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Validity of Knowledge Test to Improve the Ability of Science Literacy on Global Warming Material Based on Socio-Scientific Issues (SSI)

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Abstract. This study aims to determine the validity of knowledge tests to improve the ability of science literacy on the material of global warming based on Socio-scientific Issues (SSI). The research method used was 4-D, namely: (1) define, (2) design, (3) develop, and (4) disseminate. The results showed that the assessment of science knowledge on science literacy on the material of global warming based on Socio-scientific Issues (SSI) were namely: the validity of the material domain obtained a percentage of 94.44% with very decent category, the validity of the construction field obtained a percentage of 93, 33% with very decent category, and validity from language domain got percentage equal to 91,66% with very decent category. From this research, it can be concluded that science knowledge on science literacy on the global-based heating material of Socio-scientific Issues (SSI) deserves to be used as supporting media of learning process to improve science literacy ability.

Keywords: science literacy, socio-scientific issues, validity

INTRODUCTION

Current science education is geared toward preparing students for successful living in the 21st century. Breakthroughs and advances in science and technology have brought great changes in improving the quality of human life in various parts of the world. These developments arise new problems related to the ethics, morals and global issues that actually threaten human dignity and survival. For example, the developments in the automotive field in the form of modern transportation creates new hope for human survival, but also cause new problems that threaten human life, such as air pollution due to emissions of motor vehicles that can trigger the occurrence of global warming. This problem not only worries individuals but also the global community and the problem can only be solved through means of communication and cooperation among the global community. Rahayu (2014) stated that to solve the emerging problems, it is necessary for the community to have an understanding of scientific ideas, intellectual ability, creativity, logical, and must have concern for issues and problems that occur in nature ¹. People who have these skills are said to have scientific literacy.

Science literacy is defined as the ability to conduct science knowledge to explain and predict natural phenomena in order to overcome natural problems through scientific methods ^{2,3}. In fact, the development of science literacy has become a top priority in the field of science education in schools ⁴. In addition, the school curriculum for science should also direct the learning of science in order to manifest students who later become a science-literate of society. The new curriculum revised 2013 curriculum revised also expects this to be achieved by defining the competencies that students must possess in the future such as: (a) the ability to communicate, (b) the ability to think critically, (c) the ability to consider problems in the moral side and (d) the ability to live in a global society.

This 2013 curriculum revised demonstrates the importance of incorporating Socio-scientific Issues (SSI) into the classroom of teaching and learning activities. Levinson proposed a three-stranded framework for teachers in teaching SSI in classroom teaching activities, namely: 1) reasonable categories of disagreements; 2) good communication or essential characteristics to engage in reasonable disagreements; 3) narrative ideas and narrative experiences that can explain the best disagreements ⁵.

Socio-scientific Issues (SSI) is a strategy that aims to stimulate intellectual, moral and ethical development, and awareness of the relationship between science and social life ^{6,7}. SSI learning has moral and ethical implications. Therefore, the impetus for scientific literacy is indispensable to the moral and ethical implications of social-scientific issues. Science literacy is important for all students. Literacy of science is the ability to engage with issues related to science and with scientific ideas as reflective citizens. A person who has scientific literacy means the person is willing to engage in issues related to science and technology that require competence to: (a) explain scientific phenomena; (b) evaluate and design scientific inquiry; (c) interpret data and scientific evidence ⁸.

SSI learning is a learning that features controversial social issues related to science ⁶. SSI is conducted in science education in order to organize science literacy that emphasizes the development of scientific and moral reasoning to cope with the phenomena that occur in society. SSI can be found in a global context on environmental issues in society such as global warming. In this study, the material chosen is the material of global warming. The issue used in this material is the issue of global warming in accordance with SSI learning because it is local and also a problem that can be seen even felt in the life of the students. This issue presents the relationship between the concept of the science that is related global warming with people's lives. This study aims to produce the literature of science literacy capability on the material of global warming based on Socio-scientific Issues (SSI) valid. The validity is only reviewed from the results of the validation of experts.

EXPERIMENTAL DETAILS

The type of this research is the research of the development of the 4-D model by developing science literacy capability instrument on the global warming material based on Socio-scientific Issues (SSI). The research development model is the 4-D model of Thiagarajan, Semmel, and Semmel ⁹. Four stages of this development model include define, design, development and disseminate. But at the stage of dissemination is not done considering the realm of research development which very extensive and takes a long time so that the development research is designed only until the development stage (develop) to obtain a valid literacy ability skills.

The subject of this research is an instrument of science literacy knowledge which has been validated by three experts/experts in their field. The instrument on instrument validation sheet about science literacy knowledge used to collect data in this research is the instrument validation sheet of literacy ability of science. The instrument validation literacy literature sheets developed contain guidance and appeal to the validator to provide an assessment of the developed literacy instruments. The data collection technique that is done in this research is using the instrument validation technique literacy skills in which the assessment is done by a validator who has qualifications and experience in the field of science education.

RESULTS AND DISCUSSION

Science literacy is used to measure students' ability after the learning experience. This knowledge science literacy issue refers to indicators of knowledge with competency indicators of science literacy PISA 2015. The number of items as many as 15 questions in the form of multiple-choice questions. The formulation of knowledge indicators with competence indicators of science literacy PISA 2015 can be seen in **TABLE 1**.

TABLE 1. The Formulation of Knowledge Indicators with Competence Indicators of Science Literacy PISA 2015

No	PISA 2015 Scientific Competencies	Competency Indicators	Learning Indicators	Test indicator	No. Test
1.	Explain phenomena scientifically	Recall and apply appropriate scientific knowledge	Apply human effort to invite others in overcoming global warming	Given a number of options, students can apply human efforts to engage others in addressing global	1

No	PISA 2015 Scientific Competencies	Competency Indicators	Learning Indicators	Test indicator	No. Test
				warming	
		Identify, use and generate explanatory models and representations	Identify the sector of human activity and the percentage of greenhouse gas emissions generated	Presented in greenhouse gas percentage diagrams, students can identify the sector of human activity and the percentage of greenhouse gas emissions generated	2
		Make and justify appropriate predictions	Analyze the impact of global warming on ecosystems	Given a problem about the impact of global warming, students can analyze the impact of global warming on ecosystems	3
		Offer explanatory hypotheses	Identify the influence of the role of vegetation in overcoming global warming	Given an appropriate problem-formulation article, students can identify the influence of vegetation's role in overcoming global warming	4
		Explain the potential implications of scientific knowledge for society	Identify the causes of global warming	Presented images of global warming posters, students can identify the factors that cause global warming	5
2.	Evaluate and design scientific enquiry	Identify the question explored in a given scientific study	Identify ways to reduce the effects of global warming	Presented a percentage reduction diagram of CO ₂ gas from various sectors, students can identify ways to reduce the effects of global warming	6
		Distinguish questions that could be investigated scientifically	Determine the impact of global warming on the environment	Given 4 statements about the impact of global warming, students can determine the impact of global warming on the environment	7
		Propose a way of exploring a given question scientifically	Formulate measures to reduce the effects of global warming	Presented table of observations in different regions of Indonesia with different forest areas, students can formulate measures to reduce the effects of global warming	8
		Evaluate ways of exploring a given question scientifically	Linking the government's policy on how to tackle the waste problem to explain the 3R's relationship with global warming principles	Given a problem in the environment with garbage accumulation, students can link government policy ways to tackle waste issues to explain the 3R principle relationship with global warming	9

No	PISA 2015 Scientific Competencies	Competency Indicators	Learning Indicators	Test indicator	No. Test
		Describe and evaluate how scientists ensure the reliability of data, and the objectivity and generalisability of explanations	Identify the factors causing the gases that trigger global warming	Given a research result of activity that leads to global warming, students can identify the factors that cause the gases that trigger global warming	10
3.	Interpret data and evidence scientifically	Transform data from one representation to another	Determine the shape of the image about the causes of global warming	Presented image of the cause of global warming, students can determine the shape of the image about the causes of global warming	11
		Analyse and interpret data and draw appropriate SUMMARY	Analyze the process of greenhouse effect	Presented image of greenhouse effect process, students can analyze the process of greenhouse effect	12
		Identify the assumptions, evidence and reasoning in science-related texts	Predicting the rise in the earth's surface temperature over the next few years proposed by the IPCC	Presented graphs on the rise in surface temperature of the earth IPCC disclosed, students can predict the rise in surface temperature of the earth the next few years proposed by the IPCC	13
		Distinguish between arguments that are based on scientific evidence and theory and those based on other considerations	Distinguish between arguments based on scientific evidence and theories about earth temperature rise that affect weather and climate	Given a problem of climate and climate change, students can distinguish between arguments based on scientific evidence and theories about earth temperature rise that affect weather and climate	14
		Evaluate scientific arguments and evidence from different sources	Evaluating efforts in tackling global warming	Given a number of options, students can evaluate efforts to tackle appropriate global warming	15

Prior to the test, the knowledge about science literacy on global-based heating material Socio-scientific Issues (SSI) has been made validated by two lecturers of science and science teachers of science subjects. The purpose of this validation is to get a validity score and get suggestions and comments from the validators. Validator consists of three people, namely Dr. Elok Sudibyo, S.Pd., M.Pd., Dr. Harun Nasrudin, M.Si., and Asmaul Lutfauziah, S.Pd., M.Pd. The validation stage is done by filling the validation sheet with a rating scale of 1-4. The results of media validation can be seen in **TABLE 2**.

At the validation stage, there are several suggestions provided by the validator as the reference for further improvement. Judging from the validation result, got the score of each aspect that is validity from the realm of material got percentage equal to 94,44% with very proper category, validity from construction aspect got percentage equal to 93,33% with very proper category, and validity from sphere language got percentage equal to 91,66% with very decent category.

TABLE 2. The Result of Validation of Knowledge About Literacy of Science on Global Warming Material Based on Socio-scientifis Issues (SSI)

There some that need to	No	Component	Assessment			are things still be
			V1	V2	V3	
Matter Sphere						
	1	Item according to indicator	3	4	3	
	2	The content of the material matches the purpose of measurement	4	4	4	
	3	The content of the material in question according to the level, type of school, and grade level	4	4	4	
Total score			34			
Percentage			94,44%			
Construction Sphere						
	1	The subject matter (stem) is clearly defined	4	4	3	
	2	The subject matter does not contain double negative statements	4	4	4	
	3	If forced to use a negative word, it must be underlined, or printed otherwise	4	3	4	
	4	Discourse images or tables really works	3	4	4	
	5	The items are not dependent on each other	4	3	4	
Total score			56			
Percentage			93,33%			
Language Sphere						
	1	The formulation of a communicative sentence	4	3	3	
	2	Sentences using good and correct language and in accordance with the language	3	4	3	
	3	Formulation of sentences does not lead to multiple interpretations	4	3	4	
	4	Using language or a common verb (not local)	4	4	4	
	5	The formulation of the question does not contain words that offend students	4	4	4	
Total score			55			
Percentage			91,66%			
Average percentage overall			93,14%			
Category			Very decent			

addressed even though it is included in the category very proper and declared valid, as the suggestion from the validator. First, it is advisable to add an indicator about connecting the knowledge indicator with the question indicator. Second, it is advisable to check the relevance of the cognitive level of the problem with the taxonomy of bloom. Thirdly, it is advisable to check the discourse of the image to be synchronic and fully functional.

SUMMARY

Based on the results of the analysis and discussion can be concluded that the science of science literacy on the material of global warming based on Socio-scientifis Issues (SSI) worthy of the validity so that it can be used in the learning process.

SUGGESTION

Suggestions that can be put forward based on research that has been done temporarily is the need to validate by the experts about all research instruments that have been developed before doing research to obtain and collect data to determine the practicality and effectiveness of all learning devices in the classroom.

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