

**Development of Middle School Science Learning Module Based on Scientific Literacy
on Electrical in Nerve Cells Topic**

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ABSTRACT

Science literacy is a very crucial competency mastered by students in order to play a role in the development of science and technology and society. However, the science literacy of students at the first middle school level is still relatively low. This study aims to analyze the validity and consistency in the Junior High School Science teaching module as well as supporting devices for modules based on scientific literacy of electrical materials in nerve cells. This study used the Tessmer formatting assessment method. Research on the development of this teaching module to the stage of Expert Research Prototyping which is validated by 3 validators. New data collection techniques include teaching module validation, lesson plan validation, student response validation, and learning outcome test validation. Data analysis techniques are descriptive, qualitative and quantitative. As a result of the research shows: 1) validation of teaching modules in the very good category, 2) validation of lesson plans in the very good category, 3) validation of student responses with good value, and 4) validation of good value learning outcomes tests. It was concluded that the Junior High School Science teaching module based on scientific literacy of electrical materials on nerve cells developed is suitable for use in learning.

Keywords: teaching module, science literacy, nerve cell.

ABSTRAK

Literasi sains adalah kompetensi yang sangat krusial di kuasai siswa supaya bisa berperan pada perkembangan IPTEK serta masyarakat. tetapi, literasi sains peserta didik pada taraf sekolah menengah pertama masih tergolong rendah. Penelitian ini bertujuan buat menganalisis validitas serta konsistensi di modul ajar IPA Sekolah Menengah Pertama serta perangkat pendukung modul berbasis literasi sains materi kelistrikan di sel saraf. Penelitian ini memakai metode penilaian formatting Tessmer. Penelitian pengembangan modul ajar ini hingga di tahap Prototyping Expert Riview yang pada validasi oleh 3 validator. Teknik pengumpulan data berupa validasi modul ajar, validasi RPP, validasi respon siswa, serta validasi tes hasil belajar. Teknik analisis data berupa deskriptif kualitatif serta kuantitatif. akibat penelitian menunjukkan: 1) validasi modul ajar berkategori sangat baik, 2) validasi RPP berkategori sangat baik, 3) validasi

respon siswa bernilai baik, serta 4) validasi tes hasil belajar bernilai baik. Diperoleh konklusi bahwa modul ajar IPA Sekolah Menengah Pertama berbasis literasi sains materi kelistrikan pada sel saraf yang di kembangkan layak dipergunakan pada pembelajaran.

Kata kunci: modul ajar, literasi sains, sel saraf.

BACKGROUND

Science literacy is the ability of a person to understand science, communicate science by mouth and pen stroke, and apply scientific knowledge to solve problems as a result of having high behavior and sensitivity to themselves and their environment in reaching decisions according to scientific considerations (Toharudin, 2011). Science literacy plays an important role in decision making in everyday life issues such as health, relationships with the environment, and determining the products used and their impact on the environment. based on Özgelen (2012) that a science literate can form decisions in everyday life using the process of science, scientific knowledge, and values.

Looking at the origin of the achievement of student science literacy in PISA (*program for International Student Assessment*), Indonesia is included in the low strata, namely the bottom 10 positions when sanis literacy as a very crucial factor in determining the quality of education in a country (OECD, 2014). PISA identifies science literacy as the ability to use scientific knowledge, identify questions, and reach conclusions according to evidence in order to know and make decisions regarding nature and changes in the impact of human activities. Education today is directed at preparing students for success in the 21st century. One of the skills needed in the 21st century is scientific literacy (Liu, 2009). Science literacy is a skill for life in the 21st century era where scientific knowledge is the foundation of everyday life (Gultepe and Kilic, 2015). Science literacy skills are scientific and critical intelligence and use decision-making skills.

Based on Holbrook and Rannikmae (2007) stated that science literacy means appreciation in science using a way to enhance the learning component in oneself in order to convey contributions in the social environment. In accordance with the statement above, scientific literacy has a broad meaning, every group can make a contribution in understanding scientific literacy. Science literacy is actually not new to global education. However, since the last two decades, science literacy has been the primary topic in every discussion about the purpose of science education in schools. Literacy in the field of science education also provides that science literacy is increasingly accepted and evaluated by educators into the expected learning outcomes.

Science literacy conveys the opportunities and limits of scientific knowledge in the context of the news being discussed and debated. To have this characteristic of scientific literacy, a person is required not only to have a positive attitude towards science in order to master scientific knowledge well, but also to have the ability in the form of scientific abilities and cultivate themselves using scientific values in every dimension of life. If these aspects are owned, and strengthened again using science learning using positive science behavior, similar scientific literacy characteristics stated above will be embedded in students (Osman, 2007).

The approach used in the 2013 curriculum is a scientific approach (*Scientific Approach*) consisting of five activities (5 M), namely questioning, observing, experiencing, associating, and communicating. According to some literature, it is revealed that the scientific approach is

the same as the inquiry approach, as a result the 2013 curriculum has accommodated the development of science literacy for students. But not many schools have implemented assessment questions which relates using everyday reality and is still in the knowledge and conceptual mensi, as a result it cannot be used to measure the scientific literacy of students.

There are component aspects that can include and express reality scientifically, evaluate and design research scientifically, as a result of integrating scientific data and evidence. Details of the origin of the three components can be reviewed in Table 1. These three components are used as actions, constricting what is understood and can be done by people who are literate in science (OECD, 2019).

Table 1 PISA 2019 aspects of science competence

Science Competence	Indicators
Revealing reality scientifically	Remember and apply synchronous scientific knowledge
	Identify, wear, and form visible examples and representations
	Mention the potential consequences of the origin of scientific knowledge for society
	Propose ways of scientifically exposing a given question
Design and evaluate scientific investigations	Evaluating how to expose scientifically there are questions given
	Describe and evaluate the various methods used by scientists to determine the validity and objectivity of data and the generality of information
Interpret data and evidence scientifically	M substituting the data from one representation to another
	Analyze data and interpret data and draw perfect conclusions

As a result of observations and interviews using students in one of the Junior High Schools, information was obtained that Natural Science learning became the following: (1) The weak dominance of students on the basic concepts of science and their relation to using everyday life, (2) Science learning carried out in class did not explore scientific realities contained in the environment more or less, (3) experimental activities carried out so far tends to be in the form of synchronous proof using LKS given by the teacher, (4) There are limitations in the ability of students to convey thoughts in the form of pen strokes, (5) The accuracy of reading students is still low, students are not used to connecting news to the text to be able to answer questions.

One solution to improve the science literacy of junior high school students is to develop teaching materials in the form of learning modules. This makes it easier for teachers to improve students' science literacy skills in learning. It is necessary to develop interesting and synchronous teaching materials using the character of Natural Sciences to be an effort to provide modules that can facilitate students in forming knowledge actively while spreading scientific literacy. on deploying the Science module of Junior High School based on science literacy using Electrical material in Nerve Cells. The material taught is material in the 2013 curriculum in class IX semester gasal. This material discusses the electricity contained in nerve cells and how electrical processes work in nerve cells.

There are Core Competencies (IC) in learning that will be achieved according to the science syllabus of grade IX Junior High School, namely; 1) Respect and live the teachings of the beliefs they hold, 2) provide an attitude of trust, discipline, responsibility, care (tolerance, mutual assistance), polite, confident, on interacting effectively using the social and natural environment in the reach of association and existence, 3) know and apply knowledge (factual, conceptual, and procedural) according to their curiosity about science, technology, art, culture related to reality and visible events, 4) processing, presenting, and reasoning in the real realm (using, decomposing, composing, modifying, and producing) and formless realm (writing, reading, calculating, drawing, and composing) synchronously using what is learned in school and the same origin in point of view / theory. and Basic Competencies (KD) achieved in Electrical material in these nerve cells, namely; 3.4 mentions the concept of inactive electricity and its symptoms in everyday life, including electricity in the nervous system as well as animals containing electricity. 4.4 Presenting the consequences of observing the discourse of signs of electricity inactivity in everyday life.

The Junior High School module based on material science literacy in Nerve Cells developed in this module will only focus on Electrical material in nerve cells. This teaching module will later be related to science literacy in South Kalimantan. Using the development of modules in this material, it is necessary for students' literacy skills to be trained and can increase learning vehicles at school.

Teaching material is a set of materials that are arranged systematically, both written and not as a result created an environment / atmosphere that allows students to learn (Wasino, 2010). The selection of teaching modules is more perfect because modules can be learned by students independently in sync using their speed and ability, and are not too bound by time. Modules are teaching materials that are systematically designed according to an exclusive curriculum and packaged in the form of the smallest learning unit that allows students to learn independently at a certain time (Purwanto, 2007). The module developed in this research makes electrical material in nerve cells. This study aims to analyze the feasibility of teaching modules in the form of the validity of expert evaluations of science modules in electrical materials in nerve cells to enhance the science literacy of Class IX Junior High School students. The formulation of the problem to be studied, namely; 1) how is the validity of the Junior High School science teaching module based on scientific literacy of electrical materials in nerve cells to train scientific literacy, 2) how is the validity of supporting devices in the Junior High School science teaching module based on scientific literacy of electrical materials in nerve cells. In addition to having problems to be solved, there are research objectives that will solve research problems, namely: 1) analyzing the validity of the Junior High School Science teaching module based on electrical material literacy in nerve cells to train science literacy, 2) analyzing supporting devices in the Junior High School Science teaching module based on scientific literacy of electrical materials in nerve cells.

RESEARCH METHODS

This research uses development research methods. Development of a guided inquiry model teaching module to train critical thinking skills on electrical material in nerve cells using the example of Tessmer (Tessmer, 1993: 15). The development model consists of 5 steps, which are as follows: 1) *self-evaluation*; 2) *expert review*; 3) *one-to-one trials*; 4) *small class trials*; 5) *Field test*.

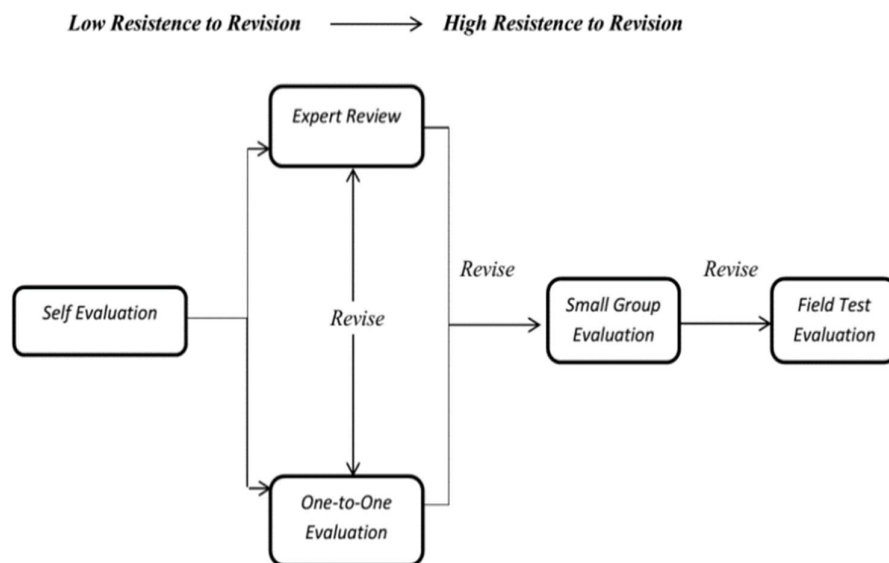


Figure 3 *formative evaluation flow* (Tessmer, 1993:15)

The Tessmer development mechanism consists of 5 steps, namely: 1) *self-evaluation* using analyzing crucial characteristics related to using learning as a basis for designing learning tool development specifications; 2) *expert opinion* consisting of content experts, design experts, and device experts; 3) *one to one trials* conducted to evaluate the device to be developed; 4) *small group trials* conducted to determine the practicality or response to the implementation of the learning tools developed; and 5) *field tests* to observe the trial process in concrete situations and student groups. In the term of *self-evaluation*, analysis and design are carried out, analyzing learning materials and then design is carried out on designed learning tools, including 1) teaching modules to be the origin of learning, 2) lesson plans, 3) learning outcomes tests to help students improve critical intelligence, 4) student response questionnaires that are designed in such a way as to see the achievement of competency standards and basic competencies and to find out students' kritis intelligence.

The prototyping stage (validation, assessment and revision) is divided into 2, namely expert review and one to one and *small class*. As a result of the design in the first prototype which was developed through self-evaluation from experts (*expert review*) to examine content, constructs and language. In parallel, it is also given to three people (one to one) to observe, do questions and comment on them. Their recommendations are used to revise the design of learning tools (teaching modules, lesson plans, learning outcome tests, and student response questionnaires), as long as they are used as revision materials. As a result of the revision of learning tools, expert opinions come from and the origin of the difficulties experienced during *one-to-one trials* is called the second prototype. Then the result of the revision should be on trial at the stage *Small class* then proceed to the field test stage, field

test is a field trial whose situation is concrete. In these 2 stages, it was not carried out because from 2020 to 2021 the learning application was closed due to the Covid 19 pandemic.

Data analysis techniques for teaching modules and supporting devices in teaching modules based on scientific literacy of electrical materials in nerve cells. The data comes from the validation of experts for learning in qualitative analysis using very valid, valid, relatively valid, less valid and invalid categories.

Table 2 Likert scale

Categories	Score
SB (excellent)	5
B (good)	4
C (sufficient)	3
K (less)	2
SK (very less)	1

Calculate the average score of each component by using the formula below;.

$$Xi = \frac{\sum x}{n}$$

Information:

Xi = Average score

$\sum x$ = Number of scores

n = Number of assessments

According to Widoyoko (2016) changed the average score obtained to qualitative assessment with the criteria in table 3 below;

Table 3 Conversion of quantitative data to qualitative data

No	Vulnerable Score	Value	Categories
1	$X > 3.4$	A	Excellent
2	$2.8 < X \leq 3.4$	B	Good
3	$2.2 < X \leq 2.8$	C	Enough
4	$1.6 < X \leq 2.2$	D	Less
5	$X \leq 1.6$	E	Very lacking

The validity of this study is the average score (X) derived from the results of expert and practitioner evaluations. Whether or not the teaching module is valid can be determined according to the suitability of the percentage derived from the validation results. Based on Akbar (2017) Science Literacy-based teaching modules can be measured through validity sheets. The validity evaluation criteria can be reviewed in table 4 below:

Table 4 Validity assessment criteria

No	Percentage Criteria Validity	Level of Validity
1	85,01% – 100,00%	Very valid
2	70,01% – 85,00%	Valid
3	50,01% – 70,00%	Less valid
4	01,00% – 50,00%	Invalid

(Akbar, 2017)

RESULT AND DISCUSSION

This development has the aim of making teaching modules and supporting devices in teaching modules developed on electrical material in nerve cells which are summarized in one basic component (KD). The validity of the teaching module was obtained according to the

validation results of the three experts using the consequence technique in the form of a module. The validated teaching modules include teaching modules, lesson plans, learning tests, and student response questionnaires. The following is the explanation due to the validation of teaching modules.

Table 5 results of data analysis validation of teaching modules

Assessed aspects	Average	Criterion
Language	4,2	Excellent
1. Language suitability using correct spelling.		
2. Communicative use of language.	4,2	Excellent
3. The language used can lead students to explore more news.	4,2	Excellent
4. The language used is obvious according to the concept.	4,2	Excellent
5. Use synchronous language using the Indonesian Spelling General Guide (PUEBI).	4,2	Excellent
6. There is no ambiguous sentence.	4,6	Excellent
7. Language used synchronously uses students' cognitive development and is practically understood.	4,2	Excellent
Technical	4,6	Excellent
Attraction		
8. Drawing images to provide a clear and interesting message of the material.		
9. The suitability of the image size uses the needs in the material and tasks presented.	4,2	Excellent
10. The appearance of the module cover is attractive.	4,0	Excellent
11. Write terms for focus markers (Bold/italics) using interesting and visible colors.	4,2	Excellent
Format	4,6	Excellent
12. The use of column formatting according to the shape of the paper size		
13. Compatibility of layout and understanding format with the paper format (Vartikel or Horizontal) used.	4,2	Excellent
14. Consistent use of typeface shapes and sizes.	4,2	Excellent
15. Consistent in the use of spacing, the distance between the heading and the first line, between the heading and the main text	4,2	Excellent
16. Consistent use of terms or symbols	4,2	Excellent
Font shape and size	4,6	Excellent
17. Font shape and size are easy to read		
18. Comparison of appropriate letters between the title, subtitle, title, and content of the manuscript.	4,2	Excellent
19. Accuracy of capital lettering	4,2	Excellent
Content	4,2	Excellent
Content accuracy		
20. The correctness of the concept corresponds to that described by the scientist.		
21. Apperception can trigger student motivation to read the material.	4,2	Excellent
22. Examples correspond to the concepts presented.	4,2	Excellent

23. There are pictures that can help students understand the material presented	4,2	Excellent
24. There is a summary that includes the material presented.	4,2	Excellent
<i>Accuracy</i>	4,2	Excellent
25. Compatibility of content with basic consistency		
26. Suitability of material content with learning objectives.	4,2	Excellent
27. Evaluation can measure the achievement of learning objectives	4,2	Excellent
28. The evaluation questions are evenly distributed in the degree of difficulty	4,2	Excellent
<i>Adequacy</i>	4,2	Excellent
29. The material in the module is presented systematically.		
30. The presentation of coherent material can be used by students to learn independently	4,6	Excellent
31. The arrangement between sub-chapters and between paragraphs shows coherence.	4,6	Excellent
<i>Average</i>	13,2	Excellent
<i>Validity</i>		Can be used with minor revisions

This study was conducted using the aim of knowing and testing the validity of the Junior High School Science teaching module based on electrical material science lieteration in nerve cells. The author conducted research on the development of the Junior High School Science teaching module using several testing processes on the module, learning result tests, learning implementation plans (RPP), and student response questionnaires. The research process carried out passes through the synchronous application stage using the *Formative* Evaluation module where this research begins in the term Self Evaluation which consists of analyzing and designing on the module, then after completing the Self Evaluation stage continued in the *Prototyping* stage Where the module developed is validated by two-three validators who are synchronous using expertise in the field developed. In addition to researchers validating modules, there are supporting devices on modules that help research as a result achieve very valid, valid, and relatively valid categories. The supporting tools intended in the module are student responses, learning outcome tests, and learning implementation plans (RPP), in quantitative evaluations.

Modules are learning vehicles in the form of writing that are arranged systematically, containing learning, learning objectives according to basic competencies and indicators. The material that was tried to be developed in the Junior High School Science teaching module based on science literacy in electrical materials in nerve cells, contains basic competencies 3.4 mentioning the concept of inactive electricity and its symptoms in everyday life, including electricity in the nervous system and animals that contain electricity. 4.4 Present the results of observations regarding signs of electricity inactivity in everyday life. In addition, researchers tried to add knowledge of scientific literacy to one of the subchapters on electrical matter in nerve cells. Science literacy in the subchapter is still relatively small and still needs research that can help in understanding the student's material, one of the models that can be taken and experienced by some people is the signs of allness. Science literacy is the ability to identify, understand, and interpret information related to science that a person needs to reach decisions according to scientific evidence. Including signs of contentment in the category of science

literacy, because the signs of contentment can be felt directly by people who feel tingling themselves. In addition to tingling signs, there are many more signs that are included in the nerves, but researchers only included one model in the module because these signs are often felt by everyone and are easy to feel. Although there are not too many elements of science literacy in the module, as a result, the material in the module can be said to be high for Junior High School. Entering the validation stage, researchers validated the Junior High School Science teaching module based on scientific literacy of electrical materials in very good category nerve cells using results that can be used using small revisions.

Table 6 results of data analysis validation of learning outcomes tests

Assessed aspects	Average	Criterion
Material aspect		
1. Compatibility of perogанизation of the problem with the material	11	Excellent
2. Suitability of concepts on the problem	10,8	Excellent
3. Compatibility of the material content on the question with learning indicators	10,4	Excellent
4. The references used are appropriate and adequate	11	Excellent
5. Compatibility of the problem with indicators of scientific literature	9,6	Excellent
Construction aspect		
6. The subject matter is formulated and chosen briefly, clearly, and firmly	12	Excellent
7. The formulation of the subject matter and the choice of answers are required statements only	12	Excellent
8. The subject matter does not give a clue to the answer key	12	Excellent
9. Free questions and negative statements	12	Excellent
10. Homogeneous and logical answer choices in terms of material	10	Excellent
11. The length of answer choices is relatively the same	12	Excellent
12. The question item does not depend on the answer to the previous question	11,8	Excellent
Language aspect		
13. Use language that is in accordance with the rules of Indonesian	11	Excellent
14. Use communicative language	12	Excellent
15. Not using local language/taboo	12	Excellent
16. Answer choices do not repeat the same word/group of words, unless they are a unity of understanding	12	Excellent
17. Easy-to-understand language	11	Excellent
Average	41,4	Excellent
Validity	Can be used with minor revisions	

Evaluation on answering questions and questions in modules and other tasks similar to experiments given to LKPD. Some of the questions in the module cannot be related to using scientific literacy found in everyday life. The questions given are relatively high to be able to be understood by students, as a result the research entered the validation stage for the category of learning outcomes tests for students in the very good category where the learning outcomes test was not able to contain more science literature news contained in the practice question module.

Research conducted by researchers makes valid categories, so that the modules that have been developed can be taught by students, although there are some that must be improved a little in the module regarding practice questions. Science teaching modules based on science literacy of electrical materials in nerve cells, convey knowledge and news that is not yet known by the public.

Table 7 results of data analysis validation of learning implementation design (RPP)

Assessed aspects	Average	Criterion
Format		
1. Completeness of RPP (according to RPP Components, namely identity, learning objectives, materials, methods, learning activities, learning resources, and assessment).	4,2	Excellent
2. RPP assessment (numbering, type, and font size).	4,6	Excellent
Fill		
3. Compatibility of learning indicators with basic competencies.	4,2	Excellent
4. Suitability of prerequisite material with the material taught	4,2	Excellent
5. Compatibility of learning activities with learning methods	4,2	Excellent
6. The learning steps are clearly spelled out.	4,2	Excellent
7. Compatibility of the estimated waktu allocation with the activities carried out	4,2	Excellent
Language		
8. The use of language is in accordance with good and correct Indonesian rules.	4,6	Excellent
9. The language used is short, concise, clear, and does not cause double understanding	4,6	Excellent
Average	13,2	Excellent
Validity	Can be used with minor revisions	

Learning mechanism to achieve a basic competency, the plan for implementing learning is a preparation that must be done by a teacher before teaching in class. The learning process that wants to be adapted using lesson plans cannot be the same as those applied in class, because students have their own thoughts and do not always follow the learning implementation plan in class. The research then entered the validation stage for supporting tools in the module, namely the learning implementation plan (RPP) with a very good category using information that can be used using small revisions. In the validation carried out by the researcher, there are

several tips and input provided by the validator to be revised as a result of which the researcher can improve the learning implementation plan that will be applied in the classroom.

Table 8 results of data analysis validation of student response questionnaires

Assessed aspects	Average	Criterion
Instrument format	4,6	Excellent
1. The numbering system is clear.		
2. The typeface and font size are appropriate.	4,6	Excellent
3. Layout space suitability	4,2	Excellent
4. Flexibility and ease of use of instruments	4,2	Excellent
Instrument contents	4,6	Excellent
5. Conformity of statement items with aspects of ease of use		
6. Conformity of statement items with benefit aspects.	4,2	Excellent
7. Conformity of statement items with time efficient aspects	4,2	Excellent
Construction	4,6	Excellent
8. General instructions for responding are clearly stated.		
9. The method of filling and scoring is clear.	3,6	Excellent
10. Statement sentences do not give rise to double interpretation.	4,2	Very good
Language	4,2	Excellent
11. General instructions use language that conforms to the correct Indonesian rules.		
12. The language used is communicative and interactive.	4,0	Excellent
13. The language used is in accordance with the level of development of students' thinking.	4,2	Excellent
14. Use terms (words) that are easy to understand.	4,6	Excellent
Average	13,2	Excellent
Validity	Can be used with minor revisions	

Evaluate responses from students in the learning taught using the teaching modules developed. The researcher analyzed that the students' response to the science module developed was still less interesting, in terms of the researcher himself conveying less attractive values because the material in the module was classified as high for first-level students. Although the research conducted did not reach students personally, the researchers tried to find understanding by asking several teachers to convey input about the modules developed. At the validation stage for module support devices in student responses, the validation obtained is categorized as very good. Assessing the origin of the validation results, students' responses to interesting modules to learn to increase knowledge.

CONCLUSION AND RECOMMENDATION

Conclusion

The development of Junior High School science teaching modules based on scientific literacy of electrical materials in nerve cells and supporting devices in the teaching modules developed is suitable for use. according to the results of the validity analysis of the Junior High School Science Teaching Module Based on Science Literacy Electrical Materials on Nerve

Cells developed based on 3 experts in their fields declared valid and suitable for use. according to the results using the validation sheet. While the results of the analysis on the supporting tools for the development of science literacy-based science teaching modules in the form of learning implementation plans (RPP), student responses, and learning outcome tests. Based on the results of validation carried out by 3 experts, it is very good and worthy of use in learning applications. The results of this development state that the development of Junior High School Science teaching modules based on scientific literacy of electrical materials on nerve cells can be used for learning in schools.

Recommendation

The module developed from the results of research needs to present more information about science literacy in the module content to support students' stimulus in knowing Electrical material in Nerve Cells. In the development of this module has not yet reached the field test stage, it is better to hold further research so that it can find out how easy and effective the Science module of Junior High School Based on Science Literacy in Electrical Materials is.

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