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The Relationship between Capability Dimension and Cognitive Dimension Ability of Grade VII Middle School Students

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Abstract. Data from PISA and TIMSS shows that the literacy ability of students in Indonesia is still lacking. Based on this, the literacy ability of junior high school students needs to be improved and measured. Scientific literacy assessment can be focused on two dimensions, namely the content dimension and the cognitive dimension. The purpose of this study was to determine the correlation between the dimensions of content and cognitive dimensions. This type of correlational research with the ability variable dimensions content (x) and cognitive dimension capabilities (y). The study involved 76 of VII grade students of a SMP (Junio High School) in Malang. Data were collected using a writing test. The results show (1) there is a positive relationship between the ability of the dimensions of content with the ability of the cognitive dimensions, (2) there is a positive relationship between the ability of the dimensions of content with the ability to: a) use knowledge or concepts in a meaningful way, b) identify problems, c) analyze and evaluate data or events, d) design investigations, e) use and manipulate tools.

INTRODUCTION

The Unesco Science Report states there are eleven important issues in science education policy, one of which is scientific literacy. The main purpose of science education is to create a young generation who are literate in science[1]. Indonesia's ranking from the PISA assessment (2000 to 2018) reflects the Indonesian education system which has not been able to facilitate the empowerment of students' scientific literacy.

The 2000 and 2003 PISA results ranked Indonesia 38. PISA results in 2006 Indonesia ranked 50. PISA results in 2009 Indonesia ranked 60. PISA results in 2012 Indonesia ranked 64. The 2015 PISA Results Indonesia ranked 69. PISA results in 2018 Indonesia ranked 62 out of 71 participating countries.

Science literacy is defined as (1) individual scientific knowledge and the ability to use that knowledge to identify problems, obtain new knowledge, explain scientific phenomena, and draw conclusions based on evidence related to science issues; (2) understanding the main characteristics of knowledge built from human and inquiry knowledge; (3) sensitive to how science and technology shape material, intellectual and cultural environments; (4) the willingness to be involved in issues and ideas related to science[6]. In 2006, PISA developed the domain of scientific literacy into four broad domains namely science content, science competencies/processes, science application contexts, and attitudes[4].

Teachers do not train students to solve problems using science concepts so students have difficulty in understanding abstract concepts. Science content refers to the key concepts of science needed to understand natural phenomena and the changes made to nature through human activities[7]. Science process refers to mental processes that involve an answer to a question or solve a problem, such as identifying and interpreting evidence and explaining conclusions. The context of the application of science, emphasizes more on everyday life and applies science in solving

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real problems. Attitudes, consisting of supporting scientific inquiry, self-confidence, interest in science and a sense of responsibility towards resources and the environment. The size of science content is specified as the subject matter or domain of the content to be assessed in science, and the cognitive measure is specified as the student's thought process that allows them to use to relate it to content. Each science question item is associated with one content domain and one cognitive domain. Based on this, it is necessary to conduct research related to the relationship between the ability of the content dimension and the cognitive dimensions of students. The purpose of this study was to determine the correlation between content dimensions and cognitive dimensions.

Previous studies that have been conducted on integrated science learning in junior high schools have found varied learning models from both teacher and subject aspects, which appear 3 types of Biology, Physics, and Chemistry subjects with 1 teacher or team teaching but not the actual teamteaching[8]. Furthermore, the results of other researchers' research also still find science learning that has not been integrated, there are still subjects with a variety, the science assessment system is still traditional yet authentic assessment[9]. In addition, other researchers also found that learning science in team teaching was effective in improving the thinking ability of junior high school students and the Triple Approach approach with integrated science material could improve the learning process and outcomes[10]. Other researchers also found that science learning and science teacher evaluation systems in junior high schools have not yet fully developed the ability to think, especially high-level thinking which is the ability needed in scientific literacy[11]. In general, junior high school science teachers do not understand very well the nature of scientific literacy[12].

MATERIALS AND METHODS

This research is a correlational study aiming to get a real picture of the relationship between the ability of the content dimension and the ability of the cognitive dimension. The study involved 76 students of a SMP (Junior High School) in Malang. Data were collected a writing test (multiple choice question). Linearity test, normality test, and Pearson product-moment correlation test were employed in this study.

RESULTS

Before being analyzed using Pearson Product Moment correlation, data were analyzed using linearity and normality tests. The results of the linearity test can be seen in Table 1.

TABLE 1. Linearity Test Results

			Sum of Squares	df	Mean Square	F	Sig
		(Combined)	37863.659	48	891.979	12.437	.000
	Between Groups	Linearity	34255.247	1	34255.247	533.547	.000
CAP* COG		Deviation from Linearity	3709.523	47	79.555	1.347	.224
	Within Groups		4234.799	66	64.553		
	Total		41987.359	123			

Table 1 shows that the significance value of Deviation from Linearity is 0.224> 0.05 so that the results of the study are normally distributed. After being tested for linearity, the data is then tested for normality. Data normality test results can be seen in Table 2 below.

TABLE 2. Normality Test Results

		Capability	Cognitive
N		124	124
Normal Parametersa,b	Mean	64.1995	47.5967
	Std. Deviation	15.41181	19.21521
	Absolute	.177	.178
Most Extreme Differences	Positive	.166	.178
	Negative	-.177	-.165
Kolmogorov-Smirnov Z		.817	.819
Asymp. Sig. (2-tailed)		.812	.797

Table 2 shows that the ability of the data dimensions of normal dimensions with a significance value of 0.812> 0.05 and the cognitive dimensions of capability data are also normally distributed with a significance value of 0.797> 0.05. Because the normal and linear assumptions have been fulfilled then it was proceed with the hypothesis test using Pearson Product Moment correlation analysis. The results of the Pearson Product Moment correlation analysis can be seen in Table 3.

TABLE 3. Pearson Product Moment Correlation Test Results

		Capability	**Cognitive**
Capability	Pearson Correlation	1	.900**
	Sig. (2-tailed)		.000
	N	124	124
Cognitive	Pearson Correlation	900**	1
	Sig. (2-tailed)	.000	
	N	124	124

Table 3 shows that there is a significant relationship between the ability of the dimensions of content with the ability of the cognitive dimensions with a significance value of 0.00 <0.05. This means that H_0 is rejected and the research hypothesis "there is a relationship between the ability of the dimension of content with the ability of the cognitive dimension" is accepted. Based on the results of the Pearson Correlation calculation it can be seen that the correlation coefficient is 0.900. This means that the relationship between the ability of the content dimension with the ability of the cognitive dimension is very strong.

DISCUSSION

The results of data analysis show (1) there is a positive relationship between the ability of the dimensions of content with the ability of cognitive dimensions, (2) there is a positive relationship between the ability of the dimensions of content with the ability to: a) use knowledge or concepts in a meaningful way, b) identify problems, c) analyse and evaluate data or events, d) design investigations, e) use and manipulate tools.

Learning in the classroom must be more innovative because most students have difficulty in applying their knowledge to everyday life because of the tendency of learning in class that does not link the content of lessons with everyday life. In accordance with Ausubel opinion that meaningful learning processes occur when a person is able to assimilate the knowledge, he already has with new knowledge[13].

Some students have a little difficulty when working on test questions, this is because students are not familiar with learning that emphasizes scientific literacy. Learners are also not accustomed to working on scientific literacy questions of the dimensions of content and cognitive dimensions associated with the concept of material that requires analytical skills to do it. Therefore, it takes the ability of the teacher to prepare learning in such a way, so as to explore and optimize the ability of scientific literacy in the dimensions and cognitive dimensions of students.

The ability of scientific literacy in the dimensions of content and cognitive dimensions is very important for students to have. Scientific literacy assessment is not only oriented to the mastery of scientific material, but also to the mastery of life skills, thinking abilities, and the ability to carry out scientific processes in real life[14].

Scientific literacy assessment can be focused on two dimensions, namely the dimensions of content and cognitive dimensions. The dimensions of content in scientific literacy include material contained in the curriculum and material that is cross-curriculum with an emphasis on understanding concepts and the ability to use them in life. The cognitive dimension includes several abilities in 1) using knowledge or concepts in a meaningful way, 2) identifying problems, 3) analysing and evaluating data or events, 4) designing investigations, 5) using and manipulating tools, materials or procedures; and 6) solving problems in order to understand the facts about nature and the changes that occur in life[15].

According to the understanding of PISA, an individual cannot be classified as someone who is "scientifically literate" or someone who is "scientifically illiterate", but in terms of the development of scientific literacy from "less developed" to "more developed". Students with less developed literacy skills are able to solve problems in simple and familiar situations, while students who have more developed literacy abilities are able to solve problems in complex and less familiar situations.

PISA science assessment is not a context assessment but assesses competence and knowledge in a particular context. The choice of this context, based on the knowledge and understanding that students might have at the age of fifteen. Sensitivity to linguistic and cultural differences is a priority in the development and selection of items, not

only in the interests of the validity of the assessment but also to respect differences in participating countries. In developing international tests, it is not possible to include differences in traditional and local knowledge about natural phenomena that exist between participating countries.

Text-oriented teachers will be more content-oriented and not spend a lot of time focusing on issues of science technology / Science technology society, personal needs, and career awareness. One of the causes of the low level of students' scientific literacy is alleged because the existing textbooks used so far emphasize the dimensions of content rather than the dimensions of the process and context as demanded by PISA.

The nature of science as a whole and the content of science is separated from the nature of science used by scientists to develop ideas and theories. The text part must not only contain Biology content but must also provide an opportunity for students to investigate on their own, understand the important role of Biology in our society, and describe the ways in which scientists work in developing their understanding of specific subjects.

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SUMMARY

The results of data analysis and hypothesis testing show (1) there is a positive relationship between the ability of the dimensions of content with the ability of the cognitive dimensions, (2) there is a positive relationship between the ability of the dimensions of content with the ability to: a) use knowledge or concepts in a meaningful way, b) identify problems, c) analyze and evaluate data or events, d) design investigations, e) use and manipulate tools.

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REFERENCES

1. P. J. Fensham, *Science Education Policy-Making: Eleven Emerging Issues,* (2018).
2. OECD, *Knowledge and Skills for Life First Result from PISA 2000*, (2001).
3. OECD, *Learning for Tomorrow's World First Result from PISA 2003*, (2004).
4. OECD, *Executive Summary PISA 2006: Science Competencies for Tomorrow's World*, (2007).
5. OECD, *PISA 2009 Results: What Students Know and Can Do - Student Performance in Reading, Mathematics and Science (Volume I),* (2010).
6. OECD, *PISA 2012 Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy,* (2013).
7. Suciati. *Identifikasi Kemampuan Peserta didik dalam Pembelajaran Biologi Ditinjau dari Aspek-aspek Literasi Sains*, (2013).
8. Y. Pantiwati, Jurnal Ilmu Pendidikan **18**, 236-243 (2012).
9. Y. Pantiwati. "*Profil Sistem Penilaian dalam Pembeljaran Biologi,"* in Prosiding Seminar Nasional Pendidikan Sains. Peran Sains dalam Abad 2 (Surabaya, 2013).
10. Y. Pantiwati, Journal of Education and Practice **5**, (2014).
11. Y. Pantiwati and Husamah, "*Pengelolaan Pembuatan Soal Berbasis Literasi Sains*," in Proceeding. 6t Paedagogy Seminar International, (UPI, USM, USAID Prioritas, Intitut Pendidikan Guru Kuala Lumpur. Bandung, 2015).
12. Y. Pantiwati, Journal of Education and Practice **8**, (2017).
13. R.W. Dahar. *Teori-teori Belajar dan Pembelajaran* (2011).
14. H. Firman. *Analisis Literasi Sains Berdasarkan Hasil PISA Nasional Tahun 2006* (2007).
15. A.R.Wulan, *Asesmen Literasi Sains* (Makalah team Hibah Pasca sarjana, 2009).