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Development of Research-Based Science Literacy Learning at State Madrasah Aliyah in Banda Aceh City

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ABSTRACT

The development of research-based learning modules is crucial for enhancing students' scientific literacy, particularly in the context of Islamic educational institutions. This study addresses the need for a validated and practical science literacy module for Physics instruction at State Madrasah Aliyah (Islamic high school) in Banda Aceh City. This research employed a development research approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) to design and validate the learning module. The module underwent a three-stage validation process, including the initial module validity test, a second validation focusing on the content material, and a third test assessing the module's practicality in classroom use. The findings indicate that the module passed through all three stages of testing with positive results. The module validity, content validity, and practicality were all rated as highly valid by respective validators, including module development experts, content specialists, and practicality assessors. The results suggest that the research-based science literacy module is not only valid in terms of content and structure but also practical for use in Physics instruction. The feedback from validators demonstrates that the module is effective and suitable for teaching purposes. The developed module is highly valid and practical for Physics instruction at State Madrasah Aliyah in Banda Aceh. It is feasible for implementation by Physics teachers to enhance students' scientific literacy in line with the research objectives.

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1. INTRODUCTION

The digital world is currently experiencing very rapid development, especially in the field of science and technology (IPTEK). This progress has a significant impact on various aspects of life, including the education system in Indonesia. With the rapid development of IPTEK, people are required to adapt and follow the changes that occur so as not to be left behind. The progress of science demands fast and precise adaptation in various aspects, both in everyday life and in the context of education. To support the

continuous development of education, human resources (HR) must have adequate literacy skills. According to Irsan (2021), one way to deal with this change is to strengthen literacy knowledge. Literacy is not just the ability to read and write, but also includes understanding, analyzing, and applying information in relevant contexts. Therefore, literacy development is very important, especially for students in madrasas.

Literacy development among madrasah students must begin with research activities, as expressed by Sutarno and Al Jumadi (2022). This research activity can help students understand and apply the knowledge they gain. With the wealth of literacy they have, learning in madrasahs can increase students' motivation to learn and make them stronger materially, morally, and mentally. Good literacy will make students more prepared to face challenges in the future and be able to contribute positively to society.

One important aspect that must be mastered by graduates is new literacy, which includes data literacy, technological literacy, and human literacy. Data literacy requires graduates to be able to understand, manage, and analyze data effectively. Technological literacy requires the ability to use, understand, and utilize modern technology. Meanwhile, human literacy focuses on interpersonal, communication, and ethical skills based on understanding and practicing religious values and noble morals.

The Programme for International Student Assessment (PISA) is an assessment conducted every three years on 15-year-old students around the world. This assessment aims to measure students' knowledge and skills, especially in core subjects such as science, reading, and mathematics. PISA looks at different demographic subgroups in each country to provide a comprehensive picture of student abilities globally (Ardianti et al., 2022). Scientific literacy is one of the main focuses in the PISA assessment, considering the importance of this ability for students in the 21st century. Scientific literacy includes understanding scientific concepts, critical thinking skills, and the application of scientific knowledge in everyday life. This ability is needed from elementary school to college so that students are ready to face the challenges of the ever-evolving modern world (Asmaturisa et al., 2023).

Many countries make science literacy a mandatory element in the school curriculum, from Kindergarten (TK) to High School (SMA). This is because science literacy not only helps students understand the subject matter, but also forms a mindset, behavior, and character that is responsible for themselves, society, and the universe. Science literacy is also important in dealing with increasingly complex technological issues that have a broad impact on everyday life. In Indonesia, international surveys such as PISA are important tools to measure the extent to which Indonesian students are scientifically literate and to assess the quality of science education in the country. The results of this survey provide insight into the strengths and weaknesses of the science education system in Indonesia, as well as serve as a basis for improving and developing a better curriculum. Thus, the PISA survey helps ensure that science education in Indonesia is able to meet international standards and prepare students for a better (Asmaturisa et al., 2023).

The importance of scientific literacy for students cannot be ignored, because this literacy helps students understand the environment, health, economy, and various other problems faced by modern society. Scientific literacy allows students to recognize and analyze these issues critically, so that they can provide solutions based on scientific knowledge. In this context, scientific literacy plays a role not only in formal education but also in everyday life, where students need to make decisions that impact themselves and society. Lubis and Rambe (2022) added that modern society is highly dependent on technology and the advancement and development of science. Therefore, scientific literacy is becoming increasingly crucial. With scientific literacy, students not only learn about scientific concepts and theories, but also about how technology and science can be used to address the challenges and problems faced by society. This makes scientific literacy an essential skill that every student must have so that they can contribute effectively in this ever-evolving world.

There are several indicators used to measure a person's level of scientific literacy. First, how effectively a person understands basic scientific concepts such as the laws of physics, principles of biology, and principles of chemistry. A deep understanding of these concepts is an important foundation in

scientific literacy, allowing individuals to apply scientific knowledge in various situations. Second, how well a person can use scientific evidence wisely. This includes the ability to make judgments based on scientific knowledge about relevant scientific issues, such as technology, the environment, and health. The main factor in improving scientific literacy is the active involvement of students in the learning process. Teachers have an important role in creating a supportive and engaging learning environment for students. One effective approach is to integrate experiences from everyday life into science learning. In this way, students can see the direct relevance between scientific knowledge and the real world, which can increase their interest and understanding of science (Nurhanifah & Diah Utami, 2023).

In practice, students' scientific literacy skills increase because since the beginning of learning, they have been trained to answer and ask questions related to the material. This learning process links the material to students' real lives through direct and contextual experiences. In addition, students are taught to manage new information related to previously learned knowledge, which helps them build a more solid and integrated understanding (Sari et al., 2022). This approach ensures that scientific literacy learning is not only theoretical but also applicable and relevant to students' daily experiences.

This study found that research-based learning can improve students' scientific literacy at Madrasah Aliyah Negeri Kota Banda Aceh. This approach helps students develop critical and analytical thinking skills. However, its application in the classroom is still constrained by limited resources and teacher readiness (Ramadhan & Siregar, 2020). Although there is awareness of the importance of scientific literacy, its implementation is still limited to theory without adequate practical application. Lack of training for teachers is also a major obstacle. Schools or madrasahs that can facilitate the improvement of scientific writing competencies. A madrasah that can be used as an example so that the culture of scientific writing literacy can continue to develop. Given that in the future there will be more and more problems that must be faced and solutions sought. Meanwhile, one of the solutions can be sought through scientific literacy which is realized by writing scientific papers (Amanah & Hariyanto, 2022).

The survey results showed that physics learning is still largely teacher-centered, with students less actively involved in the learning process. Many students show a lack of initiative in seeking information, and understanding concepts and principles of physics. In addition, their involvement in problem-solving activities and experiments or research is also very limited. This condition indicates that the learning methods used are not effective enough in motivating students to actively participate and think independently. Interviews with three physics teachers at Madrasah Aliyah Negeri Kota Banda Aceh revealed the challenges faced in encouraging independent and active learning among students. The teachers reported difficulties in reducing students' dependence on directly provided materials. This dependence hinders students from exploring and expanding their knowledge independently. Students' inability to take the initiative in learning causes the learning process to be less dynamic and less in-depth. This study analyzes the development of research-based science literacy learning at the State Madrasah Aliyah in Banda Aceh City, which shows that this approach has great potential to increase student engagement and understanding of science subjects.

2. METHODS

The research methodology used in this study is the research and development (R&D) approach. The product developed in this study is a research-based module to improve scientific literacy, especially in the context of physics education. The resulting learning module consists of a module shell, foreword, table of contents, learning exercises, assessment instruments, LKS, and basic physics materials on renewable energy and solar energy sources. This module is designed to be completed in one meeting.

The ADDIE development research model is a systematic approach consisting of five distinct stages: Analysis, Design, Development or Production, Design Implementation or Delivery, and Evaluation. The ADDIE model, designed by Dick and Carry in 1996, serves as a framework for designing learning systems. Researchers utilize the ADDIE development research model to carry out the research process involved in creating learning modules. Researchers choose the ADDIE development method because of the inherent advantages of the development stage, as it offers a more logical and comprehensive approach.

This study uses the ADDIE development model, because the ADDIE method offers a clear and organized structure through five main stages: Analysis, Design, Development, Implementation, and Evaluation. This structure ensures that each step in the development of research-based science literacy learning is carried out in a planned and methodical manner. This is important to produce quality learning modules that can be applied effectively. The ADDIE development model consists of five stages: analysis, design, development, implementation, and evaluation. The initial stage involves conducting a thorough requirements study, which includes curriculum evaluation and material assessment. The analysis can be done by examining current issues in the learning environment, technological advances, and student characteristics. The second phase involves creating a product design through the development of a storyboard, which is a series of sequential sketches. The purpose of this process is to strategically outline the concept of product production. The third phase includes refining the issues that have been examined previously to improve the quality of the product in line with the identified problems, thereby creating better learning materials that are ready to be applied. The fourth step involves implementing the resulting product to consumers or research participants, followed by its use in real-world situations. The fifth stage includes assessing the development product to ensure its suitability for use in the learning process.

3. FINDINGS AND DISCUSSION

3.1. Process of Developing Research-Based Science Literacy Learning Modules

3.1.1 Student Needs Analysis

The rapid and advanced development of information technology which is currently often known as the industrial revolution 4.0 or the digital era. This certainly also has an influence on the world of education, especially in terms of the use of learning methods that are also developing. With the current digitalization process, learning methods are no longer only conventional or manual, but the use of learning methods in the teaching and learning process has shifted to more modern learning methods, for example, the research-based science literacy learning method.

According to Jauhar (2018), From various problems faced in the field, it turns out that many students lack motivation to learn, because learning Physics is considered very boring for them, the teacher explains only through lecture strategies. This shows that students' motivation to learn is very low. Therefore, the basic concepts of physics taught in learning must be able to understand the concept of physics well. The purpose of physics is to develop students' abilities to be sensitive to critical, systematic, and precise thinking in solving problems in learning and society, have a positive attitude towards all existing inequalities, and be able to face all daily problems and those that arise, both those that befall themselves and society. Analyzing needs is a very important stage in designing learning media. This aims to develop learning media that are in accordance with the needs of students and the teaching needs of teachers who will form an interaction in the learning process.

According to Nasrulloh & Ismail (2017), needs analysis is an integral cycle with program development, implementation, and evaluation. The media development process that begins with needs analysis allows the results to be utilized optimally by teachers and students who need them. To find out students' needs in learning in the form of learning media, a needs analysis needs to be carried out in order to find out the types of students' needs, namely target needs and learning needs. Target needs include the answer to the question "Do students need something in a condition?", while learning needs include the answer to the question "Do students need something they want in learning?" Another way to see needs is to distinguish between objective needs and subjective needs.

Needs analysis was conducted to obtain information on the availability of learning modules by conducting interviews with class X teachers of State Islamic Senior High School in Banda Aceh City, they are the planners of learning implementation. According to Mrs. SQS, the learning process carried out by teachers at MAN 1 Banda Aceh City tends to be less than optimal and not in accordance with expectations. The learning process implemented at MAN 1 Banda Aceh City, especially in Physics

subjects, teachers are more active than students, learning activities are more dominated by teachers, students become passive and only accept what is conveyed by the teacher. The learning methods used still revolve around conventional methods, so that the activeness of students in the learning process is lacking, where teachers should provide opportunities for students to play a direct role in the learning process such as conducting an experiment related to learning materials, then students process the data obtained during the experiment and conclude the results obtained then present them in front of the class and students can use it as a conclusion from the learning on that day.

Furthermore, according to Mr. RD, that so far the learning process carried out in madrasahs, teachers only use textbooks issued by the Ministry of National Education for physics for class X SMA/MA as the only source of teaching materials in physics subjects. In fact, he knows that physics is one of the science subjects that can develop analytical deductive thinking skills by using various natural phenomena and problem solving both qualitatively and quantitatively using mathematics and can develop knowledge, skills and self-confidence. Furthermore, the results of the author's interviews with teachers at the madrasah revealed that in implementing learning, teachers still use conventional learning methods. Ineffective learning activities, all learning activities are still centered on the teacher, so that there are no activities that can stimulate increased student independence.

Learning in the madrasah has been conducted through a traditional face-to-face approach, utilizing methods such as question-and-answer sessions, discussions, assignments, and laboratory experiments. However, teachers express the need for innovative learning media to facilitate the delivery of lesson content and improve student comprehension during lessons. Such innovations would also help prevent students from becoming disengaged or bored during the learning process. In this context, the availability of well-designed teaching modules is essential to support both teachers and students in achieving better learning outcomes.

3.1.2 Analysis of Student Characteristics

This stage analyzes the characteristics of students at State Islamic Senior High Schools in Banda Aceh City, including State Islamic Senior High School 1 Banda Aceh, State Islamic Senior High School 2 Banda Aceh, and State Islamic Senior High School 3 Banda Aceh. The characteristics that teachers need to understand are: students' initial abilities, development of learning motivation, students' learning styles, and the ethnic diversity of the students themselves. These initial abilities are needed by teachers as a basis for organizing and delivering learning materials. If teachers teach learning materials that students have already understood, learning is inefficient and lacks appeal. Students will feel bored or fed up so that the learning atmosphere becomes unpleasant. Conversely, if teachers teach material outside or higher than students' abilities, or students have not mastered the prerequisite knowledge, students will become confused, stressed, and have difficulty understanding the learning materials.

Table 1. Initial Abilities of Grade X Students at State Islamic Senior High School 1, Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Capabilities Early	Have an understanding	153	100%
	Different initial understandings according to the basic concepts of the learning material	124	81,04%
	Telling experiences related to the material being studied	94	61,43%

Based on table 1, all grade X students at Madrasah Aliyah Negeri 1 Banda Aceh City have a basic understanding with a percentage of 100%. The initial understanding of students according to the

learning material varies with a percentage level of 81.04%. And the ability of students to tell experiences related to the material being studied turns out that there are 61.43% who can tell previous experiences related to the material to be studied.

Table 2. Initial Abilities of Grade X Students at State Islamic Senior High School 2, Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Capabilities Early	Have an understanding	71	100%
	Different initial understandings according to the basic concepts of the learning material	45	63,38 %
	Telling experiences related to the material being studied	24	33,80%

Based on table 2, all grade X students at Madrasah Aliyah Negeri 2 Banda Aceh have a basic understanding with a percentage of 100%. The initial understanding of students in accordance with the basic concept of learning materials varies with a percentage of 63.38%. And the ability of students to tell experiences with the material being studied turns out that there are 33.80% who can tell previous experiences related to the material to be studied in the learning process. This can be done by choosing one of the right teaching materials. If successful, it will have a positive impact because it increases teaching and learning activities so that it runs smoothly and also makes students understand the subject matter being taught better and later can achieve high achievements.

Table 3. Initial Abilities of Grade X Students at State Islamic Senior High School 3, Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Capabilities Early	Have an understanding	98	100%
	Different initial understandings according to the basic concepts of the learning material	72	73,46 %
	Telling experiences related to the material being studied	36	36,73%

Based on the results of table 3, all grade X students at Madrasah Aliyah Negeri 3 Banda Aceh City have a basic understanding with a percentage of 100%. The initial understanding of students according to the basic concept of learning materials varies with a percentage level of 73.46%. And the ability of students to tell experiences with the material being studied turns out to be 36.73% who can tell previous experiences related to the material to be studied.

From the data above, it can be seen that the initial abilities of MAN Banda Aceh City students are very important to analyze. Because analyzing students' initial abilities in developing learning is an approach that accepts students as they are and compiles a learning system based on the student's condition. Considering the above, learning planning really needs to identify the initial needs and characteristics of students as an analysis of students' initial abilities. The first classification, having an understanding, initial understanding that varies according to the basic concept of learning materials,

and telling experiences related to the material being studied. This needs to be done by teachers because students' initial knowledge can influence learning activities. This is in line with Astuti's opinion below. According to Astuti (2015), The initial ability of a student in the teaching and learning process is very necessary, especially to equip students in studying higher material. Students who have higher initial abilities will easily understand and comprehend the subject matter delivered by the teacher and will likely achieve better learning achievements.

Table 4. Development of Learning Motivation of Class X Students at State Islamic Senior High School 1, Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Learning Motivation	Students have the motivation to learn to prepare themselves before learning	135	91,50%
	Students have the motivation to learn to prepare themselves before learning	125	81,69 %
	Telling experiences related to the material being studied	104	67,97%

Based on Table 4, the development of students' learning motivation on the indicator of answering questions provided by the teacher is at 91.50%. Additionally, 81.69% of students are motivated to prepare themselves before learning, and 67.87% of students demonstrate the ability to share experiences related to the material being studied.

Table 5. Development of Learning Motivation of Grade X Students at Madrasah Aliyah Negeri 2 Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Learning Motivation	Students have the motivation to learn to prepare themselves before learning	65	77,46%
	Students have the motivation to learn to prepare themselves before learning	25	35,21 %
	Telling experiences related to the material being studied	14	19,71 %

Based on Table 5, the development of students' learning motivation, which is the indicator of having the motivation to answer questions provided by the teacher, is 377.46%. Students' motivation to prepare themselves before learning is 35.21%, and their ability to share experiences related to the material being studied is 19.71%.

Table 6. Development of Learning Motivation of Grade X Students at Madrasah Aliyah Negeri 3 Banda Aceh City

Variable	Indicator	Frequency (N)	Percentage (%)
Learning Motivation	Students have the motivation to learn to prepare themselves before learning	78	79,59 %
	Students have the motivation to learn to prepare themselves before learning	38	38,77 %
	Telling experiences related to the material being studied	21	21,42 %

Based on table 6, the development of students' learning motivation in the indicators has learning motivation in answering questions given by the teacher, 79.59%, students have learning motivation to prepare themselves before learning by 38.77%, and students' ability to tell experiences related to the material they are studying is 21.42%.

Thus, the existence of high learning motivation to learn and the use of appropriate learning media will make it easier for students to understand the subject matter. The purpose of having learning media is so that students are motivated to understand the subject matter being taught if the media used is appropriate, and it will increase the smoothness of the learning process. Thus, the existence of high learning motivation and the use of appropriate learning media will be able to stimulate students to learn and make it easier for students to understand the subject matter being taught. One of the things that influences student motivation in learning is the use of learning media used in the teaching and learning process. As mentioned by Briggs in Musfiqon (2012), that the right learning media in physics subjects can foster student enthusiasm and eliminate fear of difficult physics subjects.

Table 7. Learning Styles of Grade X Students at State Islamic Senior High School 1, Banda Aceh City

Variable	Indicator	Field Conditions	Frequency (N)	Percentage (%)
Learning Styles	Students demonstrate certain learning styles during learning activities.	Visual	98	64,050%
		Auditory	35	22,87 %
		Kinesthetic	21	13,72 %

Based on table 7, the students' learning styles in the student indicator show a certain learning style during learning activities with a visual style of 64.05%, the student indicator shows a certain learning style during learning activities with an auditory style of 22.87%, and the student indicator shows a certain learning style during learning activities with a kinesthetic style of 13.72%.

Table 8. Learning Styles of Grade X Students at State Islamic Senior High School 2, Banda Aceh City

Variable	Indicator	Field Conditions	Frequency (N)	Percentage (%)
Learning Styles	Students demonstrate certain learning styles during learning activities.	Visual	48	67,60 %
		Auditory	10	14,08 %
		Kinesthetic	13	18,30 %

Based on table 8, the students' learning styles in the student indicator show a certain learning style during learning activities with a visual style of 67.60%, the student indicator shows a certain learning style during learning activities with an auditory style of 14.08%, and the student indicator shows a certain learning style during learning activities with a kinesthetic style of 18.30%.

Table 9. Learning Styles of Grade X Students at State Islamic Senior High School 3, Banda Aceh City

Variable	**Indicator**	**Field Conditions**	**Frequency (N)**	**Percentage (%)**
Learning Styles	Students demonstrate certain learning styles during learning activities.	Visual	66	67,34 %
		Auditory	18	18,36 %
		Kinesthetic	14	14,28 %,

Based on table 9, the students' learning style on the student indicator shows a certain learning style during learning activities with a visual style of 67.34% on the student indicator shows a certain learning style during learning activities with an auditory style of 18.36%, and on the student indicator shows a certain learning style during learning activities with a kinesthetic style of 14.28%.

Thus, the learning style of students at the State Islamic Senior High School in Banda Aceh City is more dominant in the visual learning style. So the modules prepared by the teacher must be in visual form in order to accelerate the mastery of the teaching materials that students learn. Smaldino (2014) stated that visual learning media can produce visual literacy skills, which refers to students' ability to interpret visual messages accurately, so that visual stimuli produce better learning outcomes, for tasks of remembering, recognizing, and connecting facts with concepts. This can also influence the learning style developed by students.

Table 10. Ethnic Diversity of Grade X Students at State Islamic Senior High School 1, Banda Aceh City

Variable	**Indicator**	**Field Conditions**	**Frequency (N)**	**Percentage (%)**
Ethnic Diversity	Diversity of Tribes	Aceh	83	53,24 %
		Jawa	14	9,15 %
		Padang	3	1,96 %
		Batak	8	5,22 %
Tolerance between existing ethnic differences			153	100 %

Table 11. Ethnic Diversity of Grade X Students at State Islamic Senior High School 2, Banda Aceh City

Variable	Indicator	Field Conditions	Frequency (N)	Percentage (%)
Ethnic Diversity	Diversity of Tribes	Aceh	63	88,74 %
		Padang	3	4,22 %
		Alas	1	1,40 %
Tolerance between existing ethnic differences			67	100 %

Table 12. Ethnic Diversity of Grade X Students at State Islamic Senior High School 3, Banda Aceh City

Variable	Indicator	Field Conditions	Frequency (N)	Percentage (%)
Ethnic Diversity	Diversity of Tribes	Aceh	71	72,44 %
		Jawa	9	9,18 %
		Padang	10	10,20 %
		Batak	8	8,16 %
Tolerance between existing ethnic differences			98	100 %

Seeing the ethnic diversity of students can be utilized by teachers to plan learning activities by looking at the characteristics of students' initial abilities, motivation development, learning styles, and ethnic diversity. As for research-based science literacy learning that can be done, namely on the content of the material to be taught, the process, and the product. So that, the characteristics of these students are very useful reference data to help students get meaningful learning.

3.2. Results of the Development of Research-Based Science Literacy Learning Modules

3.2.1 First Submission Results

The module expert validity test was carried out by a validator, namely Mr. Dr. Azhar, M.Pd, who was validated on January 10, 2024. The results of the validator's assessment can be seen as stated in table 12 below.

Table 13. Expert Test Validation Results of Module

No	Indicator	Score
A. Content suitability		
1	Learning objectives in the module are conveyed clearly	4
2	The material conveyed is easy for students to understand	4
3	The material conveyed in the learning module can be practiced directly by students	3
4	The material conveyed is in accordance with the learning objectives	4
B. Linguistics		
1	The use of words and sentences in describing the learning material is clear	4
2	The learning flow is described clearly	4
3	The writing in the learning module can be read clearly	4
4	Effective learning modules are used to make it easier for students to understand the material in a short time	4
C. Presentation		
1	Learning modules can be used repeatedly	4
2	Learning modules are easy for students to use independently	4
3	Image layout in learning modules is consistent	4
4	Learning objectives are in accordance with the subject matter	3

In this study, the scale used is a Likert scale with an interval of 1-4. According to Sugiyono, this scale is used to measure opinions, attitudes, perceptions of a person or individual about social phenomena. This scale creates a ranking or score for each question. Answers that do not support are given a low score while answers that agree will be given a high score. In statements that are positive in nature support aspects in the variable, a score is given if: 4 = Strongly Agree (SS) 3 = Agree (S) 2 = Disagree (TS) 1 = Strongly Disagree (STS) (Sugiyono, 2019). Respondents' answers to the assessment will be given a score of 1 to 4, as explained in the following table: Category Score 1 = Strongly Disagree 2 = Disagree 3 = Agree 4 = Strongly Agree. Analysis of the validity test results using the Likert scale is carried out with the following steps:

According to Ridwan (2013), The validity score calculation scale is carried out using the following formula:

$$\text{Validity percentage (\%)} = \frac{number\ of\ scores\ obtained}{maximum\ score} \text{ x } 100\ \%$$

Meanwhile, the instruments used for each score are based on the following Likert scale table.:

Table 14. Likert Scale Scores

Score	Category
1	Strongly disagree
2	Disagree
3	Agree
4	Strongly agree

To determine the final results and validity criteria obtained, refer to the following table.:

Table 15. Percentage of Validity Criteria of Modified Likert Scale

Score	Percentage	Category
1	<25%	Very invalid
2	26%-50%	Invalid
3	51%-75%	Valid
4	76%-100%	Very valid

The following are the results of the validation of teaching materials from the validator for the modules that have been developed.

Table 16. Results of the Teaching Module Validation Analysis

Statement/ Aspect	1	2	3	4	Score obtained	Highest score	Validity value	Criteria
Content Suitability	4	4	3	4	15	16	93,7 %	Very Valid
Language	4	4	4	4	16	16	100 %	Very Valid
Presentation	4	4	4	3	15	16	93,7 %	Very Valid

Based on the validation of the research-based science literacy learning module that has been carried out on the expert validator of the module design on the aspect of content feasibility, a value of 93.7% was obtained with a very valid interpretation. Furthermore, for validation on the linguistic aspect, a value of 100% was obtained with a very valid interpretation, and validation of the research-based science literacy learning module on the presentation aspect obtained a value of 93.7% with a very valid interpretation.

3.2.2 Second Submission Results

Validation of this material is carried out by the validator of the Renewable Energy Solar Power learning material. The purpose of this material validation is to determine the accuracy and suitability of the learning material contained in this research-based science literacy learning module whether it is in accordance with learning needs. Validation carried out by material experts is reviewed from the aspects of content quality and learning quality. In implementing its validity, material experts review the material in this research-based science literacy learning module, then the validator gives a value to the material in the research-based science literacy learning module. The assessment results of each aspect given by the validator are analyzed using a percentage formula. The results obtained are the validation value of the resulting product material.

The validity test of the module material expert conducted by the validator, Mr. Saminan, was carried out on January 16, 2024. The results of the validator's assessment of the learning module that had been improved after the first stage of validation can be seen as shown in table 17 below:

Table 17. Results of Expert Test Validation of Module Material (Content)

No	Indicator	Score
A. Accuracy of Material		
1	Learning Objectives are clearly displayed in the learning module	4
2	Learning Objectives are in accordance with the material being taught	4
3	The material is delivered clearly	4
4	The material is delivered sequentially	3
5	The choice of words is in accordance with the material being delivered	4
6	The title and discussion of the contents of the material are in accordance	4
B. Material quality		
1	The material can be delivered in an interesting way	4
2	The material delivered in the module is important for students	4
3	The presentation of the material can attract students' interest in learning	4
4	The presentation of the material makes students listen well	4
5	The presentation of the material can increase student activity	2
6	The learning method chosen is appropriate	4
C. Suitability of Material		
1	Students can directly practice the material in the module	4
2	The learning module makes it easier for students to learn the material	4
3	The learning module can be used as a reference when carrying out practicums	4
4	The introduction in the module is correct	4
5	The explanation in the module is very useful as an initial overview for students to understand the material	4
6	The conclusion in the learning module is clear	4

Table 18. Results of Module Material Validation Analysis

Statement/ Aspect	1	2	3	4	5	6	SP	STG	NV	Criteria
Material Accuracy	4	4	4	3	4	4	23	24	95,8 %	Very Valid
Material Quality	4	4	4	4	2	4	22	24	91,6 %	Very Valid
Material Suitability	4	4	4	4	4	4	24	24	100 %	Very Valid

Based on the validation of the research-based science literacy learning module that has been carried out on the module material expert validator in the aspect of material accuracy, a value of 95.8% was obtained with a very valid interpretation. Furthermore, for validation in the aspect of material quality, a value of 91.6% was obtained with a very valid interpretation, and validation of the research-based science literacy learning module in the aspect of material suitability obtained a value of 100% with a very valid interpretation.

3.2.3 Third Submission Results

Practicality expert validity test to determine ease of use, simple but interesting presentation style, technically quality, can be learned according to the specified time, and has economic value. This validation was carried out by three validators, namely teachers who teach physics lessons at the State Islamic Senior High School of Banda Aceh City, class X, namely: SQS, which was carried out on January 16, 2024, RD validator which was carried out on January 31, 2024, and SQ validator which was carried out on February 6, 2024. The results of the validator's assessment of the learning module that had been improved after the first and second stages of validation can be seen as stated in table 19 below.

Table 19. Expert Test Validation Results for Module Practicality

No	Indicator	Score		
		SQS	RD	SQ
A. Content Eligibility				
1	Learning objectives are in accordance with learning achievements	4	3	4
2	Indicators are in accordance with learning achievements	4	4	4
3	Indicators are written with operational verbs	4	3	4
B. Language Eligibility				
1	Suitability of material with indicators	4	4	4
2	The material presented is in accordance with learning objectives	4	4	4
3	Suitability of material with students' level of thinking	3	3	4
C. Presentation Eligibility				
1	Modules are in accordance with research-based approaches	4	4	4
2	Materials are in accordance with student needs	3	4	4
3.	Instructions on competencies to be met	4	4	4
D. Image Eligibility				

1	Simplicity of language structure Attractive packaging of teaching materials Suitability of image location	3	4	4
2	Simplicity of language structure Attractive packaging of teaching materials Suitability of image location	3	3	3
3	Simplicity of language structure Attractive packaging of teaching materials Suitability of image location	3	4	3
E. Practicality of Use				
1	Formulation of competencies and learning indicators in teaching materials	4	4	4
2	The existence of assessment instruments helps	3	3	4
3.	students to learn independently	4	4	4

For the practicality test, refer to the table provided by the following expert opinion according to Ridwan. The practicality measurement scale uses the formula:

Validity percentage (%) = $\frac{number\ of\ scores\ obtained}{maximum\ score}$ x 100 %

Table 20. Practicality Criteria

Score	Criteria
81% - 100%	Very Practical
61% - 80%	Practical
41% - 60%	Quite Practical
21% - 40%	Less Practical
0% - 20%	Not Practical

The revised and validated module on research-based science literacy learning was then tested for practicality. The practicality test of the research-based literacy learning module was conducted by three physics teachers at MAN Kota Banda Aceh. The purpose of the practicality test was to determine the practicality of the research-based science literacy learning module so that it was concluded that the research-based science literacy learning module was feasible to use. The results of the module practicality assessment can be seen in the following table.

Table 21. Results of Module Practicality Test Analysis

No	Assessment aspects	Score obtained	Highest score	Validity value	Criteria
1	Content suitability	34	36	94,4 %	Very Practical
2	Language suitability	34	36	94,4 %	Very Practical
3	Presentation suitability	35	36	97,2 %	Very Practical
4	Image suitability	30	36	83,3 %	Very Practical
5	Practicality of use	34	36	94,4 %	Very Practical

Based on the validation of the research-based science literacy learning module that has been carried out on the module design expert validator, a value of 95% was obtained with a very valid interpretation.

Discussion

A module must meet certain criteria to be considered effective. According to Sanjaya (2016), a well-constructed module should include several key components. First, it should clearly state the objectives to be achieved, typically defined in terms of specific behaviors that can be measured for success. It should also provide clear instructions for use, guiding students on how to engage with the module. The module must present learning activities that contain the necessary material for students to study, along with a summary that highlights the main points of the lesson. Additionally, assignments and exercises should be included to reinforce learning, along with reading sources to deepen understanding and broaden knowledge. Test items should be provided to assess students' mastery of the material, and success criteria should be outlined to help identify when learning goals have been met. Lastly, answer keys should be included for self-assessment.

According to Sunantri (2016), for a module to fulfill the self-instructional aspect, it must adhere to several important criteria. It should clearly define both competency standards and basic competencies, and organize the learning materials into smaller, specific units to ensure thorough understanding. The module should include examples and illustrations to enhance the clarity of the content, as well as practice questions and assignments that enable students to respond and assess their level of mastery. The content should be contextual, relating to the student's environment or relevant tasks, and written in simple, communicative language. Additionally, the module should provide a summary of the key points, include self-assessment tools, offer feedback on these assessments to help students gauge their understanding, and provide references to further support the learning material.

The validation process conducted by material experts yielded a score of 95%, indicating a very high level of validity. This aligns with the view expressed by Utami Maulida (2022), who emphasizes the crucial role of teaching modules in the learning process for both teachers and students. Without comprehensive teaching modules, teachers may struggle to enhance their teaching effectiveness, and the material delivered may lack structure. This disorganization can result in content that is not aligned with the appropriate curriculum. Therefore, teaching modules are essential tools for improving the quality of learning, benefiting both teachers and students by providing a clear, systematic framework.

In the validation of the research-based science literacy learning module, conducted by module users, a score of 92% was obtained, indicating a very practical interpretation. This suggests that the module developed is well-suited to enhance learning outcomes. While teachers ideally need to create and optimize teaching modules, many still lack the skills to develop them effectively, particularly within the context of the independent learning curriculum. When teaching modules are not properly prepared, the learning process can become unbalanced, with either the teacher or the students dominating the activity. As a result, lessons can become less engaging and effective due to the absence of a well-organized teaching plan.

This aligns with Nurhanifah's (2023) research, which highlights the crucial role of teachers in fostering a culture of scientific literacy during the learning planning process. This includes tasks such as developing the curriculum, creating lesson plans, selecting appropriate learning media and approaches, and designing evaluation instruments. In terms of implementing scientific literacy, teachers play a key role by incorporating activities such as 15-minute reading sessions before class, adopting student-centered learning approaches, and engaging students in hands-on practical activities. Students' scientific literacy skills are assessed based on two main indicators: understanding investigative methods that contribute to scientific knowledge, and the ability to organize, analyze, and interpret quantitative data and scientific information. These two indicators are further broken down into specific aspects, with the first consisting of four aspects and the second of five, as outlined by Wati et al. (2019).

4. CONCLUSION

This study concludes that first, the module validity test process is carried out through three stages of testing, namely the first stage of the module validity test, the second stage of the module

material validity test, and the third stage of the module practicality test. Second, the validity of the module, the validity of the module material, and the practicality are based on the responses given by the module validator, the module material validator, and the practicality validator, which are very valid and worthy of use. The limitations of this study are the skills of teachers, and the skills and knowledge of teachers in implementing research-based learning can be limitations. If teachers do not have sufficient training or experience, this can affect the effectiveness of the program. Therefore, this study provides recommendations for further research to examine how teachers' skills are in implementing research-based learning.

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