UNIVERSITAS ISLAM NEGERI
KIAI HAJI ACHMAD SIDDIQ
JEMBER

Indonesian Journal of
Mathematics and Natursal Science Education
p-ISSN: 2721-172x e-ISSN: 2721-1746
Vol. 5 No. 1 Th 2024; Page 23-30
http://mass.uinkhas.ac.id DOI: 10.35719/mass.v5i1.163

Feasibility of Integrated Scientific Literacy Assessment Instrument

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Abstract

One of the abilities needed to survive in the global era is scientific literacy. In assessing student's scientific literacy achievements, assessment instruments are needed as a measuring tool. The survey that was conducted revealed that teachers have not used scientific literacy assessment instruments. This research aims to develop scientific literacy assessment instrument that is integrated with smartphone-based experimental set. The research method used is ADDIE model. The scientific literacy assessment instrument that has been made is carried out validation, reliabity, and prostictive test to students and teachers at SMAN 2 Padang Panjang. The results of the validation test of the assessment instrument include content, construct and language validity. The data obtained was analyzed using the Aiken'V formula to obtain an average value of 0.91. The reliability of the instrument is known from the reliability coefficient value "r", the results of the reliability test obtained an r value of 0.95. The practicality test was carried out by 3 physics teachers and 22 students. From the results of the practicality test, the practicality value according to the teachers was 75% and according to the students it was 82.49%. From the results of the validity test, practicality test, and reliability of the integrated scientific literacy assessment instrument, the Smartphone-based sound wave experiment set was proven to be feasible.

Keywords: assessment instrument, practicality, realibility, scientific literacy, validity

INTRODUCTION

Rapid developments in science and technology are a characteristic of the 21st century. Science is a science that plays a very important role in this development (Siregar et al., 2020). Science is one of the focuses of scientific literacy studies. Scientific literacy is an important skill that students need to master (Daniah, 2020). Scientific literacy discusses children's ability to master technology, knowledge, and its implementation in life (OECD, 2019). The focus of scientific literacy is not only on knowledge, but on how a person can apply this knowledge in solving problems encountered in life. Students' scientific literacy abilities should be trained in the learning process at school.

The scientific literacy abilities of Indonesian students are far behind compared to other developing countries (Fuadi et al., 2020). According to the results of a survey conducted in 2018 by the Program for International Student Assessment (PISA), it was found that Indonesian students' scientific literacy was ranked 71st out of 79 countries (OECD, 2019). The survey results reveal that students' scientific literacy in Indonesia is in the low category and needs to be improved.

Students' scientific literacy abilities

can be improved through learning activities, one of which is experimental activities (Arisman, 2015). Experimental activities help students gain knowledge through what is done and observed during direct experimental activities, so that students can understand the concepts, principles, processes, knowledge and skills provided by the teacher. To determine student's scientific literacy achievements, measurement activities are needed using assessment instruments.

It is important to measure students' scientific literacy in order to determine students' scientific literacy achievements in understanding scientific concepts. The level of students' scientific literacy attainment can be used as a standard of educational quality and a reference for improving the quality of education in Indonesia. Measuring students' scientific literacy levels can be done using scientific literacy assessment instruments. PISA has provided an assessment instrument used to measure scientific literacy, but this assessment instrument was created with an international scope (Pratiwi et al., 2019). There is a need for assessment instruments that are used for smaller scopes, such as to measure students' scientific literacy in schools, which can be used as material for evaluating the learning process.

The limited availability of scientific literacy questions in schools is one of the factors causing students' scientific literacy skills to remain low, so that students are not used to solving scientific literacy questions (Sari et al., 2017). This creates difficulties for students to connect appropriate knowledge concepts with existing problems in life. From a survey conducted on 3 teachers at SMAN 2 Padang Panjang, information was obtained that there were no scientific literacy assessment instruments available in schools. The survey results show that teachers' understanding of scientific literacy assessment is not yet deep and teachers have never used scientific literacy assessment instruments. From the analysis carried out on the sound wave questions available in schools, these questions do not meet the scientific literacy indicators. The questions available in schools only meet 3 indicators out of 8 scientific literacy indicators. In fact, scientific literacy is an important skill for students to master to survive in the global era.

Scientific literacy is the scientific ability to identify questions, obtain new information, explain scientific phenomena, and draw conclusions based on facts, as well as attitudes towards issues related to science (Thomson et al., 2013). Scientific literacy relates to students' skills in understanding information, facts and knowledge that exist in life, as well as skills in using this knowledge to solve problems encountered. Scientific literacy has four components, namely science competence, science context, science content and science attitudes (Thomson et al., 2013). Achievement of scientific literacy can be seen from students' mastery of these four components. This can be measured using assessment instruments.

There are several types of assessment instruments that can be used to measure student achievement in the learning

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process, namely test and non-test instruments (Riscaputantri & Wening, 2018). Test instruments are used to assess students' knowledge abilities, while non-test instruments are used to assess students' attitudes and skills. Indicators of scientific literacy ability shows in table 1.

Tabel 1. Indicator of scientific literacy ability

No	Indicators
1.	Identify appropriate scientific arguments
2.	Evaluate the use of scientific information
3.	Understand the elements of research design and how they impact scientific discovery
4.	Create graphs that can represent data
5.	Read and interpret data
6.	Understand and be able to interpret basic statistics
7.	Problem solving using quantitative abilities
8.	Presents conclusions, predictions based on quantitative data

Modification from : (Gormally et al., 2012; Lau, 2009; OECD, 2019)

The indicators used for non-scientific literacy test instruments are as follows table 2.

Tabel 2. Indicators of scientific literacy attitudes

No	Indicators
1.	Supports scientific inquiry
2.	Interest in scientific issues
3.	Responsibility towards resources and the environment

Source : (OECD, 2013)

Assessment can be carried out well if you have a good assessment instrument. Therefore, it is necessary to pay attention to the steps in preparing the assessment instrument. The steps for preparing test assessment instruments are making details, writing questions, analyzing questions, conducting trials, improving tests, compiling tests, carrying out tests, and analyzing test results (Kemendikbud, 2016).

In education there are things that are very important and cannot be omitted, one of which is assessment instruments. Based on the attachment to Permendikbud number 66 of 2013 concerning assessment standards, assessment instruments that are suitable for use have the following requirements : (1) represents the competency to be assessed, (2) the construction used corresponds to the shape of the instrument used, (3) the language used is good, correct and communicative.

Assessment instruments that meet the requirements and have good characteristics can be used to measure an object. In education, assessment instruments are very important to determine the abilities obtained by students. The scientific literacy assessment instrument is an instrument that functions to measure student scientific literacy. The scientific literacy instrument that has been made is a feasibility test, this is done so that the assessment instrument can test the ability of students' scientific literacy. The feasibility test includes validity, reliability, and practicality test. An instrument can be said to be good if it is able to measure what to be measured, in this way a good literacy assessment instrument can measure students' scientific literacy accurately.

METHOD

The research method used is development research (R&D) with the ADDIE model which has 5 stages, namely analysis, design, development, implementation and evaluation (Branch, 2009). Addie models are widely used to develop product. Addie is used to achieve educational goals (Branch, 2009).

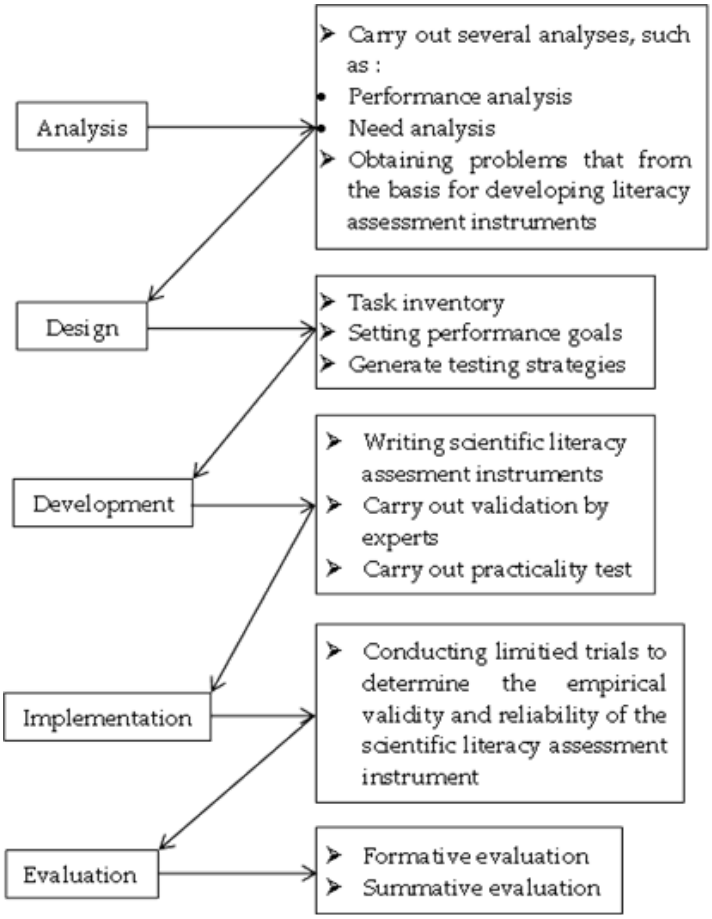

Figure 1. Research Stages

The data obtained is then analyzed through the following steps :

a) Collect data obtained from questionnaires and observation sheets
b) Analyzing validation data from experts using the Aiken's V equation.

$$V = \frac{\sum s}{n(c-1)}$$

Validation was carried out by 5 physics lecturers from FMIPA UNP.

c) Analyze data from teacher and student practicality questionnaires using the

$$final\ score = \frac{total\ score}{maximum\ score} \times 100\%$$

Practicality tests conducted 22 students and 3 teachers of SMAN 2 Padang Panjang.

d) find out the empirical validity value of the test instrument using the product moment

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{(N\sum X^2 - (\sum X)^2)(N\sum Y^2) - (\sum Y)^2)}}$$

e) using test instrument reliability using the Cronbach

$$r_{11} = \left(\frac{n}{n-1}\right)\left(1 - \frac{\sum s_i^2}{\sum s_t^2}\right)$$

RESULT AND DISCUSSION

This research began by conducting an analysis, this step was carried out by distributing questionnaires to teachers and observing the instruments available at the school. The conclusion was that teachers had never used scientific literacy assessment instruments to measure students' abilities.

The second step is to design the assessment instrument being developed. From carrying out the design, a grid of test instruments and non-test instruments is

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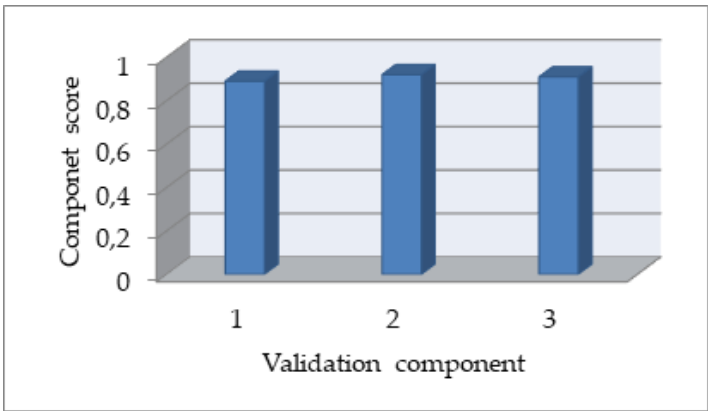

Figure 2. Results of validation of scientific literacy assessment instruments

obtained. The grids were then developed into instrument items. The scientific literacy assessment instrument developed consists of 29 scientific literacy questions, a self-assessment sheet and an observation sheet.

The completed instrument continues to the validation stage. Lecturers carry out validation activities to collect data as a basis for determining product suitability in measuring scientific literacy abilities (Kurniawan et al., 2018). Expert validation consists of 1)appropriateness of content, 2)appropriateness of construct, 3)appropriateness of language. Expert validation analysis can be seen in Figure 2.

Based on theory, an assessment instrument can be said to be valid if the validation value of the assessment instrument is ≥ 0.87. From Figure 2 it can be seen that the validation values obtained from each component are content validity 0.89, construct validity 0.92, and language validity 0.91. So the average validity value of the scientific literacy assessment instrument is 0.91, which is in the valid category.

The instrument, which has been proven to be valid. Practicality tests are carried out to see the level of practicality of the products produced. The practicality test results were obtained from the practicality questionnaire sheet which was filled in by teachers and students. The practicality test consists of 3 components, namely 1)ease of use, 2)attractiveness, 3)efficienc. Below are presented in Figure 3 the results of the practicality test of the scientific literacy

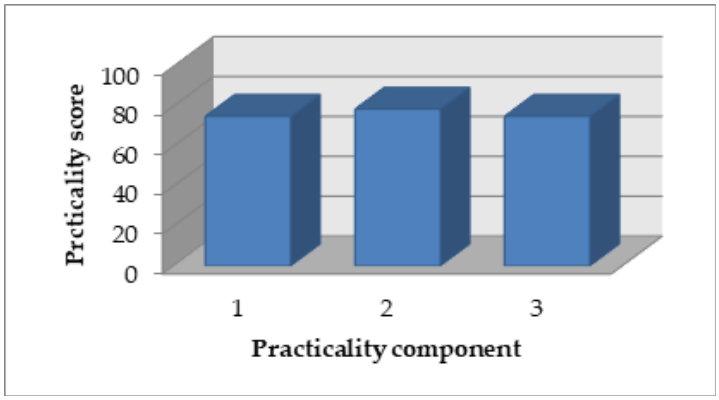

Figure 3. Results of analysis of the practicality of scientific literacy assessment instruments according to teacher

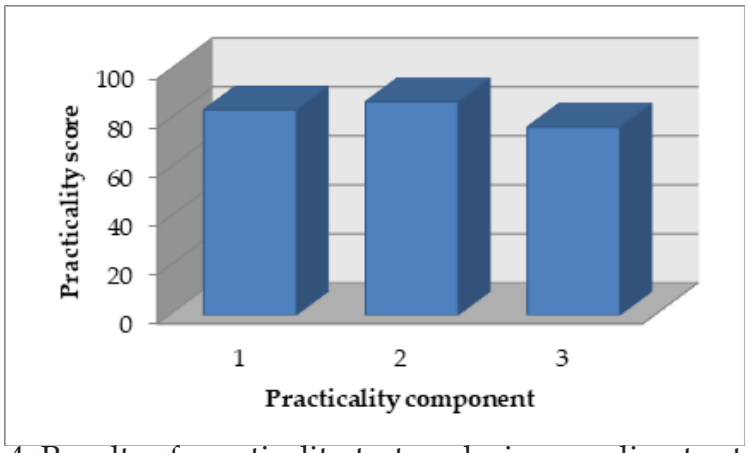

Figure 4. Results of practicality test analysis according to students

assessment instrument according to the teacher.

Based on Figure 3, it can be seen that the practicality value for each practicality component of the scientific literacy assessment instrument is 75 for ease of use, 78.57 for attractiveness, and 75 for efficiency. The average score for practicality results according to teachers is 76.19 which is in the practical category. The results of the practicality test of the scientific literacy assessment instrument according to students are presented in Figure 4.

Based on Figure 4, it can be seen that the practicality value of each component of the practicality of the scientific literacy assessment instrument according to students is 83.71 for ease of use, 87.04 for attractiveness, and 76.71 for efficiency. The average practicality score according to students is 82.49, so the science iteration assessment instrument is included in the very practical category. From the results of practicality tests carried out by teachers and students, it was found that the scientific literacy assessment instrument developed was easy to use, attractive and efficient. This is in accordance with the practical category according to Arifin (2009) and Sukardi (2008). So the assessment instrument developed can be said to be practical.

The product-moment correlation formula is used to analyze student answers. The results of the analysis from trials conducted on 22 students in Table 3.

Tabel 3. Results of Validity Analysis of the Scientific Literacy Test Instrument

Question number	rt	rh	Criteria	
			Valid	Invalid
1	0.423	0.554	√	
2	0.423	0.294		√
3	0.423	0.525	√	
4	0.423	0.519	√	
5	0.423	0.268		√
6	0.423	0.441	√	
7	0.423	0.323		√
8	0.423	0.637	√	
9	0.423	0.323		√
10	0.423	0.641	√	
11	0.423	0.628	√	
12	0.423	0.469	√	
13	0.423	0.758	√	
14	0.423	0.499	√	
15	0.423	0.201		√
16	0.423	0.554	√	
17	0.423	0.244		√
18	0.423	0.807	√	
19	0.423	0.762	√	
20	0.423	0.743	√	
21	0.423	0.883	√	
22	0.423	0.799	√	
23	0.423	0.873	√	

DOI : https://doi.org/10.35719/mass.v5i1.163

Question number	rt	rh	Criteria	
			Valid	Invalid
24	0.423	0.883	√	
25	0.423	0.890	√	
26	0.423	0.920	√	
27	0.423	0.921	√	
28	0.423	0.847	√	
29	0.423	0.913	√	

Items can be said to be valid if, for the number of respondents 22 (n=22), a significance level of 5% based on the Product Moment correlation table is obtained rt = 0.423. Table 3 explains that there are 23 valid questions out of the 29 questions that have been developed. In line with the research of Helendra & Sari (2021) and Safitri et al (2018) it is stated that an instrument whose validity has been tested is an instrument that can measure what it wants to measure. Therefore, the questions that are tested as valid can be used as a measure of students' scientific literacy abilities, while the 6 questions that are invalid cannot be used. Valid assessment instruments are calculated by calculating the reliability coefficient to determine the consistency of the instrument being developed. The reliability coefficient obtained from the Cronbach Alpha formula is 0.95 in the very high category. Instruments that have a high reliability coefficient will provide consistent results every time they are used (Martinah et al., 2022).

CONCLUSION

From the research that has been carried out, the results show that the scientific literacy assessment instrument is integrated with a set of smartphone-based sound experiments based on empirical tests. The scientific literacy assessment instrument was also proven to be reliable. The scientific literacy assessment instrument was considered practical according to teachers and students. So it can be concluded that the integrated scientific literacy assessment instrument with a smartphone-based sound experiment set is feasible for use.

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BRIEF PROFILE

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DOI : https://doi.org/10.35719/mass.v5i1.163