



## Instrument Development of Science Literacy Assessment with Socio-Sciences Contains in Natural Science Learning for Elementary School

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### Abstract

The preparation of test instruments based on scientific literacy was one of the efforts to measure students' literacy skills, especially in the field of science or science. The aim of this study was to produce a scientific literacy assessment instrument containing socio-sciences in primary school science learning with the theme of heat and its displacement. The research method used in this study was the research and development method or often referred to as 4D (Define, Design, Development, Dissemination) by simplifying the stages of development into 3D (Define, Design, Development). The results showed that the average value of the instrument content validity was 85.03% which was declared very valid and the empirical validity value was 80.00%. The results of the practicality test of the scientific literacy assessment instrument containing socio-sciences by the teacher obtained a score of 89.52% and by students 88.43%. The reliability of the scientific literacy assessment instrument containing socio-sciences shows a high category with a reliability value of 0.83, there are 80% of questions with moderate difficulty criteria, and 66% of questions with good discriminating power. Based on the results of the research, it can be concluded that the scientific literacy assessment instrument containing socio-sciences of heat material and its transfer can be declared valid, practical, and reliable.

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## INTRODUCTION

Science was one of the compulsory subjects for students at the primary and secondary education levels. Science subjects given in primary and secondary education are also intended to equip students with the ability to think logically, analytically, systematically, critically, and creatively, as well as the ability to work together. These abilities are competencies needed by students to have the ability to acquire, manage, and utilize information to survive in an ever-changing, uncertain, and competitive situation (Pearson et al., 2015). At the national level, the evaluation of science learning in schools is carried out using the National Examination (UN) standard. Meanwhile, at the international level, there are currently two main assessments that assess students' math and science abilities, namely the Trend in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA) (Khadijeh & Amir, 2015); (Pradipta et al., 2020).

Scientific literacy was not only the ability to understand scientific knowledge but also the ability to understand scientific processes and be applied to deal with real conditions that occur in the environment (Rusilowati et al., 2016). Scientific literacy prepares citizens who are responsible and sensitive to environmental problems (responsible citizens). This is because scientific literacy emphasizes decision-making on social issues when viewed in terms of scientific knowledge that has been obtained (socio-scientific issues) and problem-solving (Holbrook & Rannikmae, 2007). Therefore, several countries make scientific literacy the main goal in science education (Rusilowati et al., 2016); (Mardhiyah et al., 2016).

The achievement of scientific literacy which refers to the nature and origin of scientific knowledge, science-related career expectations for students, and motivation to learn science can be fulfilled in the learning process (Arlis et al., 2020). The three literacy

studies need to be applied in the elementary school learning process, to be able to bring Indonesian elementary school students to compete in the international world (Keefe & Copeland, 2011). The eligibility of students to compete and participate in the international world must be capitalized by the high capacity for applying scientific literacy. The application of scientific literacy includes four aspects, namely the context aspect, content aspect, competence/process aspect, and attitude aspect (Alduraby & Liu, 2014).

Science competence in elementary schools was the basis for student competence at higher levels. Student competencies in energy themes in elementary schools need to be known and measured so that student competencies can be better at the junior high and high school levels (Asyhari et al., 2019); (Azimi et al., 2017). The results of interviews with several science teachers at SDN Pringlangu Pekalongan City and analysis of the questions prepared by the teacher obtained information that the questions used to measure student learning outcomes did not contain scientific literacy, the questions emphasized content aspects and did not include process aspects. And context. The content aspect is an assessment that is obtained on three main aspects, namely the material aspect, construction, and the aspect of inculcating cultural values. Based on the facts at school, the problem that is focused on is the problem of students' scientific literacy skills, because based on the results of observations of the questions used in schools, the questions do not contain aspects of scientific literacy. Therefore, measuring scientific literacy is very important to determine the extent to which students have scientific literacy so that efforts to improve the quality of education in Indonesia can be carried out and can compete with other countries.

The preparation of test instruments based on scientific literacy was one of the efforts to measure students' literacy skills, especially in the field of science or science (Fu'adah et al., 2017); (Koh, 2011). The

position of an assessment as an assessment tool is very vital in the world of education (Aji et al., 2017). Educational assessment standards relate to procedures, mechanisms, and instruments for assessing student learning outcomes (Alduraby & Liu, 2014; Asyhari et al., 2019; Khadijeh & Amir, 2015). Success in the learning process assessed by educators is carried out sustainably so that you can observe the ongoing success of learning (Gottheiner & Siegel, 2012); (Pearson et al., 2015). The development and renewal of the learning success are carried out in ways such as daily tests, mid-semester tests, end-of-semester tests, and grade-level tests (Gottheiner & Siegel, 2012; Zolfaghari & Ahmadi, 2016); (Gormally et al., 2012). The aim of this study was to produce a scientific literacy assessment instrument containing socio-sciences in primary school science learning with the theme of heat and its displacement.

## METHODS

This study used is research and development. The development model used in this study was 4-D developed by Thiagarajan. The 4-D model consists of four stages of research and development, namely the define stage, the design stage, the developed and disseminate stage (Thiagarajan, 1976). Logically valid instruments from expert judgments validation and one-to-one test were tested on a small scale with 30 students. The results of small-scale trials were then revised and tested on a large scale. A wide-scale trial was conducted on 90 students. The data collection instruments were interview questionnaires, question analysis sheets, self-evaluation sheets, validation sheets, one-to-one test evaluation sheets, teacher and student practicality questionnaires, and student answer sheets. Research data for logical validity was measured using a validation sheet, while practicality data was measured using a

practicality test sheet. The sheet was scored according to a Likert scale. Types of qualitative data were analyzed using quantitative descriptive techniques. The empirical validity of the instrument was carried out by analyzing the validity of the item items, namely comparing the value of  $r$  in each item with the  $r$  product moment. Instrument reliability was measured using the Kuder Richardson KR<sub>20</sub> formulas.

## RESULTS AND DISCUSSION

This study produced an instrument of science literacy assessment with socio-sciences consisting of 25 multiple choice questions with four answer choices, which required students to think critically in choosing the available answer choices. When students are given a question in the form of a multiple-choice test, the student must evaluate each choice and choose the one most appropriate answer. This question has approached the distribution of the percentage of scientific literacy which includes aspects of competence, context, and knowledge (Shwartz & Hofstein., 2006). In addition, the developed socio-science-based scientific literacy assessment instrument is equipped with a cognitive level based on PISA (low, medium, and high). The level of question validity is measured using a validation sheet to determine the extent to which the instrument measures what it is intended to measure. The validity of this research is based on the value of content validity and construct validity (Gormally et al., 2012);(Martin et al., 2016). Broadly speaking, 4 aspects are assessed in the validation of this instrument of science literacy assessment with socio-sciences. These aspects include aspects of the material, construction, language/culture, and science literacy with socio-sciences contains. The results of the logical validity test can be seen in Table 1.

**Table 1.** Results Content Validity Instrument Test

Num.	Aspect	Percentage (%)	Category
1	Material	86.46	Very Good
2	Construction	87.58	Very Good
3	Language	90.73	Very Good
4	Scientific literacy with Socio-Science Contains	75.36	Good
Average		85.03	Very Good

The table 1 above shows that the average result of the content validation data analysis of the expert team in the form of a questionnaire on the material aspect obtained a percentage of 86.46%. The achievement of the material aspect is more than 75%, so it is categorized as very good or very valid. In the aspect of scientific literacy with Socio-Science content, 75.36% is categorized as good. The average construction aspect data analysis reached a very high percentage of 87.58%, categorized as very good. In the language aspect, the percentage is 90.73%, also

categorized as very good. Overall, the results of this validation indicate that the instrument is very feasible to use in the learning evaluation process. Valid instruments were then tested at the one-to-one and small group evaluation stage to see an initial picture of student responses and possible practicality values. At the field test stage, the assessment instrument was re-tested to obtain empirical validity and practicality values. The results of the practical analysis by students and teachers can be seen in Table 2.

**Table 2.** Results of Practicality Test

Num.	Aspect	Percentage (%)	Category
1	Instruction of Question	90.46	Very Practical
2	Time effectiveness	74.78	Practical
3	Equivalence	80.63	Very Practical
4	Ease of Use	78.32	Very Practical
Average		81.04	Very Practical

Based on the results of the practicality test data analysis by teachers and students, it was found that the practicality value was 81.04% with very practical criteria. This practicality value is the average value of several aspects in the practicality sheet, which includes aspects of question instructions that have functioned properly, ease of use of assessment instruments, the effectiveness of the time of working on assessment instruments, ease of checking answers, as well as their equivalence or equivalence to the demands of the applied curriculum. At school. The highest percentage of practicality values is found in the question instructions aspect of 90.46% with very practical criteria. This means that the instrument of science literacy assessment with socio-sciences contains was

equipped with question instructions that are easy to understand and function well so as not to confuse students. The instructions given before the test starts will give students peace of mind in doing the test, and in the implementation, there will not be many questions. While the percentage on the aspect of ease of use of this instrument has a practical value by the teacher of 78.32% with very practical criteria. The assessment given by the teacher on the aspect of ease in using this question is because the questions do not have to have special expertise in using them. The questions are easy to understand and the discourse contained in the questions is displayed in a context that can be applied in everyday life.

Aspects of the effectiveness of the time of the test are considered quite practical by teachers and students with a value of 74.78% because the questions tested amounted to 25 questions enough to be done for 90 minutes. This indicates that the instrument of science literacy assessment with socio-sciences contains was developed supports the effective and efficient implementation of the test. The preparation of the test should be arranged by allocating time. Adjust the time of class hours and the estimated length of time it will take students to solve all the questions. The equivalence aspect means that there is a relationship of equivalence. Obtaining very practical criteria of 80.63%, meaning that the questions already have equality with the curriculum that applies at school. This is because the curriculum which includes the learning syllabus has become a reference for the author in designing the assessment instrument grid.

The average value of the practicality test results showed that the instrument of science literacy assessment with socio-sciences contains has met the criteria for high practicality. Learning tools that meet the requirements are very practical, meaning that all components of learning tools developed in this study are feasible to be implemented in the learning process in the classroom. Furthermore, empirical validity tests and item analyses were carried out. A test is said to have empirical validity if it has been tested through experience or based on observations in the field. Empirical validity is known by analyzing the items that have been tested using the product-moment correlation formula. A question is said to be valid if the coefficient of product-moment correlation ( $r_{count}$ ) obtained is greater than the  $r$  table (Zolfaghari & Ahmadi, 2016). A reliability test is used to determine the level of consistency of the instrument. A good instrument will accurately give the same measurement results and have a consistent answer for whenever the instrument is used. The results of the reliability test using the help of SPSS version 24 obtained a

reliability value of 0.76 so this instrument is said to be reliable. A good instrument will give the same measurement results and have consistent answers (Salamah & Rusilowati, 2017). In the same way, a test is said to be reliable if it gives a constant or consistent result if it is tested many times. The results of the item analysis on the developed instrument can be seen in Table 3.

**Table 3.** Results of Item Analysis on Field Test Evaluation

Num.	Empirical Test	Score
1	Reliability	Reliable (0.76)
2	Difficulty Level	Difficult (18.00) Average (64.00) Easy (18.00)
3	Power Difference	Poor (14.00) Adequate (24.00) Good (42.00) Very Good (22.00)

The reliability value of the items obtained for multiple-choice questions is 0.76 with high criteria. This means that the instrument of science literacy assessment with socio-sciences contains was developed has a high level of determination, that is, whenever this assessment instrument is tested on students it will give relatively the same results. The test is said to be reliable if the test results show determination, in other words, if the same test is given to students at different times, then each student will be in the same order. Many factors affect test results which will indirectly affect the reliability of the test questions. The more heterogeneous the ability of the test takers, the higher the reliability of the test. The greater the number of test-takers, the greater the reliability of the test. The smaller the number of test items, the less reliable it will be because it is not representative. The level of difficulty of the questions developed has varied. Based on the results of multiple-choice analysis, it is known that 18% of questions are classified as difficult, 64% of questions are classified as moderate,

and 18% of questions are classified as easy. In general, the level of difficulty of scientific literacy questions is at a difficult level. However, the assessment instrument developed is in the range of moderate questions, namely questions that are not too easy and not too difficult. A good question is a question that is neither too easy nor too difficult (Aji et al., 2017; Koh, 2011). Problems that are too easy cause students not to increase their efforts to solve them. On the other hand, questions that are too difficult cause students to despair and do not have the enthusiasm to try again.

The instrument of science literacy assessment with socio-sciences contains has differentiating power for multiple-choice criteria, very good 22.00%, good 42.00%, moderate 24%, and poor 14.00%. Based on the analysis of discriminating power, it can be said that the instrument of science literacy assessment with socio-sciences contains can distinguish students who have low abilities and high abilities. There are several follow-ups on the results of the analysis regarding the discriminatory power of questions. Items that have good discriminating power should be included in the question bank so that they can be used in future tests. Items that have low discriminatory power have two possible follow-up actions, which are traced and then repaired, and after being repaired they can be used in future tests, or discarded and will not be issued again (Lin et al., 2020); (Andiani et al., 2020; Aristia & Sutarto, 2021); (Othman et al., 2015). Questions that have a negative index of discrimination should not be issued in future tests because they are of poor quality (testees who are intelligent are more likely to answer wrongly than stupid testees, who only have a few wrong answers).

Many factors can affect the results of an invalid evaluation test. Based on the source, there are internal test factors, external test factors, and factors originating from the student concerned that can affect the validity of an evaluation test result. The internal test factor in this study is that there are several

items with a very easy level of difficulty, thus most of the students answered correctly so that the correlation value is very low, meaning that the item value has almost no effect on the total score (Topcu, 2010); (Smith et al., 2013). Another factor that affects the value of the validity of this evaluation instrument is the atmosphere around the class that is less conducive because it uses some of the rest time. As a result, students' concentration becomes divided when working on questions.

## CONCLUSION

The instrument of science literacy assessment with socio-sciences contains was developed can be conducted based on the correlation value ( $r$ ) from the product-moment formula. The instrument of science literacy assessment with socio-sciences contains was also declared reliable with a reliability coefficient value in the high-reliability category. From the level of difficulty of the questions, the instrument is included in the category of good questions, with categories of difficult questions, moderate questions, and easy questions. From the aspect of discriminating power, the instrument based on the discrimination index shows that the average question can distinguish the abilities of students. The instrument of science literacy assessment with socio-sciences contains theme of heat and its transfer can be stated to be very valid, very practical, and the reliability of the questions is high. It is recommended for teachers to be able to develop test instruments to support the learning process so that it will be better in the future.

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