



## Scientific Literacy Test Instrument for Junior High School in Pati: The Validity and Reliability

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### Abstract

This research uses a modified Research and Development (R&D) research and development model from Thiagarajan's Four D, namely defining, designing, developing, and disseminating. The outcome of this study is a science literacy assessment tool designed for junior high school science subjects in Pati Regency. Expert assessment by 4 assessors, including; 1 lecturer, 1 language expert, and 2 junior high school science teachers. The testing carried out by experts is instrument evaluation, the results of testing the validity and reliability of the scientific literacy test instrument for junior high school students. The test instrument developed obtained language percentage results of 86%, very good, 87% very good in construction, and 89% good in material. The expert validity assessment in developing scientific literacy test instruments produced a v'Aikens index test result of 0.8120, which is included in the high validity criterion. The reliability test results indicate an average size of 0.684, based on the Intraclass Correlation Coefficient (ICC) criteria for good reliability. So, it can be concluded that the validation of scientific literacy test instruments is valid and can be used as reference by teachers. For further research, researchers can use this test instruments in learning to measure scientific literacy.

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## INTRODUCTION

With acceleration of educational development, today, students are required to master many skills (life skills) that will help them win the competition (Aprilia et al., 2021). One of the life skills that is very important for students is scientific literacy. Scientific literacy involves more than just comprehending scientific concepts; it also entails applying these principles in daily life. Assessing scientific proficiency can serve as a gauge for both education quality and human resource capabilities. A person with basic scientific knowledge can identify problems of a scientific nature, express reasonable scientific and technological positions (Saija et al., 2022).

A student's scientific literacy denotes their capacity to apply scientific understanding, assess information, and formulate conclusions grounded in evidence. The standard of education, particularly in the field of science, remains comparatively deficient in Indonesia when juxtaposed with other developing nations. Evaluating the level of scientific literacy among students is a crucial component for assessing the educational standards of a nation (Afnan et al., 2023). This deficiency in Indonesian education, particularly in science, is evidenced by the subpar levels of scientific literacy observed in PISA assessments. (Wahyunisah & Susilawati, 2023).

PISA (Program for International Student Assessment) is an assessment program organized by the OECD (Organization for Economic Cooperation and Development) that evaluates test participants' reading abilities, mathematical knowledge, and science knowledge, in 2012 (OECD, 2018) the tests conducted by PISA were taken by 510,000 students from 65 countries. Indonesia is ranked 64/65 countries. This data shows that Indonesian students' reading ability, mathematics knowledge, and science knowledge are still very low compared to the other 64 participating countries. Indonesia's PISA ranking shows that Indonesian students

have low knowledge of science. Apart from that, this ranking also shows that Indonesia is not competitive enough with other countries.

Scientific literacy is a skill that prospective teachers or prospective teachers must have. Scientific skill involves the ability to understand scientific concepts in our daily lives, enabling us to comprehend theories and find solutions to various problems (Pujawan et al., 2022). The data sources are a scientific literacy test with social-scientific issues and an open-ended essay question. The validity of the data was tested using data triangulation techniques, namely, researchers comparing data obtained through test instruments and interview results (Afnan et al., 2023). Assessment of children's scientific literacy skills in schools is not followed by the development of instruments, so in other words schools have not used appropriate instruments to assess early childhood scientific literacy skills (Effendi et al., 2021).

Creating assessment tools for scientific literacy is a step towards gauging proficiency in science-related skills. The quality of education in Indonesia faces challenges due to students' insufficient scientific literacy, highlighting areas for enhancement. It is caused by learning in Indonesia which is not yet oriented toward 21st century learning which is in sync with scientific literacy (Nazura et al., 2021).

Based on the results of observations and interviews conducted with junior high school science teachers in the Pati district showed that literacy science students still low. This is seen from questions prepared by eye teachers science lessons yet still not yet taken into account indicator literacy science (Azmi, et.al., 2023). Several studies previously show that instruments test understanding of reading, including valid and reliable categories that can used to measure the ability of literacy students (Farahiba, 2022). The results of other research reveal that tool test literacy can also be used to increase skills in science students because obtain valid and reliable assessments (Handayani & Mayasari, 2023).

Based on existing problems, the main factors the scientific literacy level of Indonesian students is low because students lack training in solving problems that are problem solving in nature because the availability of test instruments to support students for high order thinking still rare, apart from the limited questions and reading interest of students low (Amala et al., 2023). Existing test instruments so far emphasize dimensions content rather than process and context dimensions, thereby causing low level of scientific literacy of students in Indonesia. Apart from that, there are questions most of what is made is on indicators explaining scientific phenomena. No other indicators have been used, so Indonesian students have difficulty in adapting to solving problems in other types of questions with different indicators. Therefore, an alternative is needed test instruments that involve aspects containing scientific literacy namely the content, processes and attitudes of science in real life contexts. Based on this, a test instrument is needed that can increasing students' scientific literacy.

Following the background context provided, the study focused on creating assessment tools for evaluating scientific literacy among junior high school students. However, the research primarily aimed to develop a scientific literacy test concentrated on assessing content validity and reliability through the expertise of assessment professionals. The assessment instrument developed was derived from the dimensions of PISA which contain context aspects, scientific knowledge aspects, and competency aspects. The test indicators in this research are explaining the phenomenon scientifically, evaluating and designing scientific investigations, and interpreting scientific evidence and data.

The outcome of this research endeavor is a scientific literacy assessment tool designed to evaluate scientific proficiency, endorsed as valid, reliable, and practical. Comprising 20 standard multiple-choice questions, the

instrument garnered high validity ratings from language and subject matter experts, as well as favorable feedback from educators. Nineteen questions were deemed valid with strong reliability (Ardianti et al., 2022).

The validity test is testing appropriateness. Something instrument research that has been declared valid to have the meaning of the instrument can measure the variable to be measured (Sugiyono, 2019). Testing validity instrument study can done based on content (content), criteria, and concepts (construct). Validity content is testing the feasibility of research instruments by experts. Validity criteria is a feasibility test with a compare score test with reference criteria. The latter is the validity draft (construct) is tests the appropriateness instrument study by connecting the results (Oetting et al., 2009).

## METHODS

This research uses Research and Development (R&D) method that modification from Thiagarajan namely Four D's (4D). The 4D method consist of definition (define), planning (design), development (develop), and deployment (disseminate). In the initial phase, researcher defined the scope by gathering insights through observations and interviews with teachers regarding various aspects of the school such as curriculum and assessment tool. Subsequently, in the design phase researcher compiling scientific literacy instruments by referring to PISA indicators. Next, in the development stage, researchers validate and test scientific literacy instruments. Finally, in the dissemination phase, researchers disseminate it to schools to be used as a scientific literacy test. Research data was obtained from giving sheet validation evaluation experts. The scoring scale used is a Likert scale with scoring as presented in Table 1.

**Table 1.** Validity Item Scoring Scale Expert Assessment

Alternative Evaluation	Score
Bad	1
Enough	2
Good	3
Very Good	4

Futhermore, the category of expert assessment consists of aspect material, language, and construction as presented in Table 2.

**Table 2.** Category of Expert Assessment of Material, Language, and Construction Aspects.

Information	Intervals
Bad	181-260
Enough	261-340
Good	341-420
Very good	421-500

Based on Table 2, we know that to identify valid or not instrument tests scientific literacy is based on "Very Good" category and "Bad" category. Then validity test is carried out by experts. Test validity is very important part in developing instrument test.

Validity fill evaluates how well the test content aligns with the material covered in the test (Maghfiroh et al., 2023). Full validity is achieved when this alignment is objectively measured, ensuring that the test reflects the content taught in the lessons. It's essential for validity fill to encompass the entire content domain, ensuring not only comprehension but also the inclusion of relevant items measured objectively (Patria et al., 2023).

In this study, reliability testing was conducted to assess the instrument's feasibility and effectiveness. According to Stylos et al. (2023), the Intraclass Correlation Coefficient (ICC) results were categorized as follows: a coefficient value  $0.90 < r \leq 1.00$  indicates very good reliability,  $0.75 < r \leq 0.90$  indicates good reliability,  $0.5 < r \leq 0.75$  indicates quite good reliability, and a coefficient value  $r \leq 0.5$  indicates low reliability.

## RESULTS AND DISCUSSION

The process of developing assessment literacy science in junior high school students is initiated with data collection during the defining stage. The outcomes of assessing the validity and reliability of literacy science in junior high school students are examined professionally in this study, focusing on their credibility and consistency. According to Chasanah et al., (2022) stage is what is needed for the analysis beginning and study end. Based on results analysis from two science teachers at Junior High School in Pati Regency test that developed not yet form question literacy science with the use of PISA indicators.

The test indicators in this research are explaining the phenomenon scientifically, evaluating and designing scientific investigations, and interpreting scientific evidence and data. The next step is design. At this stage, researcher prepared test format based on materials and programs. Furthermore, the next step is development which is step validation validator. Validation objectives expert is for know validity and feasibility tool created tests (Rusmansyah et al., 2023). Based on the results of testing professional knowledge in three aspects including language, materials, and construction can be shown in Table 3. The rating result experts is the average of the four validators.

**Table 3.** Rating Result Experts

Aspect	Mark	%	Information
Language	439	86	Very good
Construction	435	87	Very good
Material	450	89	Very good

Based on Table 3, it can be seen that the expert assessment was assessed through 3 aspects, the language aspect based on the verifier's assessment obtained a score of 439 with a rate of 86% and was included in the very good category. The language aspect is demonstrated through the use of scientific

literacy questions that comply with Indonesian writing rules, communicative discussions, and the use of clear and easy-to-understand vocabulary. The construction aspect received a score of 435 with a rate of 87%, which is classified as very good, meaning that the inspection tool based on the construction aspect meets the requirements for clarity of material content, according to material content. Criteria, levels, and answers are inconsistent, and the completeness of the questions does not correspond to the skills required to create conditions for students to acquire knowledge.

Aspect fill material according to 3 validators obtained assessment score 450 with an assessment of 89% and classified as very good, where aspect this covers clarity presented images, instructions processing questions, formulas sentence form sign questions and regulations election size text presentation. Validity tests carried out by experts are very important in development tool testing because testing validation can determine the suitability of some tool testing (Darman et al., 2024). The validity test results

for scientific literact test instrument can be shown on Table 4.

**Table 4.** Validity Test Results

Criteria	Question Item Number	Amount
Valid	13. 14. 15. 18. 12. 16	6
Medium Valid	3. 4. 8. 9. 11. 21. 22. 23. 25. 27. 2. 30	12
Very Valid	1. 2. 5. 6. 7. 10. 17. 19. 20. 24. 26. 28	12

The results of the assessment of 4 expert validators on 30 questions were divided into 3 criteria, namely valid criteria, medium valid criteria, and very valid criteria. Assessment by experts regarding the development of scientific literacy test instruments for junior high school students obtained index test results v'Aikens 0.8120 which is included in the very valid criteria. In addition to assessing the validity of the testing instrument, a reliability test was also conducted. This analysis of reliability was derived from the agreement among the raters involved in its development. The outcomes of the reliability test are presented in Table 5.

**Table 5.** Reliability Test Results

Intraclass Correlation Coefficient							
	Intraclass Correlation <sup>b</sup>	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.354a	0.155	0.581	3.188	24	72	0.000
Average Measures	.684c	0.423	0.847	3.188	24	72	0.000

According to Table 5, the reliability test findings indicate an average score of 0.686, meeting the criteria for good reliability according to the Intraclass Correlation Coefficient (ICC). Recommendations and feedback from validators during the development process include the first validator proposing enhancements to evaluate each metric and its components. The second validator suggests refining the vocabulary and explanatory language of each question item to

ensure clarity and full comprehension for students. The third validator offers suggestions on linguistic aspects requiring further investigation and recommends recalibrating each indicator. The fourth validator noted that several reading and writing questions still needed language refinement to align more consistently with the material's content.

## CONCLUSION

The development of literacy test instruments science subjects for junior high school students in Pati Regency based on expert assessments on three aspects of language, structure, and material is very good. The test instrument developed obtained language percentage results of 86%, very good, 87% very good in construction, and 89% good in material. The expert validity assessment in developing scientific literacy test instruments produced a v'Aikens index test result of 0.8120, which is included in the high validity criterion. The results of the reliability test show an average size of 0.684 which is included in the Infraclass Correlation Coefficient (ICC) criteria for good reliability. So, it can be concluded that the validation of scientific literacy test instruments is valid and can be used as reference by teachers. For further research, researchers can use this test instruments in learning to measure scientific literacy. Expert recommendations and critiques are employed to enhance the evolution of testing instruments.

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