P-ISSN: 1693-1246
E-ISSN: 2355-3812
June 2025

Jurnal Pendidikan Fisika Indonesia 21 (1) (2025) 86-96
DOI: 10.15294/jpfi.v21i1.8381

http://journal.unnes.ac.id/journals/jpfi

The Profile of Alternative Electrical Energy Literacy (AEEL) among High School Students in West Java and East Java

Fian Rifqi Irsalina[1]*, Riski Amelia[2], Andi Suhandi[3], Firmanul Catur Wibowo[4]

[1,2]Department of Master Physics Education, Faculty of Mathematics and Science Education,
Universitas Pendidikan Indonesia
Dr. Setiabudhi No. 229, Bandung, 40154
[3]Department of Physics, Faculty of Mathematics and Science Education,
Universitas Pendidikan Indonesia
Dr. Setiabudhi No. 229, Bandung, 40154
[4]Department of Master Physics Education, Faculty of Mathematics and Science Education,
Rawamangun Muka Raya No.11, Jakarta, 13220
Universitas Negeri Jakarta

*Corresponding Author: fianrfq@upi.edu

Received: 15 January 2025. Accepted: 20 March 2025. Published: 12 June 2025

Abstract

This study aims to describe the profile of alternative electrical energy literacy (AEEL) among West Java and East Java high school students, covering cognitive, affective, and behavioral aspects. The research procedure employed a descriptive survey method with a random sample of 237 students, consisting of 130 students from East Java and 107 students from West Java. The instruments used included a knowledge test and a questionnaire on attitudes and behaviors related to alternative electricity energy. The results show that students' affective and behavioral abilities are above average, while their cognitive skills remain below average, with significant differences between the two provinces. Students in West Java understand alternative electricity energy concepts better than students in East Java. Based on these findings, this study is a foundation for schools and policymakers to develop a curriculum focused on alternative electrical energy literacy, aiming to enhance students' understanding of renewable energy sources and prepare the younger generation to face future energy challenges.

Keywords: alternative electrical energy literacy, descriptive survey, Likert scale, Rasch model

INTRODUCTION

Indonesia consumes a substantial amount of energy. According to data from the Ministry of Energy and Mineral Resource Republic of Indonesia (2023), electricity consumption per capita has steadily increased since 2017. In 2023, the average per capita consumption reached 1,285 kWh, up from 1,173 kWh in 2022.

One of the challenges associated with resource shortages, such as petroleum or other resources, is an energy crisis (Poudyal, Loskot, Nepal, Parajuli, & Khadka, 2019). An energy crisis is a condition where there is a disruption or shortage in energy supply or an increase in the prices of energy resources like crude oil, which impacts the country's economy (Afifa; Khoirunnisa, Pratiwi & Meitaza 2024; Zhao et al., 2022; Chien, Kamran, Albashar, & Iqbal, 2021; Khan et al., 2017)—citing

Azhar & Satriawan, state that energy is one of the most relevant physical materials. Energy encompasses resources that enable various activities, including fuel, electricity, mechanical energy, and heat. In the context of the importance of energy for Indonesian society, ensuring the sustainability of electricity sources is imperative. Crucial steps that the government and the public can take include practicing energy-saving behaviors and seeking alternative energy sources. In today's technological era, electricity usage has become integral to daily life. However, the current energy infrastructure is dominated by unsustainable fossil fuels due to high dependence on them, highlighting the need to develop sustainable electricity sources (Yüksel, 2019).

Transitioning to renewable energy is critical in addressing climate issues and reducing our dependence on fossil fuels. Potential sustainable alternative electrical energy solutions include solar, wind, and biomass energy. The general public, primarily as consumers, also needs good literacy in alternative energy sources to ensure the success of this transition. It is crucial for the public, especially the younger generation, to understand alternative electrical energy technologies and concepts. Literacy in alternative electrical energy, particularly among high school students, is important in shaping an energy-conscious generation that cares about the environment.

Akistu, Ishihara, Okumura, & Yamasue (2017), citing Barrow and DeWaters, indicating that energy literacy goes beyond mere knowledge. Energy-literate people exhibit signs such as awareness and knowledge of energy use daily. Understanding the impacts of excessive energy consumption, the importance of conservation, the development of alternative energy sources, and the ability to take actions that reflect their capabilities are crucial for sustainable communities.

Education plays a vital role in enhancing energy literacy. According to DeWaters & Powers (2013) and DeWaters & Powers (2011)Informed and energy-literate communities are likelier to engage in decision-making processes. They will be better prepared to make wise and responsible decisions, choices, and energy-related actions. Previous research on the importance of energy literacy for students has been conducted, and various efforts have been made. According to DeWaters & Powers in Martins, Madaleno, & Dias (2019)Education that enhances energy literacy is essential to influence students' attitudes, values, behaviors, and broad content knowledge.

Although energy literacy has become the focus of various educational research in Indonesia, identifying specific literacy on alternative electrical energy among high school students has yet to be carried out. Most studies examine energy literacy in general without distinguishing between different types of energy sources or specializing in alternative electrical energy that includes technologies such as solar, wind, and biomass power. This creates a significant knowledge gap, considering the important role of alternative electrical energy in future energy sustainability strategies. Research by Nindyatami, Rochman, Nasrudin, Malik, & Muslim (2023) Shows that energy literacy among high school students in Indonesia (Pangandaran District) is still intermediate, without sufficient focus on specific renewable energy sources. More in-depth research on alternative electrical energy literacy needs to be conducted, which indicates the need for more education to prepare students to face future energy challenges with more focused and applicable knowledge.

This research describes the profile of alternative energy for electricity (AEEL) among high school students in West Java and East Java. So far, similar research has yet to be conducted in Indonesia, examining their contributions to knowledge, attitudes, and behaviors related to alternative energy sources. Thus, the findings of this research can serve as a basis for designing strategic steps to improve students' understanding and awareness of the importance of alternative electrical energy. These steps will support Indonesia's transition to more sustainable electricity use and equip the younger generation with the knowledge and skills they need to be agents of change in global efforts to address the global electricity energy crisis.

METHOD

The following is a chart of the research design survey methods used in this research.

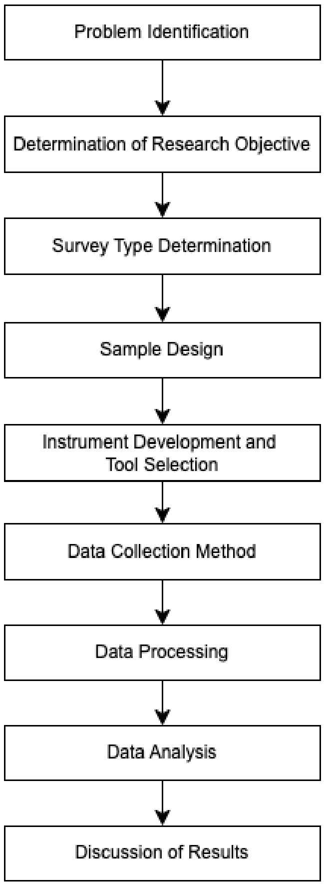

Figure 1. Survey Method Research Design Chart

Problem Identification

This research begins by identifying the problem, which is the level of alternative electrical energy literacy among high school students in West Java and East Java, Indonesia. This literacy is crucial in physics education because it directly relates to students' understanding of key physics concepts and their real-life applications. The study aims to describe the profile of alternative electrical energy literacy, which includes students' knowledge, attitudes, and behaviors related to alternative electrical energy. This problem identification step is vital as it serves as the foundation for formulating the research objectives and determining the overall direction of the study.

Determination of Research Objective

After the problem is identified, the research objectives are formulated. This study aims to measure and describe the knowledge, attitudes, and behaviors of high school students in West Java and East Java related to alternative electrical energy. These objectives are important because each alternative electrical energy literacy component—knowledge, attitudes, and behaviors—is integral to comprehensive physics education. Measuring these three components will provide a deeper understanding of how students comprehend and respond to the use of alternative electrical energy in the context of their education.

Survey Type Determination

This research employs a descriptive survey method to understand and describe the phenomenon of alternative electrical energy literacy among students. A descriptive survey was chosen because this method is effective in collecting in-depth data about existing conditions or situations for descriptive and interpretive purposes. (Aggarwal, 2008). Given the lack of deep knowledge about this phenomenon, this method is highly suitable for explaining the existing variables and contexts in detail. (Dubin, 1978). Thus, it allows researchers to gather a large sample. (Oluwaseyi, 2023).

Sample Design

The next step is the sample design, where participants are selected through a random sampling technique. In this study, 237 high school students were randomly selected from two provinces, namely West Java and East Java, with 130 students from East Java and 107 students from West Java. The random sampling technique ensures that every student has an equal chance of being a respondent, making the research results more representative of the general population. (Tanti et al., 2021). This step is crucial for ensuring the research findings can be generalized to a broader population.

To view the demographic profile of the respondents in this study, please refer to Table 1.

Table 1. Respondent Demographic Profile

Categories	Groups	Frequency	%
Class	X	108	45.6
	XI	100	42.2
	XII	29	12.2
State of School	Public School	193	81.4
	Private School	44	18.6
Type of School	Senior High School	180	75.9
	Islamic Senior High School	57	24.1
Area	West Java	107	45.1
	East Java	130	54.9

Instrument Development and Tool Selection

The research instrument consists of two main parts: a knowledge test and an attitude and behavior questionnaire developed from the energy literacy instrument by DeWaters & Powers (2013). The criteria for creating the instrument are based on the common characteristics of individuals with energy literacy, covering aspects of knowledge, attitude, and behavior. This framework consists of three main dimensions, forming the basis for designing the instrument with three sub-aspects. Each sub-aspect includes a group of questions focusing on one domain: knowledge (knowledge of alternative electricity energy, cognitive abilities, understanding of the impacts of developing and using alternative electricity energy resources), attitude (awareness, attitudes, government policy support, and values of alternative electricity energy), and behavior (use of alternative electricity energy technologies, participation, and perceptions). These criteria are guidelines for developing a comprehensive survey instrument to measure alternative electricity energy literacy.

The instrument developed based on this framework has been proven valid in measuring cognitive, affective, and behavioral aspects of energy literacy with acceptable Cronbach's alpha coefficients. Additionally, experts evaluate these instruments to ensure their alignment with the research objectives.

The knowledge test measures students' understanding of alternative electricity energy and consists of 25 multiple-choice questions. The non-test-based attitude and behavior questionnaire uses a Likert scale to assess students' responses to various statements about their attitudes and behaviors toward alternative electrical energy. Participants are requested to indicate their level of agreement with the provided statements (items) on a scale ranging from strongly disagree to strongly agree (Singh, 2006). The questionnaire includes 30 statements to measure attitude and 20 statements to measure behavior using a 4-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree) (Slightam, SooHoo, Greene, Zulman, & Kimerling, 2024).

Using a 4-point Likert scale has several significant advantages, particularly in reducing central tendency bias, often seen with a 5-point Likert scale, where respondents tend to choose the neutral middle option. This is important in developing the Turkish version of the Cognitive Failures Questionnaire (CFQ) with a 4-Likert scale to reduce bias and improve response accuracy. (Eser et al., 2020). Additionally, the 4-point scale simplifies the decision-making process for respondents, allowing them to express clear preferences or opinions more easily and resulting in more definitive data. This is very useful in educational research, where clarity and accuracy of feedback are crucial for evaluating training programs and cognitive assessments, and it emphasizes the importance of clear and consistent measurement tools (Velandia-Mesa, Serrano-Pastor, & Martínez-Segura, 2021).

Data Collection Methods

The data collection process was conducted using questionnaires distributed via Google Forms. This tool was chosen for its ease of use and high accessibility, allowing for quick and efficient creation, distribution, and analysis of surveys without additional costs (Setiawan, Herawati, & Saidi, 2022; Mondal, Mondal, Ghosal, & Mondal, 2019). Data collection was carried out from May 26 to June 10, 2024. During this process, students' knowledge was measured through a series of structured test questions, while their attitudes and behaviors were assessed through statements that the students had to respond to.

Data Processing

The collected data were then processed using the Rasch model, which was analyzed using Winstep Version 3.73 software. The Rasch model was chosen for its ability to detect unnecessary items and provide a more accurate measurement of responses according to the research objectives (Che Lah, Tasir, & Jumaat, 2023). This model can also transform ordinal scale data into ratio scale data, providing more detailed reliability values than Cronbach's alpha coefficient, including item and respondent reliability and their separation (see Table 3).

Data Analysis

The processed data were then analyzed using the Rasch model to generate a Wright Map, which depicts the profile of students' ability to understand alternative electrical energy compared to the difficulty level of the test items provided. The Wright Map displays symbols M, S, and T on both sides of the vertical line. The symbol M represents the average student ability, S indicates one standard deviation above and below the average, while T indicates two standard deviations above and below the average (Boone & Staver, 2020). This analysis clearly shows how students' ability to understand alternative electrical energy is distributed.

Discussion of Results

The results of this research are discussed by highlighting the main findings and their implications for physics education, particularly in the context of alternative electrical energy literacy. This discussion also includes an interpretation of the Wright Map and the relevance of these findings to developing a more focused curriculum on alternative electrical energy literacy (see Table 2). These findings emphasize the importance of creating a more targeted curriculum to enhance students' energy literacy, better preparing them to face future challenges in the energy sector.

RESULT AND DISCUSSION

Alternative Electricity Energy Literacy (AEEL) Response consists of the Knowledge Aspect (KA), Affective Aspect (AA), and Behavior Aspect (BA), which are detailed in Table 5.

According to Sumintono & Widhiarso (2015), the following is a guide for analyzing the quality of overall student response patterns and interactions between persons and items.

Table 2. Interpretation *of* Person Measure

Value	Explanation
< 0,0	Ability tendency < question difficulty level

Table 3. Interpretation of Person Reliability and Item Reliability

Interval	Explanation
0.94 ≤ r ≤ 1.00	Special
0.91 ≤ r ≤ 0.94	Very Good
0.81 ≤ r ≤ 0.91	Good
0.67 ≤ r ≤ 0.81	Enough
0.00 ≤ r ≤ 0.67	Weak

Table 4. Interpretation of Cronbach's Alpha

Interval	Explanation
α < 0.8	Very Good
0.7 ≤ α ≤ 0.8	Good
0.6 ≤ α ≤ 0.7	Enough
0.5 ≤ α ≤ 0.6	Low
α ≤ 0.5	Very Low

Table 5. Reliability, Separation, Person Measure, Infit, and Outfit MNSQ

Area	Aspect of AEEL	Person Measure	Reliability		Infit MNSQ		Outfit MNSQ		Separation	
			Person	Item	Person	Item	Person	Item	Person	Item
West Java	KA	-0.54	0.46	0.84	1.00	1.00	1.00	1.00	0.91	2.26
	AA	0.48	0.73	0.96	0.98	0.94	1.07	1.07	1.64	5.17
	BA	0.45	0.79	0.56	1.02	1.01	1.02	1.02	1.96	1.12
East Java	KA	-0,24	0.79	0.87	1.00	0.99	1.02	1.02	1.91	2.64
	AA	0.79	0.67	0.98	1.02	0.99	0.98	0.98	1.41	7.34
	BA	0.21	0.80	0.90	1.00	1.00	1.03	1.03	2.00	2.96

West Java

Based on Table 5, the Knowledge Aspect (KA) analysis in West Java shows a Person Measure value of -0.54, indicating that the overall cognitive ability of the students is below average. The person reliability of 0.46 indicates weak measurement consistency, while the item reliability of 0.84 indicates good consistency. The Outfit MNSQ values for persons and items are 1.00, which is ideal as it shows a good fit with the Rasch model and no significant noise in individual responses to test items (Sumintono & Widhiarso, 2015). The separation value for persons is 0.91, indicating that individuals' abilities in the test are not separated. In contrast, the item separation value of 2.26 indicates good ability to distinguish individuals with different abilities.

In the Affective Aspect (AA), the Person Measure value is 0.48, indicating that the affective abilities of students are above average. The person reliability of 0.73 indicates reasonably good measurement consistency, while the item reliability of 0.96 indicates very good consistency. The Outfit MNSQ values for persons and items are 1.07, slightly above ideal but still acceptable. The separation value for persons is 1.64, indicating good separation ability, while the item separation value of 5.17 shows very good separation ability. These values suggest that the test instrument can separate individuals and items, providing accurate results in measuring individual ability.

In the Behaviour Aspect (BA), the Person Measure value is 0.45, indicating that students' behavioral abilities are above average. The person reliability of 0.79 indicates reasonably good measurement consistency, but the item reliability of 0.56 indicates weak consistency. The Outfit MNSQ values for persons and items are 1.02, approaching the ideal value. The separation value for persons is 1.96, indicating good separation ability, while the item separation value of 1.12 indicates low separation ability.

Overall, the profile of alternative electrical energy literacy among students in West Java shows that their affective and behavioral abilities are above average, while their cognitive skills still need improvement. The measurement instruments used demonstrate good separation ability in the affective and behavioral aspects, but require improvement in the knowledge aspect.

East Java

Based on Table 5, the Knowledge Aspect (KA) analysis in East Java shows a Person Measure value of -0.24, indicating that the overall academic abilities of students are still below average. The person reliability of 0.79 indicates reasonably good measurement consistency, while the item reliability of 0.87 indicates good consistency. The Outfit MNSQ values for both persons and items are 1.02, slightly above ideal but still acceptable. The Separation value for persons is 1.91, and for items, it is 2.64, indicating that this test can distinguish individuals and items well. However, adjustments may still be needed to improve the accuracy of cognitive ability measurements.

In the Affective Aspect (AA), the Person Measure value is 0.79, indicating that students' affective abilities are above average. The person reliability of 0.67 indicates reasonably good measurement consistency, while the item reliability of 0.98 indicates very good consistency. The Outfit MNSQ values for persons and items are 0.98, approaching the ideal value. The Separation value for persons is 1.41, indicating good separation ability, and the item separation value of 7.34 indicates very good separation ability.

In the Behaviour Aspect (BA), a Person Measure of 0.21 indicates behavioral abilities above average. A personal reliability of 0.80 indicates good measurement consistency, and an item reliability of 0.90 indicates good consistency. The Outfit MNSQ values for persons and items are 1.03, slightly above ideal but still acceptable. The Separation value for persons is 2.00, and the item separation value of 2.96 indicates that the test instrument can distinguish individuals and items well.

Overall, the profile of alternative electrical energy literacy among students in East Java indicates that their academic abilities are still below average, while their affective and behavioral skills are above average. The measurement instruments demonstrate a good ability to separate the affective and behavioral aspects and reasonably good measurement consistency.

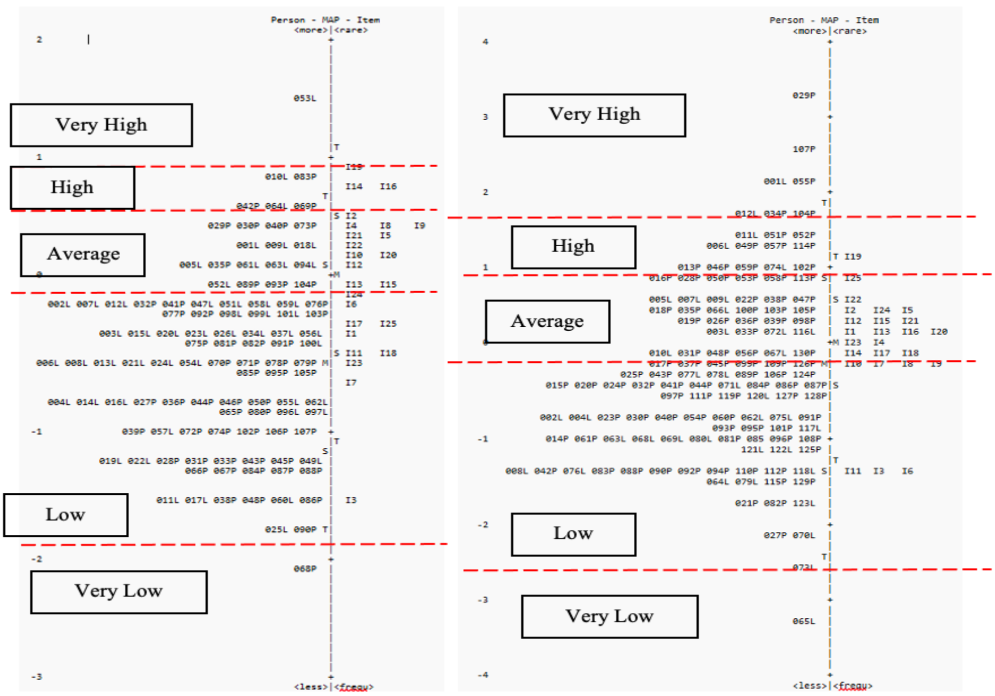

Figure 2. Wright Maps Knowledge Aspect of (a) West Java and (b) East Java.

Figure 2 presents data that has undergone the person fit examination and cleaning stages, presented as a Person Wright Map. Figure 2(a) displays the distribution of proficiency levels in alternative electricity energy literacy among 107 students from West Java. In comparison, Figure 2(b) shows 130 students from East Java, grouped by item and individual. At the "very low" level of alternative electricity energy literacy, Figure 2(a) indicates three students from West Java. In contrast, Figure 2(b) shows two students from East Java. At the "low" proficiency level, 86 students were in West Java, and 82 were in East Java. At the "moderate" proficiency level, there are 15 students in West Java and 32 students in East Java. At the "high" proficiency level, there are two West Java students and ten East Java students. Finally, at the "very high" proficiency level, one student was in West Java, and four were in East Java.

In Rasch's evaluation, Wright maps are a useful analysis tool for showing the distribution of student abilities and item difficulties on the same scale. The analysis of Wright maps for alternative electricity energy literacy knowledge compares high school students in West Java and East Java. Figure 2(a) shows that the distribution of student abilities in West Java spans all categories from "Very Low" to "Very High." However, a significant concentration of students in the "High" and "Very High" categories indicates that most students have a good knowledge of alternative electrical energy. The distribution of item difficulties is also evenly spread from "Very Low" to "Very High," showing that the test includes questions with varying difficulty levels, effectively differentiating student abilities is also evenly spread from "Very Low" to "Very High", showing that the test includes questions with varying difficulty levels, allowing for effective differentiation of student abilities.

Meanwhile, according to Figure 2(b), representing students in East Java, the distribution of student abilities also spans all categories. Still, it has a more significant concentration in the "Average" and "High" categories. This indicates that most students have moderate to good knowledge, with fewer students in the "Very High" category. The distribution of item difficulties in this map is also evenly spread, showing that the test in East Java is well-designed to measure various levels of student abilities. Comparatively, students in West Java tend to have a higher concentration in the "High" and "Very High" categories compared to East Java, where more students fall into the "Average" category. This suggests that students in West Java may have a slightly better understanding of alternative electrical energy concepts than those in East Java. However, the even distribution of item difficulties in both regions indicates that the tests are well-constructed to measure a wide range of abilities in both groups of students.

Overall, the Wright maps show that the knowledge tests on alternative electricity energy literacy in both regions effectively differentiate students' knowledge levels. The slight differences in student ability distribution between West Java and East Java may be due to curriculum differences, teaching methods, or access to learning resources.

In the Affective Aspect (AA), the highest-scoring student in West Java is a male student with code 053L, scoring 107 out of 120. In East Java, the highest-scoring students are three female students with codes 024P, 059P, and 105P, each scoring 108 out of 120, 105 out of 120, and 105 out of 120, respectively. The lowest-scoring student in West Java is the student with code 086P, scoring 54 out of 120, while in East Java, the lowest-scoring students are students with codes 032P and 100P, each scoring 73 out of 120.

For the Behavioral Aspect (BA), the highest-scoring students in West Java are students with codes 015L, 017L, 023L, 024L, and 031P, each scoring 73 out of 80. The lowest-scoring student is a student with code 052L, scoring 29 out of 80. In East Java, the highest-scoring student for the Behavioral Aspect is a student with code 075L, scoring 73 out of 80. The lowest-scoring students are students with codes 018P, 048P, and 070L, scoring 36 out of 80.

The low, moderate, and high scores observed among students for the three aspects (knowledge, attitude, and behavior) in East Java and West Java can be explained by considering factors such as differences in curriculum, teaching methods, and access to learning resources. In the

Knowledge Aspect, students in West Java tend to have a higher concentration in the "High" and "Very High" categories, which may reflect a better understanding of alternative electrical energy concepts compared to students in East Java, who are more concentrated in the "Moderate" category. The study by Dangkua, Mooduto, and Tilome (2022) highlights challenges in improving energy literacy, which is relevant to the need for more targeted curriculum development in both regions.

In the Affective Aspect, students in East Java show good performance, with some students achieving the highest scores, which suggests that more effective teaching approaches could influence building positive attitudes towards energy in East Java schools. However, students in West Java also demonstrate strong affective abilities, albeit with some lower scores. The research by Akistu Ishihara, Okumura, & Yamasue (2017) Indicates that conceptual understanding of energy can influence energy-saving behavior, as reflected in the affective performance of students in both regions. Both studies emphasize the importance of formal and non-formal education in enhancing energy literacy.

In the behavioral aspect, West Java and East Java scores reflect how students apply their knowledge in real-world energy conservation actions. Factors such as family support, involvement in school activities related to energy, and practical experiences outside the classroom likely play a role in these score differences. This aligns with the findings of Hendinata, Ardiwinata, and Pratama (2022), who emphasize that energy literacy is key in shaping energy-related behavior.

Overall, the variation in scores between the two Overall, the variation in scores between the two regions suggests that while there is a good understanding of alternative electrical energy, its application in everyday behavior may still need improvement through more focused education and integration of theory and practice. The previous studies collectively support the importance of a holistic educational approach to enhancing energy literacy and preparing students to face future energy challenges, as reflected in this research.

CONCLUSION

This study indicates that the level of alternative electricity energy literacy (AEEL) among West Java and East Java high school students encompasses cognitive, affective, and behavioral aspects with diverse profiles. Students in both provinces generally exhibit above-average affective and behavioral abilities, while their cognitive abilities remain below average. There is a significant difference between students' abilities in the two regions, with students in West Java tending to better understand alternative electricity energy concepts compared to students in East Java. These findings highlight the importance of enhancing energy literacy, particularly in alternative electricity energy, through a curriculum focused on renewable energy sources. Based on the findings of this study, it is recommended that schools and educational departments in West Java and East Java develop a curriculum that emphasizes alternative electricity energy literacy, with a focus on enhancing students' cognitive understanding of renewable energy sources. This recommendation is also directed at educational policymakers to design more in-depth educational programs and school activities related to energy conservation and the use of alternative energy, preparing the younger generation to face future energy challenges.

REFERENCES

Afifa, M., Khoirunnisa, R., Pratiwi, S. M. V., & Meitaza, D. (2024). Utilizing the Rasch Model to Analyze A Gender Gap in Students' Scientific Literacy on Energy. *Jurnal Pendidikan Fisika Indonesia*, *20*(1), 85–95. https://doi.org/10.15294/jpfi.v20i1.44472

Aggarwal, Y. P. (2008). *Statistics of Education* (Second Edition). Sterling.

Akistu, Y., Ishihara, K. N., Okumura, H., & Yamasue, E. (2017). Investigating energy literacy and its structural model for lower secondary students in Japan. *International Journal of Environmental & Science Education*, *12*(5), 1067–1095.

Boone, W. J., & Staver, J. R. (2020). *Advances in Rasch Analyses in the Human Sciences*.

Springer International Publishing. https://doi.org/10.1007/978-3-030-43420-5

Che Lah, N. H., Tasir, Z., & Jumaat, N. F. (2023). Applying the alternative method to evaluate online problem-solving skill inventory (OPSI) using Rasch model analysis. *Educational Studies*, *49*(4), 644–666. https://doi.org/10.1080/03055698.2021.1874310

Chien, F., Kamran, H. W., Albashar, G., & Iqbal, W. (2021). Dynamic planning, conversion, and management strategy of different renewable energy sources: A Sustainable Solution for Severe Energy Crises in Emerging Economies. *International Journal of Hydrogen Energy*, *46*(11), 7745–7758. https://doi.org/10.1016/j.ijhydene.2020.12.004

Dangkua, T., Mooduto, Y., & Tilome, A. (2022). Energy Literacy Education Characteristics in Gorontalo City, Indonesia: Cognitive Scale. *Journal La Lifesci*, *3*(2), 82–91. https://doi.org/10.37899/journallalifesci.v3i2.608

DeWaters, J. E., & Powers, S. E. (2011). Energy literacy of New York State (USA) secondary students: A measure of knowledge, affect, and behavior. *Energy Policy*, *39*(3), 1699–1710. https://doi.org/10.1016/j.enpol.2010.12.049

DeWaters, J., & Powers, S. (2013). Establishing measurement criteria for an energy literacy questionnaire. *Journal of Environmental Education*, *44*(1), 38–55. https://doi.org/10.1080/00958964.2012.711378

Dubin, R. (1978). *Theory building* (Rev. ed). Free Press.

Eser, H. Y., İnan, M. Y., Kucuker, M. U., Kilçiksiz, C. M., Yilmaz, S., Dinçer, N., Kiliç, Ö., Ercan, A. C., & Aydemir, Ö. (2020). Development, Validity and Reliability of the 4-point Likert Turkish version of Cognitive Failures Questionnaire. *Annals of Medical Research*, *27*(5), 1. https://doi.org/10.5455/annalsmedres.2020.04.308

Hendinata, L. K., Ardiwinata, T., & Pratama, F. K. T. (2022). The Role of Energy Literacy in Supporting Energy Conservation: Perspective from Indonesian Citizens. *Indonesian Journal of Energy*, *5*(2). https://doi.org/10.33116/ije.v5i2.113

Khan, S., Siddique, R., Sajjad, W., Nabi, G., Hayat, K. M., Duan, P., & Yao, L. (2017). Biodiesel Production From Algae to Overcome the Energy Crisis. *HAYATI Journal of Biosciences*, *24*(4), 163–167. https://doi.org/10.1016/j.hjb.2017.10.003

Martins, A., Madaleno, M., & Dias, M. F. (2019). Energy Literacy: Does the education field matter? *Proceedings of the Seventh International Conference on Technological Ecosystems for Enhancing Multiculturality*, 494–499. https://doi.org/10.1145/3362789.3362938

Ministry of Energy and Mineral Resources, Republic of Indonesia. (2023). *Handbook of Energy & Economic Statistics of Indonesia* (C. Anditya, F. Lasnawatin, A. B. Prananto, & L. Halim, Eds.). Ministry of Energy and Mineral Resources, Republic of Indonesia.

Mondal, H., Mondal, S., Ghosal, T., & Mondal, S. (2019). Using Google Forms for Medical Survey: A Technical Note. *International Journal of Clinical and Experimental Physiology*, *5*(4), 216–218. https://doi.org/10.5530/ijcep.2018.5.4.26

Nindyatami, Z., Rochman, C., Nasrudin, D., Malik, A., & Muslim. (2023). Profil literasi energi terbarukan pembangkit listrik tenaga air (PLTA) Jatiluhur pada siswa SMA di Kabupaten Purwakarta. *WaPFi (Wahana Pendidikan Fisika)*, *8*(2), 171–180. https://doi.org/10.17509/wapfi.v8i2.55482

Oluwaseyi, O. E. (2023). Evaluation of Teachers' Pedagogical Method of Teaching Physics and Its Effects on Academic Performance of Physics Students in Senior Secondary School in South West Nigeria. *International Journal of Oceanography & Aquaculture*, *7*(4), 1–6. https://doi.org/10.23880/ijoac-16000268

Poudyal, R., Loskot, P., Nepal, R., Parajuli, R., & Khadka, S. K. (2019). Mitigating the current energy crisis in Nepal with renewable energy sources. *Renewable and Sustainable Energy Reviews*, *116*, 109388. https://doi.org/10.1016/j.rser.2019.109388

Setiawan, E., Herawati, N., & Saidi, S. (2022). Sosialisasi penggunaan google form bagi perangkat desa dan guru sido makmur. *BUGUH: JURNAL PENGABDIAN KEPADA MASYARAKAT*, *2*(2), 20–23. https://doi.org/10.23960/buguh.v2n2.973

Singh, Y. K. (2006). *Fundamentals of Research Methodology and Statistics*. New Age International (P) Limited, Publisher.

Slightam, C., SooHoo, S., Greene, L., Zulman, D. M., & Kimerling, R. (2024). Development and Validation of a Measure to Assess Patient Experiences With Video Care Encounters. *JAMA Network Open*, *7*(4), e245277.

https://doi.org/10.1001/jamanetworkopen.2024.5277

Tanti, T., Astalini, A., Kurniawan, D. A., Darmaji, D., Puspitasari, T. O., & Wardhana, I. (2021). Attitude for Physics: The Condition of High School Students. *Jurnal Pendidikan Fisika Indonesia*, *17*(2), 126–132. https://doi.org/10.15294/jpfi.v17i2.18919

Velandia-Mesa, C., Serrano-Pastor, F. J., & Martínez-Segura, M. J. (2021). Evaluación de la investigación formativa: Diseño y validación de escala. *Revista Electrónica Educare*, *25*(1), 1–20. https://doi.org/10.15359/ree.25-1.3

Yüksel, Y. E. (2019). Elementary science teacher candidates' views on hydrogen as a future energy carrier. *International Journal of Hydrogen Energy*, *44*(20), 9817–9822. https://doi.org/10.1016/j.ijhydene.2018.12.009

Zhao, J., Patwary, A. K., Qayyum, A., Alharthi, M., Bashir, F., Mohsin, M., Hanif, I., & Abbas, Q. (2022). The determinants of renewable energy sources for fueling a green and sustainable economy. *Energy*, *238*, 122029. https://doi.org/10.1016/j.energy.2021.122029