International Journal of Education and Teaching Zone. Volume 3 (Issue 1): 01-02 (2024)
DOI: https://10.57092/ijetz.v3i1.194

THE JOURNAL OF IJETZ
(International Journal of Education and Teaching Zone)
P-ISSN: 2963-7899 I E-ISSN: 2830-7925
jurnal.yayasannurulyakin.sch.id/index.php/ijetz

Materials Analyzing Students' Scientific Literacy Abilities: Does It Impact Their Ability to Complete the Learning Process?

Tasa Ratna Puri[1]*, Boby Syefrinando [1] , Muhammad Reyza Arief Taqwa[2]
[1] Department of Physics, UIN Sulthan Thaha Saifuddin Jambi, Jambi, Indonesia
[2]Department of Physics, Universitas Negeri Malang, Jawa Timur. Indonesia

Article History:
Received: December 18, 2023
Revised: January 19, 2024
Accepted: January 25, 2024
Published: February 01, 2024

Keywords:
Learning Process,
Scientific Literacy,
Student Abilities

***Correspondence Author:**
tasaratnap@gmail.com

Abstract: This research was conducted to analyze how students' scientific literacy abilities are seen from their ability to solve physics questions on work and energy. The research design used is quantitative research with descriptive methods (quantitative descriptive). The population used in this research was the entire class X of SMK N 3 Tanjung Jabung Barat. The sampling technique in this research is purposive sampling because the initial data obtained from the entire population is normally distributed and homogeneous. The samples in this study were class X TKRO 1 and class X TKRO 2 because these two classes had the same number of students, namely 52 students. From the results of the data analysis that has been carried out, it can be stated that the level of students' scientific literacy abilities is 13.46% of students in the high category, 67.31% in the medium ability category, and 19.23% of students in the low category. On average, students' abilities are in the medium category.

INTRODUCTION

The educational paradigm has experienced quite a big shift, following a shift in the form of learning from a classical to a technological modernization process caused by differences in teachers' perspectives in the 21st-century era, where all learning processes are prioritized using digital technology, in its implementation marked by the use of technology in learning in the classroom. The educational system needed in the 21st century does not only focus on the distribution of material provided by teachers, but must be changed from a horizontal to a loop of knowledge that combines knowledge, application, and continuous contribution (Osman & Marimuthu, 2010). Therefore, 21st-century education aims to encourage students to have skills that can support themselves so that they are ready to respond to changes in the times to produce human resources who are superior, capable, think critically, are sensitive to the surrounding environment, are well literate both in the field of information and communication technology and especially in the world of education (Turiman et al., 2012, Thomas L Good, 2009). Students must be able to use thinking skills to analyze a problem or argument on a phenomenon, to be able to generate a critical way of thinking that can encourage students' abilities to become better and more meaningful, the aim of which is that

students can use their understanding to bring it to a better stage so that they can express it clearly. logical, correct, and rational (Budiyanto et al., 2019). To obtain this, all the skills that students must have in the 21st century are scientific literacy skills (Lemke, 2002). With these skills, students can keep up with current developments more easily and effectively.

Literacy comes from the word "literacy" which means literacy, while science comes from the word "science" which means knowledge (Author et al., 2015). Scientific literacy is a knowledge of scientific concepts that allows a person to make decisions with the knowledge they have so that scientific literacy is able to play an active role in various aspects of life, especially in the aspects of science that they study. Scientific literacy relates to how students' ability to protect the environment is based on previously mastered scientific and technological knowledge so that understanding of science is not only theoretical but also applied (Budiyanto et al., 2019). Scientific literacy is not only said to be smart and know science but also to be able to apply it to life (Okada, 2013). According to PISA, scientific literacy is the skill of using scientific abilities, asking questions, getting conclusions based on facts in understanding, and making decisions related to nature (Tustin, 2021). In other words, students can connect the scientific concepts they have acquired so that they gain new knowledge and apply it in everyday life (Armas et al., 2019).

Literacy comes from the word "literacy" which means literacy, while science comes from the word "science" which means knowledge (Author et al., 2015). Scientific literacy is knowledge about scientific concepts that enables a person to make decisions with the knowledge they have so that scientific literacy can play an active role in various aspects of life, especially in the aspects of science that they study. Scientific literacy relates to how students' ability to protect the environment is based on previously mastered science and technology so that understanding of science is not only theoretical but also applied (Budiyanto et al., 2019). Scientific literacy is not only said to be intelligent and knowing science but also able to apply it in life (Okada, 2013). According to PISA, scientific literacy is the skill of using scientific abilities, asking questions, drawing conclusions based on facts in understanding, and making decisions related to nature (Tustin, 2021). In other words, students can connect the scientific concepts they have acquired so that they gain new knowledge and apply it in everyday life (Armas et al., 2019). With scientific literacy, students will be sharpened to understand the material more critically, because their perspective in understanding a problem is always aligned with the knowledge or studies they already have, so analyzing a phenomenon will give them greater and more complete abilities, so that problems can be solved. given can be answered easily.

Low scientific literacy skills make students less responsive in dealing with problems around them. This is due to the lack of curiosity of students, the lack of ability of students to connect related science topics, and the lack of the role of teachers in shaping students into literate students (Flores, 2018). Another cause that makes students' scientific literacy skills low is learning activities that do not yet lead to the development of scientific literacy. Apart from that, other factors that cause students' low scientific

literacy abilities are inadequate school infrastructure, school human resources, and school management (Kurnia et al., 2014). Based on the statements made by several experts above, it can be concluded that students' scientific literacy abilities are influenced by all educational sectors.

Judging from the conditions above shows that efforts are needed to improve science learning in schools, especially physics learning. Efforts to improve the quality of the learning process in schools need to be supported by accurate information regarding the level of scientific literacy abilities. This is because literary ability will be an ability that can make students able to compete in global development so that all the understanding they provide can become a better quality encouragement. Several studies actually show how scientific literacy skills can make it easier for students to answer physics phenomena. Therefore, it is necessary to analyze the scientific literacy abilities of students at SMK N 3 Tanjung Jabung Barat, so that with the scientific literacy information provided, students will be truly good and of good quality and will be in line with current developments.

METHOD

Basically, in the research on scientific literacy skills we have researched using a quantitative research design with descriptive methods (quantitative descriptive)(Creswell, 2012; Johnston, 2014; Methods et al., n.d.), with the hope that all the data obtained will be able to provide a more comprehensive understanding of the knowledge possessed by students so that students' grades can be described clearly in faithful to the category of the level of scientific literacy ability. Quantitative descriptive research design is where the data disclosed will provide a complete picture, not just raw data but all descriptions of activities during the time the research was carried out. Data collection and processing in this research is by presenting data based on the researcher's findings using test questions. This research does not provide treatment, manipulation, or replacement of independent variables, but describes a condition as it is (Sukmadinata, 2012). The population used in this research was all class X of SMK N 3 Tanjung Jabung Barat, namely class X TKRO 1 and class The sampling technique in this research is purposive sampling, where the purposive sampling technique is a sampling technique based on criteria where students are taught by the same teacher and have the same number of students, namely 26 students in each class. The instruments used in this research were physics questions, the questions that are commonly used in assessing students' literacy skills in work and energy in the form of essay or essay questions. The questions consist of 9 items, each of which corresponds to an indicator of the scientific literacy competency aspect. For more details, see the following Table 1.

Table 1 Questions on The Competency Aspect

Competency Aspect	Question Number
Menjelaskan fenomena secara ilmiah	1, 3, 5, 4
Menginterpretasikan data dan bukti secara ilmiah	2, 6, 7
Evaluate and design scientific investigations	8,9

For the data obtained, namely the test results, the percentage of each scientific literacy indicator will be determined, apart from that, the average and standard deviation from the data results will also be calculated. The results of students' test scores will then be categorized into three, namely high, medium and low, the categorization of which is in accordance with the Table 2.

Table 2 Criteria for Student Learning Outcomes

category	Information
Tall	$x > \bar{x} + S$
Currently	$\bar{x} - S \leq x \leq \bar{x} + S$
Low	$x < \bar{x} - S$

RESULT AND DISCUSSION

Table 2 shows how the criteria are formed from the results of analyzing the level of students' scientific literacy abilities. The level of students' scientific literacy abilities will be divided into 3 categories, namely high, medium and low categories, so that they are able to describe and separate clearly and in detail how students' literacy abilities are in understanding physics, especially work and energy. As for the data obtained, after the answer sheets of the students who were the sample for this study were examined, the results of the statistical analysis were obtained as shown in Table 3.

Table 3 Statistical Test Results of Student Test Scores

Statistic test	Score
Maximum Score of Questions	32
Minimum Score of Questions	0
Highest Score of Students	13
Lowest Score of Students	2
Average Score	7,6
Standard Deviation	2,8

The average score and standard deviation obtained are used to group the criteria for students based on table 1. Students are grouped into three categories, namely high, medium and low. The results of students' scientific literacy scores based on categories can be seen in the Table 4.

Table 4 Student Scores Obtained for Each Category

Category	Total Students
Tall	7
Currently	35
Low	10

Based on the table above, students' data regarding scientific literacy abilities can be clearly divided into each category, including high, medium and low literacy abilities. Where the scores obtained in the high category were 7 students, in the medium category there were 35 students, in the low category there were 10 students. Differences in student scores based on categories are possible because the information received is different, the amount of initial knowledge possessed by students is different so that their ability to argue is also likely to be different, of course this is interesting for further analysis. The

research then continued by carrying out a process to calculate the percentage of students' answers based on scientific literacy indicators in the competency aspects that had been determined, namely high, low and medium. The results of the percentage calculation can be seen in table 5. Where Question number 1 is an indicator of explaining students' scientific phenomena specifically on the material of work and energy. For more details, see the following Table 5.

Table 5. Question 1 (Explaining Phenomena Scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	30	58%
1	22	42%
0	0	0

Based on question number 1, it is known that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 58% of students answered with a score of 2, 42% of students answered with a score of 1, and 0% of students answered with a score of 0. This means that there are still many students whose answers are wrong. This error in answering is thought to be due to the student's information being disconnected from the initial concept, where the knowledge they have is not yet complete so they only use limited knowledge to analyze the questions given. As for the next question, namely Question number 2, which includes indicators for interpreting data and scientific evidence, see Table 6.

Table 6. Question 2 (Interpreting Data and Evidence Scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	0	0
1	41	79%
0	12	23%

Based on question number 2, it was found that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 0% of students answered with a score of 2, 79% of students answered with a score of 1, and 23% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 3 is an indicator of explaining scientific phenomena. For more details, see the following Table 7.

Table 7 Question 3 (Explaining Phenomena Scientifically)

Value	Number of students	Percentage
4	0	0
3	3	5%
2	12	23%
1	31	60%
0	6	12%

Based on question number 3, it was found that 0% of students answered with a score of 4, 5% of students answered with a score of 3, 23% of students answered with a score of 2, 60% of students answered with a score of 1, and 12% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 4 is an indicator of explaining scientific phenomena. For more details, see the following Table 8.

Table 8. Question 4 (Explaining phenomena scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	3	6%
1	27	52%
0	22	42%

Based on question number 4, it was found that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 6% of students answered with a score of 2, 52% of students answered with a score of 1, and 42% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 5 is an indicator of explaining scientific phenomena. For more details, see the following Table 9.

Table 9 Question 5 (Explaining phenomena scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	24	46%
1	12	23%
0	16	31%

Based on question number 5, it was found that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 46% of students answered with a score of 2, 23% of students answered with a score of 1, and 31% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 6 includes indicators for interpreting data and evidence scientifically. For more details, see the following table 10.

Table 10 Question 6 (Interpreting data and evidence scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	0	0
1	13	25%
0	39	75%

Based on question number 6, the data is still not very different, but it is known that 0% of students answered with a score of 4. 0% of students answered with a score of 3. 0% of students answered with a score of 2. 25% of students answered with a score of 1.

As many as 75% of students answered with a score of 0. This means that there are still many students whose answers are not correct in answering questions, this is actually an early warning for teachers in improving students' abilities to be even better. Then the question continues with the next question, namely Question number 7 which includes indicators for scientific interpretation of data and evidence. For more details on the data obtained, see Table 11.

Table 11. Question 7 (Interpreting data and evidence scientifically)

Value	Number of students	Percentage
4	0	0
3	0	0
2	0	0
1	29	56%
0	23	44%

Based on question number 7, it was found that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 0% of students answered with a score of 2, 56% of students answered with a score of 1, and 31% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 8 includes indicators for evaluating and designing scientific investigations. For more details, see the following table 12.

Table 12 Question 8 (Evaluating and designing scientific investigations)

Value	Number of students	Percentage
4	0	0
3	0	0
2	0	0
1	34	65%
0	18	35%

Based on question number 8, it was found that 0% of students answered with a score of 4, 0% of students answered with a score of 3, 0% of students answered with a score of 2, 65% of students answered with a score of 1, and 35% of students answered with a score of 0. This means that there are still many students whose answers are incorrect. Question number 9 includes indicators for evaluating and designing scientific investigations. For more details, see the following table 13

Table 13 Question 9 (Evaluating and designing scientific investigations)

Value	Number of students	Percentage
4	0	0
3	0	0
2	0	0
1	38	73%
0	14	27%

Research data also shows that based on question number 9, it is known that the assessment is not much different, where only 0% of students answered with a score of 4.0%, in other words the quality of students in terms of scientific argumentation is still

very low and still in the quite good category. , where students who have a fairly good category in answering the question or with a score of 3 are also 0%, then the student's ability is in moderate ability, namely students who can answer or give an answer with a score of 2 is 73% and it is analyzed that students answered with a score of 1, and almost 27% of students answered with a score of 0. This means that there were still many students who answered the scientific literacy question incorrectly.

Analysis of Students' Scientific Literacy Ability in the High Category

Based on the results of observations that have been made, it can be seen that students' abilities in the realm of scientific literacy are in the high category at 13.46%. This certainly shows that students' scientific literacy skills, especially in wor and energy material, are still at a stage that is not optimal. Students' ability to provide answers to the information used has not been able to provide complete understanding to students so new understanding is only in the form of a separate transfer of knowledge, not complete and quality knowledge (Basile & White, 2000; Mascarenhas et al., 2017; Parno et al., 2018). Complete and quality knowledge will enable students to become individuals who can convey a good understanding of the material. High scientific literacy is believed to be able to encourage students to want to understand learning or work and energy material more deeply, because knowledge, in this case in the form of good and quality knowledge information, will make it easier for students in various ways and at the same time transfer their knowledge from the information provided(Pe'er et al., 2007; Yotongyos et al., 2015). obtained which can be used in solving a given problem. In understanding material, literacy skills must be well-supported

In looking at how the questions contribute to showing students' level of scientific literacy maturity, it can be seen from the data that students answer the questions given, for example, it can be explained from questions number 1, 3, 4, 5, including indicators for explaining phenomena scientifically, the average student answers with score 1, where a score of 1 indicates the student's answer is wrong or inaccurate. This means that most students still do not understand the questions that explain phenomena scientifically. Apart from that, there are still many students who do not answer and get a score of 0. This is a clear indication that the filtering ability of students in the high category is still very poor, so assistance must be added such as models or appropriate learning strategies that can provide not only ease for teachers in learning but but students also enjoy the learning process that is carried out, so that truly good and high-quality scientific literacy emerges (Karpudewan et al., 2016; Yotongyos et al., 2015).

In order to increase high literacy, especially in work and energy material, there are several things that need to be considered, namely students must be given more opportunities to obtain information about the material provided so that the learning process should not only be about transferring knowledge but more than that, students should be given the opportunity to further explore their knowledge and try to connect some knowledge in answering problems, the aim of which is for all students to become good and qualified individuals, especially in scientific arguments(Clair, 2003; Yuliati, Karim, et al., 2018; Yuliati, Parno, et al., 2018). These efforts are all made so that

students understand the material of work and energy in physics without really starting with information from the beginning, but there is information provided that is able to encourage students to easily understand the material that has just been presented and is not really new material. Understanding existing material from the start will provide a little encouragement to students to be better able to complete their understanding of a problem in the material with the effort and energy given so that they can become students who are truly ready to solve physical problems, in other words, which occurs due to high literacy. students' scientific knowledge so that students are able to solve physics problems better. Then there is an analysis of students' understanding of scientific literacy which is in the category that produces the most results so changes must be made to the learning process with the aim of increasing the quality of learning to a better level.

Analysis of Students' Scientific Literacy Skills in the Medium Category

From the data outlined above, the students' scientific literacy mastery category is actually in the medium category. Where the data that researchers found was 67.31% correct or said to be in the medium category. Literacy abilities in the medium category actually reflect that the learning process has been provided quite well, but there is still a need for a learning system that is truly capable of encouraging students' scientific improvement for the better (Reyza et al., 2022; Sulman, Yuliati, Kusairi, et al., 2022; Sulman, Yuliati, Purnama, et al., 2022). Scientific literacy in the medium category is a big hope for a teacher, which requires slight changes to be able to arouse interest and motivation in students to understand and interpret the learning outcomes that have been presented. This is a student's ability to actually understand literacy skills and must continue to improve student's learning abilities, where all learning abilities, especially physics material, which in this research is work and energy material, are believed to be able to build a good understanding, especially children's scientific literacy(Permatasari, 2014; Rhosalia, 2017).

Scientific literacy abilities that are in the medium category can actually be easily changed because students' learning abilities must be the driving force for creating good and quality interest in learning. Interest in learning physics subjects will be able to become the basis for building the ability to think critically, so that the study concepts given must be able to enter into a broad understanding, where learning can build an effective learning atmosphere that is more interesting and efficient(Honey et al., 2014; Smith et al., 2015; Sutopo, 2022). With sufficient scientific literacy skills, it is hoped that the process of changing literacy skills can take place easily, namely leading to changes in the individual's attitudes and character which will really give rise to a desire to understand physics material better. Interest is a person's curiosity about a study that is being analyzed so that children will be motivated to find out the solution to a problem being studied.

The understanding of students with sufficient scientific argumentation skills can be assessed by working on Questions No. 2, 6, and 7 which includes working on indicators to interpret data and evidence scientifically. Interpreting data and evidence scientifically actually makes us individuals who have to use communication and analysis skills in an

event, which in this case is about work and energy. All human activities are of course inseparable from the concept of work and energy where energy is a source of power that cannot be destroyed but can be increased and divided into several energies, this indicates that students will have a lot of direct contact with problem-solving so that students will be encouraged to have several arguments which are usually called quality scientific literacy to improve understanding and quality, as well as student learning outcome(Neuman, 2014; Nieminen et al., 2012)s. Judging from the research data, where on average students answered quite well or in the moderate category as explained above, it shows that the students' answers were quite good but not very accurate and comprehensive so their scientific literacy could be said to be in the adequate category. This means that some students still do not understand the questions related to scientific interpretation of data and evidence, but others have begun to understand the material or can analyze the questions presented. Sufficient literacy skills make the teacher's actual role a little easier because teachers can encourage and improve students' understanding, especially their scientific literacy skills.

Analysis of Students' Scientific Literacy abilities in the Low Category

The data obtained also clearly shows that there are still many students who have very low literacy skills. This is shown by the research results obtained which are in the low category at 19.23%, this shows that scientific literacy abilities are still very low and must be improved and progressed again so that students become individuals who can develop, especially during the development period in the industrial era 4.0. So it cannot be denied that scientific literacy skills must be used properly(Nguyen & Rebello, 2011; Serway & Jewett, 2010; Stoen et al., 2020). The process of mastering scientific literacy is not easy, there must be a long process that can simultaneously run well. Understanding literacy becomes an inseparable part of when children have to solve a problem(Acar et al., 2015; Mazens & Lautrey, 2003; Sulman et al., 2023). This is because solving problems requires really good abilities in using knowledge to solve a physics problem.

Research data shows that students' low scientific literacy can be seen when students answer Questions No. 8 and Question 9, which are reviewed by including the indicator Evaluating and designing scientific investigations. Where the results obtained regarding the level of scientific literacy of students are very low and are actually no different from other questions, students also answer on average and get a score of 1, where a score of 1 indicates the student's answer is wrong or incorrect. This means that students still have difficulty answering questions. Difficulties like this clearly indicate that there is still a need for scientific literacy skills that are able to support students' abilities in solving problems so that students will be able to have an understanding and also the ability to analyze the questions given.

CONCLUSION

Based on the results of the research that has been carried out, it is concluded that the scores obtained by students can be divided into 3 categories, where the scores in the high category are 7 students or 13.46%, then in the medium category there are 35

students or 67.31%, and There are 10 students in the low category or 19.23%. This means that the average value is in the medium category. This means that students' scientific literacy skills still need to be improved. The researcher also suggests that other researchers who are interested in continuing this research prepare or validate this instrument first or use standard instruments so that the resulting research can be generalized in general.

REFERENCES

Acar, Ö., Büber, A., & Tola, Z. (2015). The Effect of Gender and Socio-economic Status of Students on Their Physics Conceptual Knowledge, Scientific Reasoning, and Nature of Science Understanding. *Procedia - Social and Behavioral Sciences*, *174*, 2753–2756. https://doi.org/10.1016/j.sbspro.2015.01.962

Basile, C., & White, C. (2000). Environmental Literacy: Providing an Interdisciplinary Context for Young Children. *Contemporary Issues in Early Childhood*, *1*(2), 201–208. https://doi.org/10.2304/ciec.2000.1.2.7

Clair, R. St. (2003). Words for the world: Creating critical environmental literacy for adults. *New Directions for Adult and Continuing Education*, *2003*(99), 69–78. https://doi.org/10.1002/ace.111

Creswell, J. W. (2012). *Planning, Conducting, and Evaluating Quantitative and Qualitative Research*.

Honey, M., Pearson, G., & Schweingruber, H. (2014). STEM Integration in K-12 Education. In *STEM Integration in K-12 Education*. https://doi.org/10.17226/18612

Johnston, J. S. (2014). John Dewey and science education. In *International Handbook of Research in History, Philosophy and Science Teaching*. https://doi.org/10.1007/978-94-007-7654-8_75

Karpudewan, M., Ponniah, J., & Ahmad, A. N. (2016). Project-Based Learning: An Approach to Promote Energy Literacy Among Secondary School Students. *Asia-Pacific Education Researcher*, *25*(2), 229–237. https://doi.org/10.1007/s40299-015-0256-z

Mascarenhas, S. S., Moorakonda, R., Agarwal, P., Lim, S. B., Sensaki, S., Chong, Y. S., Allen, J. C., & Daniel, L. M. (2017). Characteristics and influence of home literacy environment in early childhood-centered literacy orientation. *Proceedings of Singapore Healthcare*, *26*(2), 81–97. https://doi.org/10.1177/2010105816674738

Mazens, K., & Lautrey, J. (2003). Conceptual chnge in physics: Children's naive representations of sound. *Cognitive Development*, *18*(2), 159–176. https://doi.org/10.1016/S0885-2014(03)00018-2

Neuman, W. L. (2014). Social Research Methods; Qualitative and Quantitative Approaches Seventh Edition. In *Pearson*. http://arxiv.org/abs/1210.1833%250Ahttp://www.jstor.org/stable/3211488?origin=crossref%250Ahttp://www.ncbi.nlm.nih.gov/pubmed/12655928

Nguyen, D. H., & Rebello, N. S. (2011). Students' understanding and application of the area under the curve concept in physics problems. *Physical Review Special Topics - Physics Education Research*, *7*(1), 1–17.

https://doi.org/10.1103/PhysRevSTPER.7.010112

Nieminen, P., Savinainen, A., & Viiri, J. (2012). Relations between representational consistency, conceptual understanding of the force concept, and scientific reasoning. *Physical Review Special Topics - Physics Education Research*, *8*(1), 010123. https://doi.org/10.1103/PhysRevSTPER.8.010123

Parno, P., Yuliati, L., & Munfaridah, N. (2018). The profile of high school students ' scientific literacy on fluid dynamics The profile of high school students ' scientific literacy on fluid dynamics. *Journal of Physics: Conference Series*, *4*(1013), 1–7.

Pe'er, S., Goldman, D., & Yavetz, B. (2007). Environmental literacy in teacher training: Attitudes, knowledge, and environmental behavior off beginning students. *Journal of Environmental Education*, *39*(1), 45–59. https://doi.org/10.3200/JOEE.39.1.45-59

Permatasari, E. A. (2014). Implementasi Pendekatan Saintifik Dalam Kurikulum 2013 Pada Pembelajaran Sejarah. *Indonesian Journal of History Education*, *3*(1), 11–16.

Reyza, M., Taqwa, A., Sulman, F., & Faizah, R. (2022). College Students ' Conceptual Understanding of Force and Motion : Research Focus on Resource Theory College Students ' Conceptual Understanding of Force and Motion : Research Focus on Resource Theory. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/2309/1/012073

Rhosalia, L. A. (2017). Pendekatan Saintifik (Scientific Approach) Dalam Pembelajaran Tematik Terpadu Kurikulum 2013 Versi 2016. *JTIEE (Journal of Teaching in Elementary Education)*, *1*(1), 59–77. https://doi.org/10.30587/jtiee.v1i1.112

Serway, & Jewett. (2010). *Physics For Scientists and Engineers with Modern Physics Eighth Edition*.

Smith, A. L., Purcell, R. J., & Vaughan, J. M. (2015). Student Centered Education Guided Inquiry Activities for Learning about the Macro- and Micronutrients in Introductory Nutrition Courses Introduction / Background. *Biochemistry and Molecular Biology Education*, *43*(6), 449–459. https://doi.org/10.1002/bmb.20913

Stoen, S. M., McDaniel, M. A., Frey, R. F., Hynes, K. M., & Cahill, M. J. (2020). Force concept inventory: More than just conceptual understanding. *Physical Review Physics Education Research*, *16*(1), 10105. https://doi.org/10.1103/PhysRevPhysEducRes.16.010105

Sulman, F., Yuliatai, L., Kusairi, S., Hidayat, A., Pentang, J., & Mensah, B. (2023). *Investigating concept mastery of physics students during online lectures through Rasch models on force and motion materials*. *9*(1), 95–106.

Sulman, F., Yuliati, L., Kusairi, S., & Hidayat, A. (2022). Hybrid Learning Model : Its Impact on Mastery of Concepts and Self- Regulation in Newton ' s Second Law Material. *Kasuari: Physics Education Journal*, *5*(1), 65–74. https://doi.org/https://doi.org/10.37891/kpej.v5i1.273

Sulman, F., Yuliati, L., Purnama, B. Y., & Arief, M. R. (2022). *Creativity In Deriving The Fermi-Dirac Equation Through STEAM Approaches*. *10*(3). https://doi.org/10.20527/bipf.v10i3.13182

Sutopo, S. K. (2022). *Utilizing Isomorphic Multiple-Choice Items to Diagnose Students '*

Misconceptions in Force and Motion. *72*(4), 311–318.

Yotongyos, M., Traiwichitkhun, D., & Kaemkate, W. (2015). Undergraduate Students' Statistical Literacy: A Survey Study. *Procedia - Social and Behavioral Sciences*, *191*, 2731–2734. https://doi.org/10.1016/j.sbspro.2015.04.328

Yuliati, L., Karim, S., & Prima, E. C. (2018). Building Scientific Literacy and Physics Problem Solving Skills through Inquiry-Based Learning for Building Scientific Literacy and Physics Problem Solving Skills through Inquiry-Based Learning for STEM Education. *Journal of Physics: Conference Series*, *5*(1108). https://doi.org/10.1088/1742-6596/1108/1/012026

Yuliati, L., Parno, P., Yogismawati, F., & Nisa, I. (2018). Building Scientific Literacy and Concept Achievement of Physics through Inquiry-Based Learning for STEM Education Building Scientific Literacy and Concept Achievement of Physics through Inquiry-Based Learning for STEM. *Journal of Physics: Conference Series*, *5*(1097), 1–7. https://doi.org/10.1088/1742-6596/1097/1/012022