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Analysis of the Validity of Problem-Based Learning Physics Modules to Facilitate Scientific Literacy in High School Student

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ABSTRACT

This research is driven by the students' scientific literacy has not been well facilitated because the teaching materials used have not optimally supported its development. The purpose of this study is to develop and analyze the validity of the problem-based learning physics module intended to facilitate students' scientific literacy. This study employed a research and development (R&D) method to develop and validate the module. The validation process was carried out by three physics lectures from the State University of Padang (UNP) and two high school physics teachers. Expert validation was carried out to assess six component: content feasibility, presentation, graphics, language, problem-based learning steps, and scientific literacy. Based on the data analysis, the developed module obtained a Aiken's V index of 0.89, which falls into the valid category. Therefore, it can be concluded that the problem-based learning physics module developed to facilitate high school students' scientific literacy is valid and appropriate for use as an innovative teaching material that effectively supports the physics learning process, particularly on the topic of climate change.

INTRODUCTION

The objective of physics learning in the independent curriculum is not only centered on students' understanding of theoretical concepts, but also aims to shape scientific attitudes so that they can apply knowledge and skills that can be used in real-life contexts. This is in line with the concept of science literacy, whereby students not only understand theory but are also able to solve problems they encounter, enabling them to interpret science in their daily lives (Firdaus & Asmali, 2021). Therefore, scientific literacy are very important in physics learning in order to help students build their knowledge. Scientific literacy is the ability to use scientific knowledge and inquiry processes meangningfully in everyday life, rather than simply knowing scientific concepts or facts (Lavonen, 2021).

To develop scientific literacy, students must not only understand scientific concept but also apply them in real life situations (Bossér, 2024). Understanding alone is not enough without the ability to use that knowledge meaningfully. Students who are good at physics but unable to apply it wisely in their daily lives have not yet become accustomed to using scientific literacy. Those who possess scientific literacy can solve problems, understand social issues through scientific concepts, and critically evaluate information that lacks logical support.

Teachers and the government both support the growth of scientific literacy. One of the government's initiatives is the National Literacy Movement. This movement aims to improve quality of life by fostering the growth and development of literacy culture within the educational ecosystem (family, school, and community) (Nasrullah et al., 2024). In order to help students develop scientific literacy, educators have also used a range of strategies, such as implementing innovative teaching methods like the problem-based learning model that are tailored to the needs of the students and the subject matter being studied. Along with creating instructional resources to be used in the teaching and learning process, teachers also create a welcoming and well-organized learning environment.

The truth is that due to inadequate facilitation, scientific literacy among kids remains poor. This is based on the outcomes of exams that were administered to 81 participating nations by the Programme for International Student Assessmen (PISA) in 2022. To represent the PISA sample, 15-year-old students were selected at random 54% of high school, vocational school, and Islamic high school students out of 14,340 students and 413 schools/madrasas took the PISA exam, compared to 46% of junior high school and Islamic junior high school students. Based on the data, Indonesia is placed 64th out of 81 countries with a scientific literacy score of 383 (OECD, 2023). These findings that students' understanding of science is not as good as it should be. This suggests that schools haven't done a complete job in helping students develop their scientific literacy. As a result, this affects students' capacity to gain knowledge, particularly in these area of physics.

Low scientific literacy among students can be attributed to several factors. First, physics education has not facilitated students' scientific literacy due to the teaching materials used during lessons. This is supported by Table 1's findings from an examination of the instructional resources used with students at SMAN 2 Sungai Penuh.

Table 1. Result of the analysis of teaching materials used in learning

No	Indicator	Yes	No
1	Recognizing valid scientific views	65.30%	34.70%
2	Assessing how trustworthy the source are	41.70%	58.30%
3	Examining how scientific information is used correctly or incorrectly	36.10%	63.90%
4	Learning the parts of design research and how they affect scientific results or conclusions	38.90%	61.10%
5	Making accurate graphs from information	38.90%	61.10%
6	Understanding and analyzing charts and graphs that show data	36.10%	63.90%
7	Using math skills to solve problems, including simple statistics	66.70%	33.30%

No	Indicator	Yes	No
8	Grasping and explaining basic statistics	41.70%	58.30%
9	Making educated guesses, forecasts, and conclusions based on numerical data	50.00%	50.00%
	Average results	46.16%	53.84%

Based on Table 1, only two indicators had the highest percentage of "yes" answers, namely identifying valid scientific opinions and solving problems using quantitative skills, including basic statistics. Meanwhile, the other six indicators produced the highest percentage of "no" answers, assessing how trustworthy the source are and grasping and explaining basic statistics with 58.30%, examining how scientific information is used correctly or incorrectly and understanding and analyzing charts and graphs that show data with 63.90%, learning the parts of design research and how they affect scientific results or conclusions and making accurate graphs from information with 61.10%. Then, there were balanced results on the indicators of making educated guesses, forecasts, and conclusions based on numerical data with 50.00% of yes and no answers respectively. Thus, as many as 46.16% stated that the teaching materials used during learning had facilitated scientific literacy. Meanwhile, as many as 53.84% indicated that the teaching materials used had not facilitated scientific literacy. This shows that the teaching materials used in learning are not optimal in facilitating students' scientific literacy.

Second, school-based learning activities still heavily emphasize learning concepts and physics formulas, but comprehensive science-based learning activities are still highly limited. Not only that, the materials used have not implemented steps that encourage students to independently discover concepts and solve existing problems (Hufri et al., 2019). This statement is reinforced in a study conducted by (Sibuea et al., 2019) which found that learning has not guided students to discover concepts and solve problems they face, but instead contains material, evaluations, questions, and solutions. This can result in students being incompetent in dealing with real-world problems.

Third, the learning model also influences students' scientific literacy. Learning that focuses primarily on memorizing formulas without involving students in direct experiences can hinder active participation. Such an approach makes students passive and less engaged in constructing and acquiring knowledge (Kurniati & Adelia, 2023). If this continues, students will find it difficult to develop their understanding of science and interpret it in real life.

One teaching method that can help students in facilitate their scientific literacy is the Problem-Based Learning model. (Alwathoni et al., 2024) studied this method and discovered that it is a great way to boost scientific literacy. They concluded that the Problem-Based Learning model is helpful in encouraging the growth of these skills. The model focuses on four aspects of student science : competency, knowledge, context, and attitude. Through this model, it is hoped that students will not only gain knowledge about the problems they face but also improve their problem-solving skills (Auliya, 2024).

Students must improve their problem-solving abilities, get more involved in the learning process, and collaborate in groups to solve the issues presented in the PBL approach. The PBL approach requires instructional resources that can enhance learning in order to be applied as effectively as possible. Based on interviews with three physics teachers at SMAN 2 Sungai Penuh, they stated that they had not used teaching materials appropriate to the model when implementing the PBL model. One solution that can be used to overcome this condition is to develop teaching materials that can be used in accordance with the PBL model applied so that it can help students in facilitating their scientific literacy so that they can build their knowledge optimally.

Modules are teaching materials that play a direct role in student learning activities and are suitable for supporting problem-based learning. Learning tools or facilities known as modules are composed of materials, techniques, and constrainst that have been written by educators themselves. They are aesthetically pleasing and methodically structured to attain expected abilities based on their level of complexity, and students can study them on their own (Al Mamun & Lawrie, 2023). The use of modules in learning has advantages, namely focusing on individual student abilities, there is control over learning outcomes by using competency standards in each module that must be achieved by each student, and the relevance of the curriculum is shown by the objectives and how to achieve them, so that students can understand the relationship between lessons and the results they will obtain (Al Mamun & Lawrie, 2023). Furthermore, there is a significant influence between the use of problem-based science teaching materials on improving students' scientific literacy (Mutmainnah, 2023). Because the PBL paradigm requires students to learn how to explain scientific phenomena, conduct assessments, organize scientific investigations, and interpret scientific data and evidence, among other things, it can also help students become more scientifically literate (Pozuelo-muñoz et al., 2023).

The module is considered appropriate for use in the learning process based on its pedagogical benefits. In recent years, considerable attention has been directed toward the development of Problem-Based Learning (PBL) modules that can facilitate the improvement of students' scientific literacy. Previous studies have shown that the implementation of PBL-based modules in physics learning can facilitate students' ability to apply scientific concepts, reason critically, and connect their knowledge to real-world contexts (Karien Herlina Wiandari et al., 2023), (Asnidar et al., 2024). However, many of the existing modules have not yet undergone adequate validation to ensure their feasibility, accuracy, and effectiveness in supporting learning objectives. Without proper validation, it cannot be determined whether the developed learning materials align with learning outcomes, are linguistically appropriate, and are pedagogically effective in facilitating students' scientific literacy. Therefore, this study aims to develop and validate a physics module based on the Problem-Based Learning (PBL) model to ensure its quality, readability, and instructional effectiveness. The validated module is expected to serve as a useful tool for teachers and students in facilitating scientific literacy and supporting active, problem-centered learning in physics classrooms.

METHODS

This research employs a Research and Development (R&D) design, which aims to produce a valid instructional product. The study focuses on developing a Problem-Based Learning (PBL)-based physics module designed to facilitate high school students' scientific literacy on the topic of climate change. The research adopts the ADDIE development model (Analysis, Design, Development, Implementation, and Evaluation) as the guiding framework. However, this study was limited to the development phase, which includes expert validation and product revision to enhance the quality of the final module.

At the analysis stage, the researcher examined the needs for teaching materials, student characteristics, and curriculum requirements. The findings from this stage served as the foundation for the design phase, where the module structure was developed based on the Kemendikbud, (2017) module development guidelines. The development phase involved creating the initial draft of the module and conducting expert validation with five validators—three physics lecturers and two high school physics teachers. The validation process used instrument that have been previously validated by three physics lecturers. The module validity instrument was adapted from the Depdiknas (2008) material development guide, which comprised components of content feasibility, presentation, graphics, and language. Then, problem-based learning steps and scientific literacy were added to align with the research title. Revisions were made based on expert feedback to refine the final product. To illustrate the research process clearly, Figure 1 presents the procedural flow of this study following the ADDIE model.

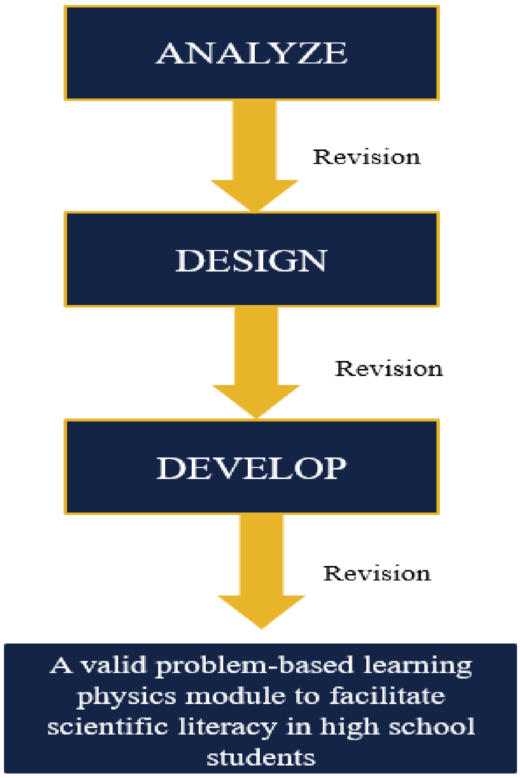

Figure 1. Module development stages carried out

After validation by experts, the data is processed using the Aiken formula:

$$V = \frac{\Sigma s}{[n(c-1)]} \quad (1)$$

$$S = r - I_0 \quad (2)$$

Information :
V = Assessment Agreement Index
S = Score given by the assessor minus the lowest score on the scale
r = Score given by the assessor
n = Number of assessors (expert)
I_0 = 1 = Lowest validity score
C = Number of categories on the Assessment Scale

The validity of a module is determined using the Aiken Validity Index. The minimum criterion or limit for module validity is $V \geq 0.80$. This minimum limit is based on the validity coefficient table established by Aiken (1985) by looking at the number of assessors and the number of assessment scale categories. The results obtained using Aiken's formula are used to determine the validity of a module. Since the minimum validity limit is 0.80, a module is considered valid and invalid as can be seen in Table 2.

Table 2. Aiken's V Index

V	Category
V < 0.80	Invalid
$V \geq 0{,}80$	Valid

Source : (Aiken, 1985)

As can be seen from the table, a module is deemed invalid if the V is <0.80, but it is deemed legitimate if $V \geq 0{,}80$, meaning that both teachers and students can use it to aid in the learning process.

RESULTS AND DISCUSSION

Results

Designing a legitimate problem-based learning physics module to improve high school students' scientific literacy on climate change was the goal of this study. This development process followed the ADDIE development model, as explained in the method section. The first stage was an analysis that included analysis of teaching material needs, student characteristics, and the curriculum used. The results of this analysis were needed in developing the module later. The module structure was created following the module development guidelines so that the developed module could be structured systematically. After the module was developed in accordance with the analysis results and also the module structure based on the guidelines, a validity evidence was then carried out on five experts to determine the validity of the module. The module validation process used a validation instrument that had previously gone through a validation test process. The instrument contained six assessment components: content feasibility, language, presentation, graphics, problem-based learning steps, and scientific literacy indicators.

Validation results for the first component, namely content feasibility. The content feasibility component contains several indicators, namely conformity with CP, TP, IKTP, ATP, suitability to student needs, suitability to teaching material needs, validity of the material substance, and benefits for increasing knowledge. The results of the Aiken's V index for the content feasibility component can be seen in Figure 2.

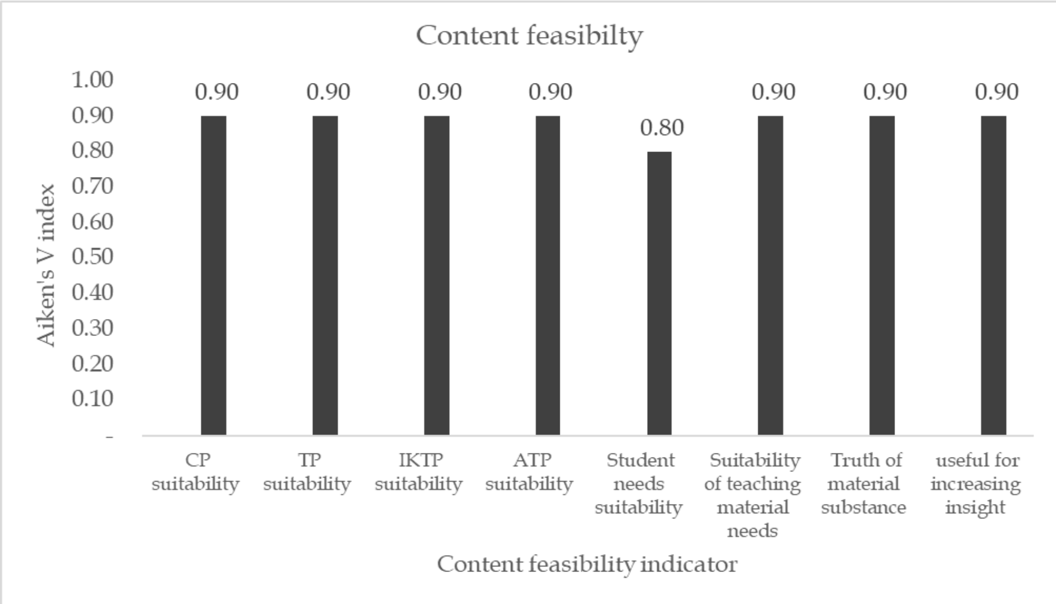

Figure 2. Aiken's V index results of content feasibility components

Based on Figure 2, it can be seen that the Aiken's V indeks of the content feasibility component is in the range of 0.80 to 0.90. The lowest score is only found in the indicator of suitability to student needs, but it is still within the valid criteria. While the other indicators obtained the same Aiken's V index, namely 0.90. The average Aiken's V index for the content feasibility component is 0.89. Based on this, the assessment of the content feasibility component is within the valid criteria.

Then, the second component focuses on language, which includes indicators such as readability, clarity of information, compliance with Indonesian language standards. It also emphasizes the use of language that is effective and efficient. The findings from the Aiken's V index of this language component are shown in Figure 3.

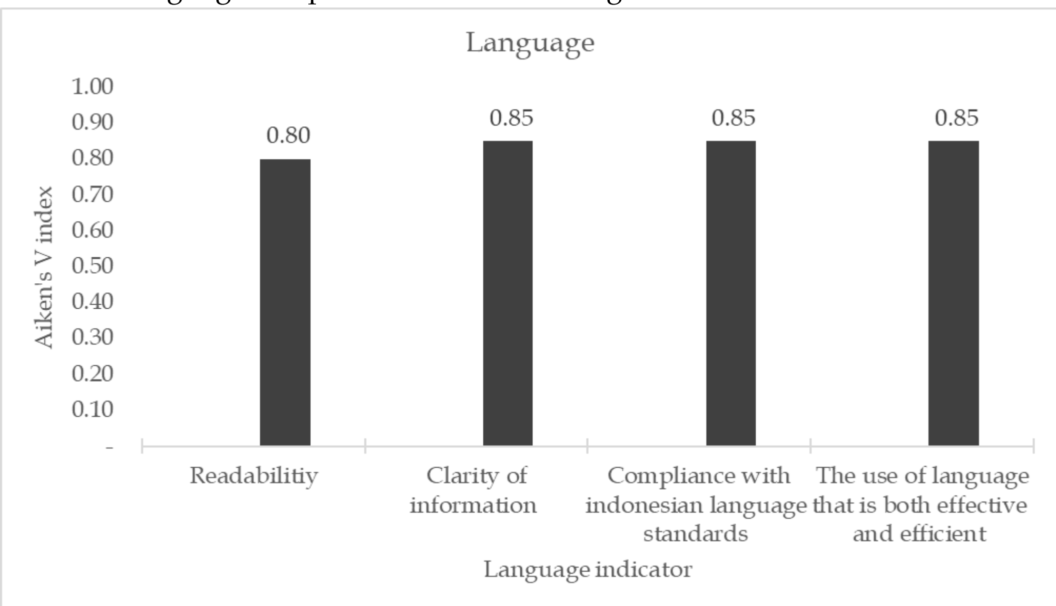

Figure 3. Results of Aiken's V index of language components

Based on Figure 3, it can be seen that the Aiken's V index of the language component in the readability indicator is 0.80, with valid criteria. For the information clarity indicator, it is 0.85, with valid criteria. For the conformity to Indonesian language rules indicator, it is 0.85, with valid criteria. Finally, for the effective and efficient language use indicator, it is 0.85, with valid criteria. The lowest Aikens' V index is for the readability indicator, while the other three indicators obtained the same Aiken's V index, namely 0.85. The average Aikens' V index for the language component is 0.84, with valid criteria.

The third component is presentation, which includes clarity of purpose, order of presentation, motivation, interactivity (stimulus and response), and completeness of information. This component assesses how well the material is organized and how effectively it engages learners. The outcomes of checking how accurate the presentation part is can be observed in Figure 4.

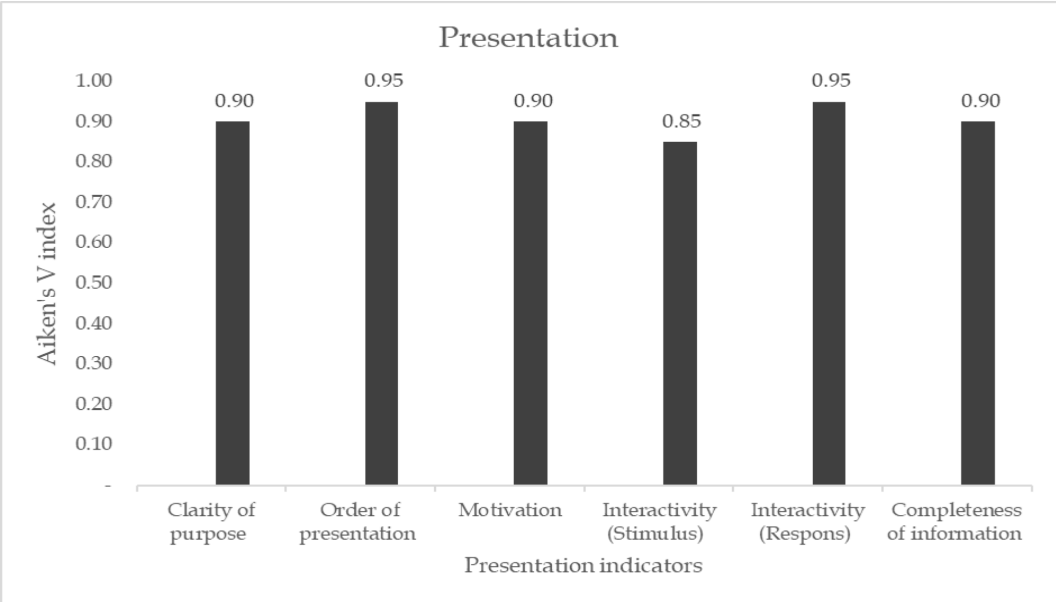

Figure 4. Results of presentation component validation

Figure 4 shows that, with proper criteria, the presentation component's score in the clarity of aims indication is 0.90 with valid criteria, the presentation sequence indicator then achieved a Aiken' V index of 0.95 with valid criteria, the motivation indicator's Aiken's V index was 0.90. The interactivity indicator consisting of stimulus and response obtained Aiken's V index of 0.85 and 0.95, respectively, with valid criteria for both. Ultimately, using appropriate criteria, the information completeness indicator yielded a result of 0.90. The interactivity (stimulus) indicator had the lowest Aiken's V index, at 0.85, while the presentation sequence and interactivity (reaction) indicators had the highest Aiken's V index, at 0.95. With correct criteria, the presentation component's average Aiken's V index was 0.91.

Next, examine the graphical component's assessment results. Font use (type and size), layout, graphics, photographs and photos, and display design are indicators for this component. Figure 5 displays the findings of the graphic component's Aiken's V index.

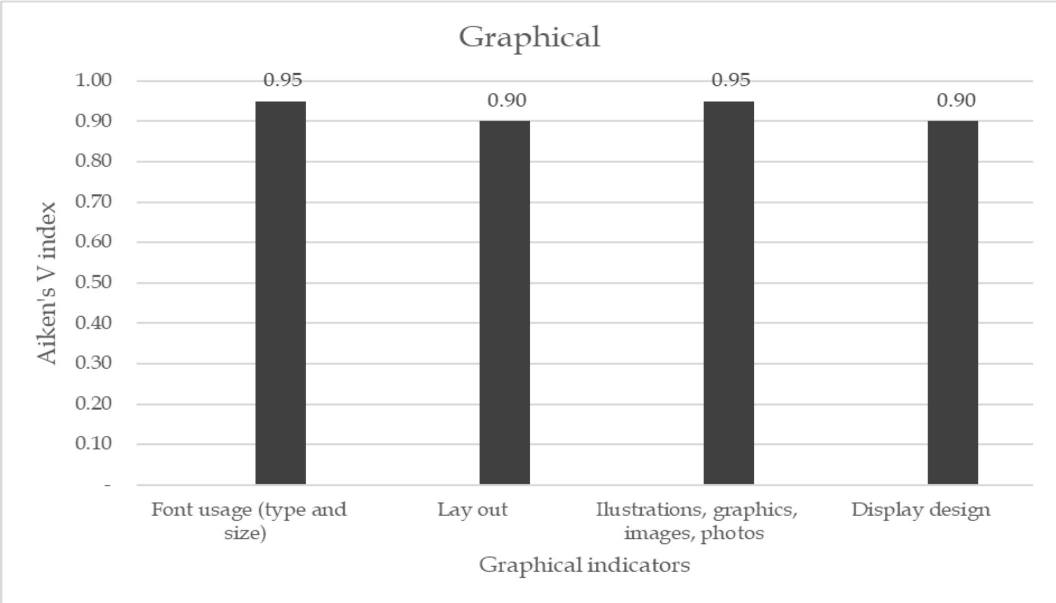

Figure 5. Results of graphical component Aiken's V index

Figure 5 shows that, according to valid criteria, the graphic component's Aiken's V index on the font usage indication (type and size) is 0.95 with valid criteria, the layout therefore received a Aiken's V index of 0.90 for the layout indicator with valid criteria, the illustration, graphics, images, and photos indicator has a Aiken's V index of 0.95. Using proper criteria, the display design indication received a Aiken's V index of 0.90. Thus, the font usage indicator (type and size) and illustrations, graphics, images, and photos had the highest Aiken's V index (0.95), while the layout, layout, and display design indicator had the lowest Aiken's V index (0.90). The average Aiken's V index for the graphical component is 0.93 with valid criteria.

The results of the validity analysis for the problem-based learning component, which consists of five stages. Each stage was evaluated to determine its suitability and effectiveness in supporting the learning process. The overall results of this validity analysis are presented in Figure 6.

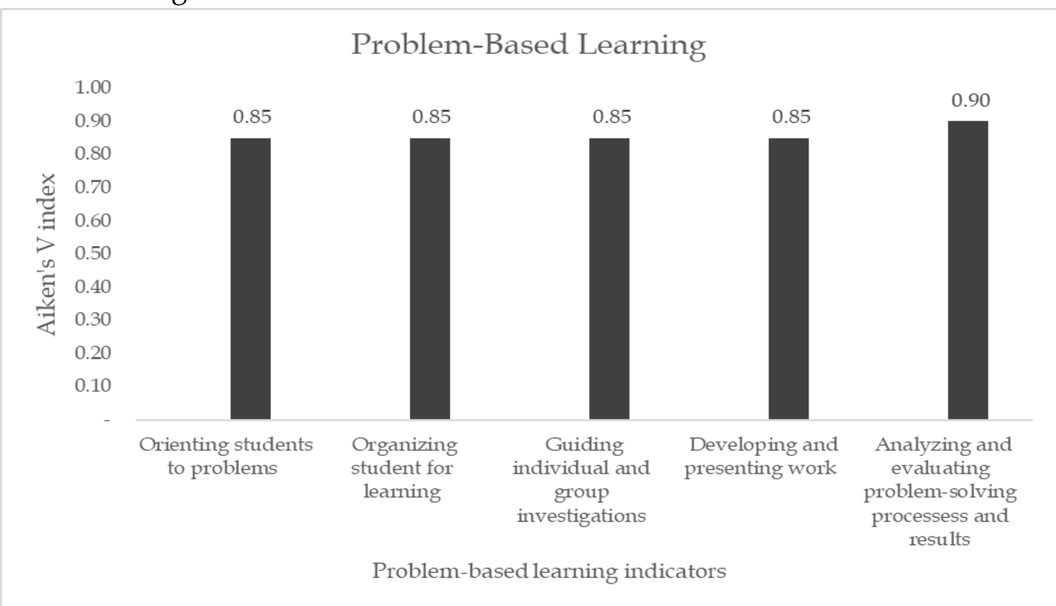

Figure 6. Aiken's V index results of *problem-based learning* components

Based on Figure 6, it is shown that the Aiken's V index of the problem-based learning component for the student orientation indicator toward the problem is 0.85 categorized as valid. The second indicator, organizing students for learning, also achieved a Aiken's V index of 0.85 with valid criteria. Likewise, with valid criteria, the third indicator-which directs both individual and group investigations-got a Aiken's V index of 0.85. the validity of the indicator for creating and presenting outcomes was further demonstrated by its 0.85 Aiken's V index. In the meantime, the problem-solving process analysis and evaluation indicator achieved a Aiken's V index of 0.90, which is likewise within the acceptable range. As a result, the fifth indicator, which analyzes and evaluates the problem-solving process, has the highest Aiken's V index of 0.90 in this problem-based learning component, while the lowest Aiken's V index is 0.85 throughout the four indicators. The problem-based learning component has an average Aiken's V index of 0.86, which is considered valid.

Sixth, the assessment of the scientific literacy components was conducted on three aspects of scientific literacy: context, competence, and knowledge. Each aspect was evaluated to determine its level of validity and contribution to overall scientific literacy. The average Aiken's V index for these three aspects is presented in Figure 7.

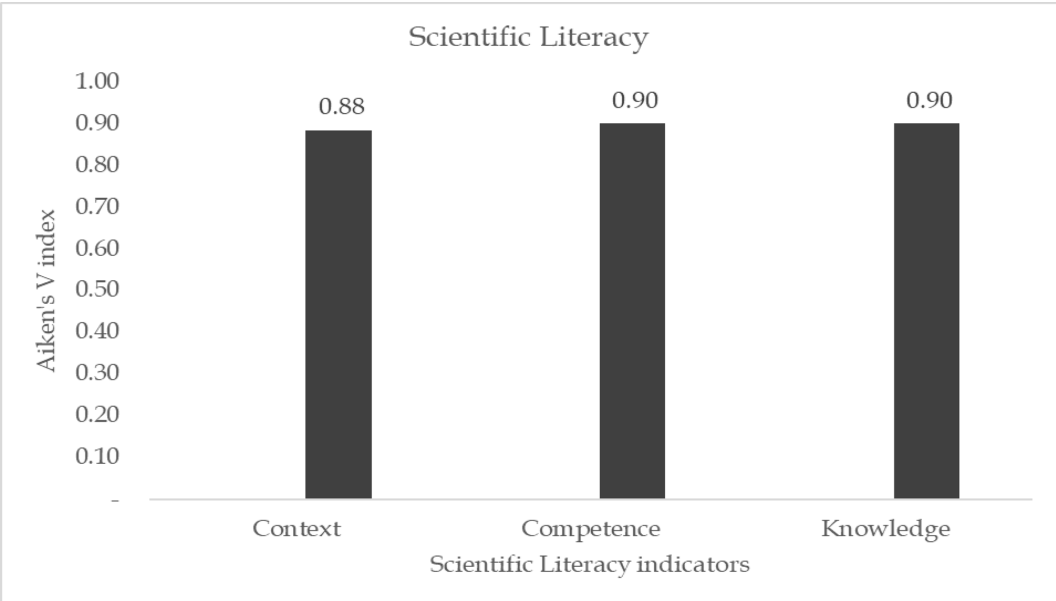

Figure 7. Results of Aiken's V index of scientific literacy components

Figure 7 shows that the scientific literacy component Aiken's V index for the context aspect is 0.88, meeting the valid criteria. The Aiken's V index for competences indicators is 0.90, meeting the valid criteria. Finally, the Aiken's V index for knowledge is 0.90, meeting the valid criteria. The average Aiken's V index for the scientific literacy component was 0.89, meeting the valid criteria.

The average scores of the six componets indicate that the problem-based learning module has a high level of validity. This validity demonstrates that each component effectively facilitates the development of students' scientific literacy. Table 3 displays the mean scores for these six elements.

Table 3. Average Aiken's V index module

Validity Components	V	Category
Content feasibilty	0.89	Valid
Language	0.84	Valid
Presentation	0.91	Valid
Graphics	0.93	Valid
Problem Based Learning	0.86	Valid
Scientific Literacy	0.89	Valid
Average	0.89	Valid

Based on Table 3, the average Aiken's V index for the content feasibility component is 0.89, which falls under the valid category. The language component obtained a Aiken's V index of 0.84, also classified as valid. The presentation feasibility component achieved a Aikens' V index of 0.91 within the valid range, while the graphical component recorded an average Aiken's V index of 0.93, indicating validity as well. Additionally, the part of the problem-based learning model that deals with the steps received a Aiken's V index of 0.86, which is considered valid. Finally, the section on scientific literacy had an average Aiken's V index of 0.89, which also fits the valid standards. In summary, the overall average Aiken's V index of the module is 0.89, putting it in the valid range.

This demonstrates that the developed module fulfills the required feasibility standards for use in physics learning, particulary in supporting high school students' scientific literacy. During the module validity assessment, the validators also offered valuable feedback and suggestions, which were used by researchers to make revisions and improvements, ensuring that the final module is of higher quality and appropriate for implementation in classroom learning. These improvements consist of changes to the learning outcomes used, which currently in the independent curriculum include a deep learning approach. All components of scientific literacy must be covered in the product by labeling each part of the product that facilitates scientific literacy. Student orientation to problems should be complemented by discourse, not just videos. In addition, investigation tasks should be answered directly in the module so that they are given a special place to answer, as well as correcting misspelled or inappropriate words and sentences in the module.

Discussion

This research was conducted to produce a valid problem-based learning module to facilitate students' scientific literacy using the ADDIE development model. Product validity was assessed by five experts using six assessment components. The assessment components refer to the teaching materials development guidelines, which include content, language, presentation, and graphical appropriateness (Depdiknas, 2010). It is believed that if pupils are proficient in problem-solving techniques, they would acquire new perspectives as a results of their efforts. Aspects of scientific literacy are also included in the assessment component (Eymur & Seda, 2024) define scientific literacy as the capacity to comprehend and apply science in daily life. The scientific literacy components used in the development of this module are based on the three primary dimensions of the PISA 2018 framework: knowledge, competency and content (OECD, 2019).

The validation result for the content feasibility component of the module was 0.89, which is categorized as valid. This score shows that the module meets the indicators of content feasibility, such as alignment with learning objectives, students needs, and material substance. This finding supports the view of (Angelina et al., 2022) who highlight the importance of content validity in educational materials. It is also consistent with (Zhao et al., 2023), who emphasize aligning learning modules with curriculum standard and learner characteristics to ensure content relevance and effectiveness. Such alignment enables students to connect to presented concepts with real-world contexts, thereby facilitating the development of scientific literacy.

The second component, language, obtained a Aiken's V index of 0.84 which indicates a valid category. Although this value is the lowest compared to other components, it still meets the minimum standard for validity. This result suggests that the language aspect of the instrument is considered appropriate and reliable for use. Furthermore, it highlights the role of clear and accurate language in supporting comprehension. This finding is consistent with Sarip et al., (2022), who emphasize the importance of linguistic clarity and rule-compliant Indonesian usage in ensuring the readability and comprehensibility of learning modules.

The presentation component received a Aiken's V index of 0.91, categorizing it as valid. This result demonstrates that the developed module meets the standards of module design established by the Kemendikbud, (2017). The standards include essential structural components such as cover, table of contents, glossary, introduction, learning activities, evaluations, and appendices. A well-structured presentation contributes to the clarity and organization of the learning material. These results are consistent with recent studies emphasizing that a well-organized and systematically presented module enhances readability, motivation, and student engagement (Iriani* et al., 2024)(Diansyah et al., 2024).

The graphical component obtained a Aiken's V index of 0.93, which is categorized as highly valid. This indicates that the visual aspects of the module-including layout, typography, and illustrations-have met the standards of effective instructional design. A well-designed visual presentation plays an important role in supporting learning affectiveness. According to (Wang & Lee, 2021), appropriate visual presentation can facilitate cognitive processing and improve learners' comprehension. Similarly, recent studies emphasize that clear and proportional visual design in modul enhances readability, engagement, and motivation (Ghai & Tandon, 2022).

The problem-based learning component achieved a Aiken's V index of 0.86, categorized as valid. This result shows that each learning activity in the module was developed according to the principles of problem-based learning. The following steps are part of the physics module's problem-based learning model: presenting the issue to the students, setting up their classroom, guiding their individual and group study, producing and presenting their results, and assessing and analyzing the process of problem-solving (Richard I. Arends, 2012). These steps ensure that students actively construct their understanding through collaboration. Futhermore, recent studies confirm that structured implementation of PBL in physics modules enhances students' conceptual understanding, engagement, and problem-solving skills (S. A. Lestari & Jatmiko, 2023).

Finally, the scientific literacy component obtained a Aiken's V index of 0.89, categorized as valid. This finding suggests that elements of scientific literacy have been introduced in the physics module to help students develop their scientific literacy. The ability to apply one's scientific knowledge to solve problems by evaluating and determining the root causes of the issue is known as scientific literacy (Deswita & Hufri, 2018). The aspects contained in the module are context, competence, and knowledge (OECD, 2019). The explanation is as follows: first, the context aspect of the indicators consists of personal, local, and global contexts. This aspect is found in the first stage of PBL where the problems presented are based on students' personal problems, local problems, and global problems that are tailored to the topic of each learning activity. Second, signs like scientifically understanding phenomena, assessing and planning scientific research, and scientifically analyzing data and evidence are all part of the competency component.

These three competencies are integrated into the stages of problem-based learning. Third, the knowledge aspect encompasses content, prosedural, and epistemic indicators. Content knowledge lies in the description of the material, procedural knowledge lies in the group investigation task, and epistemic knowledge lies in the reflection of learning. Based on the results of the study, the physics problem-based learning module designed to assist high school students in enhancing their scientific literacy on climate change received a Aiken's V index of 0.89, placing it in the "valid" category. This indicates that the developed module satisfies the requirements for viability in physics education while effectively fostering the growth of students' scientific literacy. Valid, which means correct, refers to the tool being created that can actually measure what it's supposed to measure (Zahfa et al., 2025).

These results are in line with the research conducted by (E. P. Lestari et al., 2022), which demonstrated how a problem-based learning module may develop students' scientific literacy, assisting them in addressing practical issues and addressing global challenges. Similarly, research by Umaro et al., (2024) reinforces these results, stating that the problem-based learning model module is appropriate as an alternative teaching resource and plays a significant role in developing students' scientific literacy. There are some drawbacks to consider, although the test results show that the problem-based learning physics module is good for helping high school students to develop their science literacy in school. One drawback is that these modules are printed, so the paper's durability is limited. Over time, the color of the paper can fade and rot. Furthermore, the paper is susceptible to termite attack and tears easily (Kaygısız, 2025).

CONCLUSION

According to the results of this study, the physics problem-based learning (PBL) module created to help high school students facilitate their scientific literacy on climate change issues had a validation score of 0.89, putting it in the valid category. According to established assessment criteria, this outcome shows that the module satisfies the necessary requirements for viability as a physic learning resource. The validity of the module is based on a number of important factors, such as the presentation, graphics, language quality, content feasibilty, use of PBL stages, and how well it develops students' scientific literacy. This module effectively integrates scientific concepts with real environmental issues, thereby helping students think critically, analyze problems, and apply scientific reasoning in meaningful contexts. This research contributes to the development of science education by demonstrating that the PBL approach can serve as an effective model for facilitating science literacy through contextual and problem-oriented learning activities. Consequently, the module is considered suitable for use in physics education, especially when discussing climate change, and it offers proof that the problem-based learning approach may successfully facilitate students' scientific literacy.

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