literasi Sains Anak Usia Dini," *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, vol. 7, no. 2, Art. no. 2, Mar. 2023, Accessed: May 09, 2024. [Online]. Available: https://www.obsesi.or.id/index.php/obsesi/article/view/4037
[7] O. PISA, *PISA 2018: Penilaian dan Analitik Kerangka*. PISA, Penerbitan OECD Paris, 2019.
[8] OECD, *Executive Summary PISA 2006: Science Competencies for Tomorrow's World*. OECD Publishing: Paris-France, 2007.
[9] OECD, *PISA 2012 Assessment and Analytical Framework Mathematics, Reading, Science, Problem Solving and Financial Literacy*. OECD Publishing, 2013.
[10] W. T. Emilya and F. Mufit, "Analisis Penggunaan Bahan Ajar Berbasis IT dan Keterlaksanaan Literasi Sains SMA Padang," *Jurnal Penelitian Pembelajaran Fisika*, vol. 15, no. 1, Art. no. 1, Jan. 2024, doi: 10.26877/jp2f.v15i1.17014.
[11] F. Mukharomah, W. Wiyanto, and N. M. D. Putra, "Analisis Kemampuan Literasi Sains Fisika Siswa Sma Pada Materi Kinematika Gerak Lurus Di Masa Pandemi COVID-19," *Journal of Teaching and Learning Physics*, vol. 6, no. 1, Art. no. 1, Feb. 2021, doi: 10.15575/jotalp.v6i1.10391.
[12] Kemendikbudristek, *Capaian Pembelajaran Mata Pelajaran Fisika Fase E – Fase F Untuk SMA/MA/Program Paket C*. Jakarta: Badan Standar, Kurikulum, dan Asesmen Pendidikan, 2022.
[13] A. Pramono and F. Mufit, "Design of Cognitive Conflict-Based Interactive Multimedia Using Adobe Animate CC 2019 On Global Warming Materials," *Jurnal Geliga Sains: Jurnal Pendidikan Fisika*, vol. 10, no. 2, Art. no. 2, Dec. 2022, doi: 10.31258/jgs.10.2.89-100.
[14] A. Asrizal, A. Hendri, H. Hidayati, and F. Festiyed, "Penerapan Model Pembelajaran Penemuan Mengintegrasikan Laboratorium Virtual dan Hots untuk Meningkatkan Hasil Pembelajaran Siswa SMA Kelas XI," *JURNAL PDS UNP*, vol. 1, no. 1, Art. no. 1, Dec. 2018, Accessed: Feb. 11, 2024. [Online]. Available: http://pdsunp.ppj.unp.ac.id/index.php/PDSUNP/article/view/9
[15] A. Setiawan, S. Sutarto, and I. Indrawati, "Metode Praktikum Dalam Pembelajaran Pengantar Fisika SMA : Studi Pada Konsep Besaran Dan Satuan Tahun Ajaran 2012-2013," *Jurnal Pembelajaran FisikA*, vol. 1, no. 3, Art. no. 3, Feb. 2021, doi: 10.19184/jpf.v1i3.23172.
[16] W. Tulaiya, "Analisis Kemampuan Literasi Sains Peserta Didik SMA/MA di Kabupaten Sumenep," *IPF: Inovasi Pendidikan Fisika*, vol. 09, no. 03, pp. 417–427, Sep. 2020.
[17] N. Ngadimin, A. Hamid, N. Nurulwati, and N. Nasution, "Kemampuan Literasi Sains Siswa SMA Negeri 3 Banda Aceh Setelah Diterapkan Pembelajaran Kooperatif Tipe Jigsaw," *Jurnal Serambi Akademica*, vol. 11, no. 9, Art. no. 9, Nov. 2023, doi: 10.32672/jsa.v11i9.7020.
[18] N. Sutrisna, "Analisis Kemampuan Literasi Sains Peserta Didik Sma Di Kota Sungai Penuh," *Jurnal Inovasi Penelitian*, vol. 1, no. 12, Art. no. 12, Apr. 2021, doi: 10.47492/jip.v1i12.530.
[19] H. Fuadi, A. Z. Robbia, J. Jamaluddin, and A. W. Jufri, "Analisis Faktor Penyebab Rendahnya Kemampuan Literasi Sains Peserta Didik," *Jurnal Ilmiah Profesi Pendidikan*, vol. 5, no. 2, Art. no. 2, Nov. 2020, doi: 10.29303/jipp.v5i2.122.
[20] I. S. Wekke, *Metode Penelitian Sosial*. Jakarta: Gawe Buku, 2019.
[21] U. Puspitasari, S. Syahmani, and S. Suryajaya, "Kelayakan Pengembangan Konten Instagram Berbasis Authentic Problem Untuk Meningkatkan Literasi Sains Peserta Didik SMP," *Journal of Banua Science Education*, vol. 3, no. 1, Art. no. 1, 2022, doi: 10.20527/jbse.v3i1.129.
[22] Q. Fariyani, A. Rusilowati, and Sugianto -, "Pengembangan Four-Tier Diagnostic Test Untuk Mengungkap Miskonsepsi Fisika Siswa SMA Kelas X," *Journal of Innovative Science Education*, vol. 4, no. 2, Art. no. 2, 2015, Accessed: Feb. 16, 2024. [Online]. Available: https://journal.unnes.ac.id/sju/jise/article/view/9903
[23] OECD, *Knowledge and Skills for Life First Result from PISA 2000*. OECD Publishing: Paris-France, 2001.
[24] R. Entino, E. Hariyono, and N. A. Lestari, "Analisis Miskonsepsi Peserta Didik Sekolah Menengah Atas pada materi Fisika," *PENDIPA Journal of Science Education*, vol. 6, no. 1, Art. no. 1, 2022, doi: 10.33369/pendipa.6.1.177-182.
[25] C. P. Rini, S. D. Hartantri, and A. Amaliyah, "Analisis Kemampuan Literasi Sains Pada Aspek Kompetensi Mahasiswa PGSD FKIP Universitas Muhammadiyah Tangerang," *1*, vol. 6, no. 2, Art. no. 2, Jan. 2021, doi: 10.29407/jpdn.v6i2.15320.
[26] P. R. Ramadhani, A. Akmam, D. Desnita, and Y. Darvina, "Analisis keterampilan proses sains pada buku ajar fisika sma kelas XI semester 1," *Pillar Of Physics Education*, vol. 12, no. 4, Art. no. 4, Dec. 2019, doi: 10.24036/7130171074.

[27] F. A. Putri and F. Mufit, "Analysis of Students' Scientific Literacy on Work and Energy as Well as Momentum and Impulse," *Jurnal Penelitian Pendidikan IPA*, vol. 9, no. 12, Art. no. 12, Dec. 2023, doi: 10.29303/jppipa.v9i12.5990.
[28] I. K. Suparya, I. W. Suastra, and I. B. P. Arnyana, "Rendahnya Literasi Sains: Faktor Penyebab Dan Alternatif Solusinya," *Jurnal Ilmiah Pendidikan Citra Bakti*, vol. 9, no. 1, Art. no. 1, Mar. 2022, doi: 10.38048/jipcb.v9i1.580.
[29] H. M. Dirman and F. Mufit, "Analisis Penggunaan Instrument Penilaian Pemahaman Konsep dan Literasi Sains di SMA Kabupaten Solok," *Jurnal Penelitian Pembelajaran Fisika*, vol. 13, no. 2, Art. no. 2, Sep. 2022, doi: 10.26877/jp2f.v13i2.12923.
[30] M. Novita, A. Rusilowati, S. Susilo, and P. Marwoto, "Meta-Analisis Literasi Sains Siswa di Indonesia," *UPEJ Unnes Physics Education Journal*, vol. 10, no. 3, Art. no. 3, Nov. 2021, doi: 10.15294/upej.v10i3.55667.