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Analysis of Biological Science Literacy a Program for International Student Assessment (PISA) Class IX Junior High School Students at Solok Town

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Abstract **–The Indonesian students' achievement of science literacy needs to develop, considering there is low degree of students' achievement of science literacy based on the research had done by PISA. This result shows that the Indonesian students achievement of science literacy was too apprehensive, and need a serious concern from sort of side. The score achievement of Indonesian students that in low degree reflects the Indonesian students' prestation in science is also in low degree. This research aims to analyze the students' achievement of science literacy at PISA Biology test at State Junior High School at Solok Town. This research is a descriptive quantitative research. The kind of this research is survey and the data taken did by test, questionnaire and interview with the student and teacher. The questions of used of the questions of Science Literacy PISA 2006 specially the Biology content that had already translated into Indonesian. The population in this research are all students of class IX in state junior high school in the city of Solok registered in the academic years 2016-2017.The sampling taken by using purposive sampling method. The research result show that the student, achievement of science literacy PISA in Biology subject at SMP Negeri 1 Kota Solok based on total score got very low degree that is 46,93%.**

Keywords **–Scientific Literacy, Biology, PISA.**

I. INTRODUCTION

Science is one of science that prioritizes the process of acquiring a knowledge and experience. Science education has great potential and strategic role in preparing quality human resources to face the era of industrialization and globalization. Suastra (2013: 2) states that science also produces products in the form of technology used by society in life. Between science, technology, and society have a very close relationship. Therefore the teaching of science in schools should not be directed solely to prepare students to continue education to a higher level, but the most important is preparing students to be able to solve problems encountered in everyday life using the concept of science that they have learned, capable make decisions appropriately using scientific concepts, able to anticipate the negative impacts of science and technology and be able to think anticipatively into the future.

Given that science education has an important role in preparing children to enter the world of their lives, science education must be able to produce capable students in their fields and succeed in fostering logical thinking, creative thinking, problem-solving skills, critical, technological and adaptive skills to change and development era. Chabalengula, et al., (2008: 211) states that through science, people can learn not only how to make decisions about the use of science and technology, but also to assess the application and effects of those findings. Thus the process of science education is expected to form a literate man of science (science literacy) and technology completely.

Literacy of science can be interpreted as an act of understanding science and applying it to the needs of society. Science literacy provides a concrete contribution to the formation of life skills. The National Research Council of the United States (1996 in Shwartz, et al., 2006: 207) also states that the achievement of science literacy by students is one of the main objectives of science education. This scientific

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literacy effort is considered important given the ability of Indonesian children aged 15 years in comparison with other children in the world is still relatively low, i.e. less than 50% of the scores set by the OECD (Organization for Economic Cooperation and Development) 2009: 110).

Given the importance of science Literacy due to its wide application in various fields, OECD member countries organize PISA (Program for International Student Assessment). PISA aims to monitor the results of educational systems related to the ability of 15-year-old students in reading literacy, mathematical literacy, and literacy science. In addition, PISA is designed to help the government not only to understand but also improve the effectiveness of the education system. PISA collects reliable information every three years. PISA findings are used, among others, to: (a) compare literacy of reading, math and science of students of a country with other participating countries; and (b) understand the strengths and weaknesses of each country's education system.

The involvement of Indonesia in this study is to look at the development of Indonesia's education program compared to other countries in the world so as to know the readiness of students facing international competition. Based on the results of PISA assessment in 2000, 2003, 2006, 2009 and 2012 the score of science literacy of Indonesian students aged 15 years is 393, 395, 395, 383, and 382 well below the average score of OECD member countries of 500. PISA results in 2012 also showed Indonesian students are still bottomed down, ranking 64 of 65 participating countries (OECD: 2014: 5). By 2015 the result of PISA assessment of Indonesian students is in position 69 of 76 participating countries (BBC News: 2015). This shows that the literacy ability of Indonesian children's science is very apprehensive and requires serious attention from various parties.

Given the increasing complexity of challenges and problems that young people will face in the future, science education is responsible for the achievement of science literacy of the nation's children. Thus the literacy of Indonesian children's science needs to be improved in quality (Liliasari, 2011: 4). Improving the quality of science education can be done through thinking science. Where science thinking can be developed through the ability of high-level thinking (expert thinking). This high level of thinking ability can be the foundation to shape the character of the nation. Where the character of a child of a nation who is capable of high-level thinking will not be easily fooled by issues that provoke conflict in the community.

As a part of science, science is defined as the knowledge gained through data collection by experimentation, observation, and deduction to produce an explanation of a reliable phenomenon. One of the subjects that are skilled in science is science, especially biology. Through the subjects Biology is expected students are able to develop the ability of analytical thinking inductive and deductive in solving problems related to natural events around. Students are said to be literate towards science or literate to science when able to apply concepts or facts obtained in school with natural phenomena that occur in everyday life. The science literacy is important for students to master in relation to how students can understand the environment, health, economics and other issues faced by modern societies that rely heavily on technology and the advancement and development of science. Literacy of science is considered a key learning outcome in education at the age of 15 for all students whether to continue learning science or not afterwards. This encourages the study of the analysis of biological views on the process of thinking that became one of the learning missions of science (Rustaman, 2005: 76).

Factors that cause low literacy of Indonesian students' science are not yet trained students in solving problems in PISA that involves context in each item, personal, social and global context (Rohayati, 2011: 67). In addition, the evaluation provided by the teacher has not led the students to think high level like the characteristics of the PISA problem. For that students need to get used to do the questions with the characteristics of PISA problems. With the frequent students working on the PISA questions, it is expected that the results of students' science literacy will also increase. In addition to the above factors, students 'interest in science also influences the low achievement of students' science literacy, students who achievement of high science literacy also have a high interest in science (Ekohariadi, 2009: 37).

II. THEORETICAL REVIEW

2.1 Science Literacy

Literally literacy comes from the word "literacy" which means literacy or literacy prevention movement. While the word science comes from the word "science" which means science or "scientific" which means scientific (Echols and Shadily, 1990: 361). So science literacy can be interpreted as science literate or scientific literate. The term literacy of science or literacy was first introduced by Paul de Hurt of Stanford University. Hurt defines science literacy as an act of understanding science and applying it to the needs of society.

National Science Education Standard (1996: 12) states "scientific literacy is knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity". Based on the above understanding, the emphasis of scientific literacy is not on the mastery of knowledge and understanding of the concepts and processes of science, but rather directed towards allowing a person to make a decision and engage in community life based on his knowledge and understanding of science.

Literacy of science according to PISA is defined as "the capacity to use scientific knowledge, to identify questions and to draw evidence based on conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity". This definition of scientific literacy involves viewing scientific literature as multidimensional, not just an understanding of science knowledge, but more than that. PISA also assesses students' understanding of the characteristics of science as a scientific inquiry, awareness of how science and technology shape the material, intellectual and cultural environment, and the desire to engage in issues related to science, as reflective human beings (OECD, 2006: 20).

Literacy of science is considered a key learning outcome in education at the age of 15 for all students, whether to continue studying science or not afterwards. Scientific thinking is a demand of citizens, not just scientists. The inclusiveness of science literacy as a general competence for life reflects a growing trend in scientific and technological questions (Rustaman, 2006: 6).The science literacy in science education is to develop the ability to creatively utilize knowledge and skills in accordance with scientific evidence and scientific processes, especially with relevance in everyday life and career, not only solving personal challenges but also significant scientific problems as well as making social decisions scientifically responsible (Holbrook and Rainnikmae, 2009: 278).

People who have scientific literacy have a better chance to engage in the productive career of the world of work and the global community. This is because of his ability in applying scientific work, critical thinking and able to make decisions responsible for decisions made (Yuenyong and Narjaikaew, 2009: 337).

Literacy of science is the ability to use science knowledge to identify problems and draw conclusions based on evidence in order to understand and make decisions about nature and changes made to nature through human activities (OECD, 2006). Durant (1987, in Zuriyani, 2011: 5) suggests that knowledge commonly associated with science literacy is understanding natural science, norms, and methods of science and scientific knowledge, understanding key scientific concepts, understanding how science and technology in society, competence in the context of science, the ability to read, write, apply some scientific knowledge and the ability to consider in everyday life.

2.2 Science Literacy Assessment.

PISA is a study of international student assessment programs organized by the Organization for Economic Cooperation and Development (OECD). PISA aims to assess the extent to which students sitting at the end of the year of primary education (15-year-olds) have mastered the knowledge and skills necessary to participate as citizens or members of a developing and responsible society. Matters assessed in the PISA study include mathematical literacy, literacy reading, science literacy, and financial literacy.

The PISA Assessment is an assessment with a matter tested using the PISA or equivalent or similar PISA equivalent of customs, culture and nature of a country. According to Stacey (2010: 2) PISA is an international literacy study in reading literacy, mathematics literacy, problem solving (literacy), and science literacy and the latest is financial literacy. Indonesia itself has joined PISA since 2000.

According to Hayat and Yusuf (2010: 30) PISA assessment can be distinguished from other assessments in terms of the following mentioned (1) PISA-oriented policy design and assessment methods and reporting tailored to the needs of each participating PISA countries to easily withdraw the lesson of policy which has been made by the participating countries through comparison of the data provided; (2) PISA uses an innovative literacy approach, a concept of learning related to the capacity of students to apply knowledge and skills in key subjects with the ability to analyze, reason and communicate effectively, and solve and interpret problems in various situations; (3) The concept of learning in PISA relates to the concept of lifelong learning, which is the concept of learning that is not limited to the assessment of student competence in accordance with curriculum and cross-curriculum concepts, but also the learning motivation, their own concepts, and applied learning strategies; (4) Implementation of regular PISA assessments over a period of time allowing participating countries to

monitor their progress in accordance with predetermined learning objectives.

The purpose of PISA is to assess students' ability to solve real problems, the strategies used to determine the range of content to be assessed, i.e. using a phenomenological approach to describe concepts, structures, or mathematical ideas. This means the content is related to the phenomenon and the type of problem occurring.

III. METHODS

The research method used in this research is descriptive quantitative. In this study, researchers did not give special treatment to the samples used so that it does not require the control class or experimental class. This descriptive research aims to analyze the literacy ability of science students of State Junior High School class IX at Solok Town on biological content through science literacy questions PISA 2006.

The PISA 2006 science literacy problem used contains 13 themes (40 items). This matter is adapted to the material that has been studied by students during junior high school and has been adapted to the applicable curriculum, as illustrated in table 1.

Table 1. Mapping of PISA Science Literacy Problem 2006 On Biology Content Based on Curriculum 2013.

No	Unit	Amount Question	Class	Semester
1	Biodiversity	2	VII	2
2	Cloning	5	X	1
3	Antibiotics	4	VII	2
4	Insecticide Resistance	2	IX	2
5	Cloning Cow Children	2	X	1
6	Environmental Pollution	2	X	1
7	Bacteria	3	X	1
8	Virus	2	X	1
9	Organ System	2	VIII	1
10	Fermentation	2	IX	2
11	Organ and Transplant System	2	IX	2
12	Vaccinations	3	X	1
13	Greenhouse effect	3	X	2

The type of this research is surveys and data collection conducted by way of tests, questionnaires, and interviews with students and teachers. This research was conducted in all State Junior High School in Solok City which amounted to six schools namely, State Junior High School 1 at Solok Town, State Junior High School 2 at Solok Town, State Junior High School 3 at Solok Town, State Junior High School 4 at Solok Town, State Junior High School 5 at Solok Town and State Junior High School 6 at Solok Town.

The population in this study is all students of class IX in Junior High School (SMP Negeri) in Solok Town registered in the Lesson Year 2016/2017. Sample selection method in this study is Purposive Random Sampling. Samples taken to be members of the sample are certain individuals who have characteristics or traits that fit the entire population and are taken at random (Netra, 1974: 15). The test was followed by 161 students, 88 women and 73 men.

In order for the data to represent all the characteristics of junior high school students of class IX, then each class is chosen randomly from each school. If a school does not have a superior locale in terms of its homogeneous population, then the class is chosen at random. If the population is not homogeneous in the sense that the school has a superior locale then the sampling is done by selecting samples from each class until the students collect as many as 25 people, students are taken the students who have high ability, moderate and low. Of the six sample schools, only Junior High School 1 at Solok Town has a superior locale and the sample is taken from representatives of each class of 3 students.

IV. RESULT

The results of the research discussed in this study are the achievement of student science literacy per unit of questions and based on total score.

1.1. Unit Question

The percentage of students' science literacy on the PISA biology test of SMP Negeri in Kota Solok based on the unit of problem can be seen in Table 2.

From Table 2 it can be seen that of the 40 units tested by schools that received the highest percentage of highest average was State Junior High School 1at Solok Town and the school that got the lowest average percentage was State Junior High School 6 at Solok Town. Students of State Junior High School 1 at Solok Town were able to complete 19 units of questions with better results from the other five school students and State Junior High School 1 at Solok Town students completed 16 units of problems with lower results than the other five school students.

The percentage of students' science literacy scores on the PISA biology tests of State Junior High School at Solok

Town based on the overall problem unit can be seen in Figure 1.

Table 2. Percentage of Science Literacy of Students at the PISA Biology Test of State Junior High School at Solok Town Based on Unit Problem.

Unit Question	School Name					
	SMPN 1	SMPN 2	SMPN 3	SMPN 4	SMPN 5	SMPN 6
1.1	79,31	**96,88**	91,67	*66,67*	*66,67*	84
1.2	65,52	*6,25*	33,33	55,56	58,33	**72**
2.1	41,38	*3,13*	20,83	29,63	**41,67**	32
2.2	44,83	**100**	54,17	62,96	*16,67*	56
2.3	*37,93*	40,63	45,83	**61,11**	54,17	46
2.4	67,24	68,75	66,67	61,11	**70,83**	*60*
2.5	**51,72**	*0*	25	16,67	31,25	22
3.1	**27,59**	6,25	8,33	7,41	8,33	*4*
3.2	**86,21**	62,5	58,33	59,26	*50*	64
3.3	**86,21**	59,38	*45,83*	59,26	75	48
3.4	**62,07**	*15,63*	29,17	14,81	25	36
4.1	20,69	**23,44**	6,25	14,81	8,33	*4*
4.2	**17,24**	*0*	6,25	1,85	*0*	*0*
5.1	**25,86**	*3,13*	12,5	20,37	20,83	8
5.2	39,08	**53,13**	41,67	34,57	34,72	*32*
6.1	50	**67,19**	*25*	48,15	29,17	28
6.2	**62,07**	*25*	29,17	48,15	58,33	32
6.3	**93,1**	84,38	66,67	72,22	87,5	*66*
6.4	**88,51**	72,92	79,17	74,07	73,61	*54,67*
7.1	**65,52**	59,38	41,67	48,15	*37,5*	44
7.2	34,48	*25*	37,5	40,74	**45,83**	44
7.3	75,86	75	47,92	51,85	**77,08**	*48*
8.1	51,72	*0*	**62,5**	51,85	50	32
8.2	**81,61**	71,88	63,89	54,32	73,61	*53,33*
8.3	71,26	**72,92**	69,44	61,73	68,06	*49,33*
9.1	34,48	28,13	37,5	18,52	**41,67**	*28*
9.2	91,95	78,13	70,83	81,48	**94,44**	*66,67*
9.3	48,28	15,63	37,5	37,04	**58,33**	*12*
9.4	**67,82**	63,54	*37,5*	39,51	51,39	40
10	*13,79*	18,75	33,33	**37,04**	16,67	16
11.1	**74,71**	56,25	68,06	54,32	70,83	*50,67*
11.2	**87,93**	62,5	50	55,56	75	*32*
11.3	75,86	**78,13**	41,67	51,85	70,83	*36*
11.4	56,32	*31,25*	50	34,57	**63,89**	37,33
12.1	**100**	71,88	75	66,67	79,17	*52*
12.2	65,52	**65,63**	54,17	48,15	75	*44*
12.3	**72,41**	59,38	29,17	*25,93*	66,67	32
13.1	**82,76**	18,75	20,83	9,26	33,33	*8*
13.2	**53,45**	15,63	4,17	*3,7*	16,67	4
13.3	2	**8,62**	*0*	*0*	4,17	*0*
Max	19	9	1	2	8	1
Min	2	8	3	4	3	16

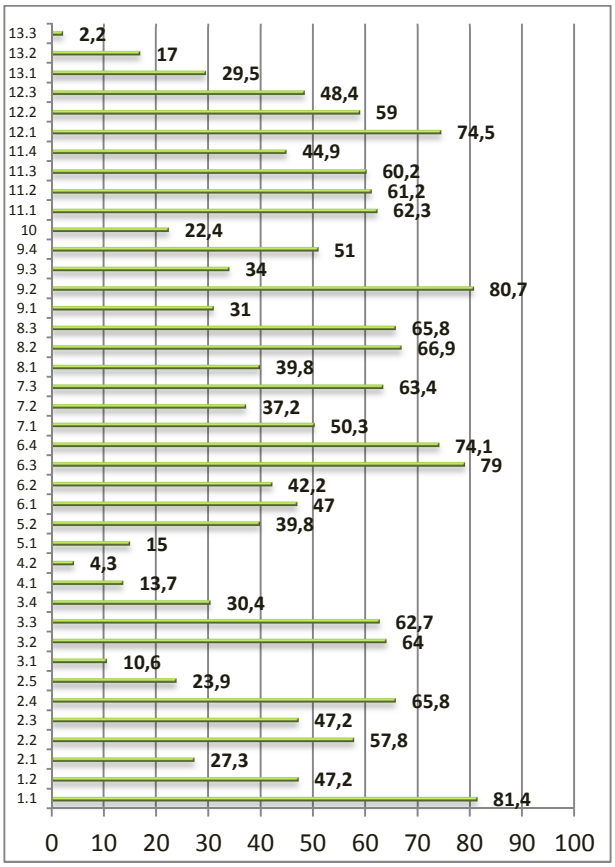

Figure 1. Scientific Literacy Score Percentage Score Students at the PISA Biology Test State Junior High School at Solok Town Based Unit Problem.

From Figure 1 it can be seen that the highest percentage achieved from the entire sample for each unit of question is a matter with the theme of Biodiversity on unit number 1.1 with a percentage achievement of 81.4%. Problem number 1.1 is a matter with an objective format, which questions the scientific phenomenon that may occur in a food chain if one of its food chains is cut off. This question asks students to analyze the possible occurrences of the food webs A and B if one of the components of the feeding chain is dead or missing. Overall, students in each school were able to answer the question, marked by the percentage of students who answered the problem high that is 81.4%. This is because the theme of Biodiversity has been learned by students in the class. In addition to that problem has provided narration and images that support students' reasoning to answer this matter.

The hardest problem with this test is 13.3 which is a matter of themed Greenhouse Effect (Global Warming and Carbon Emissions) with the format of description, including into scientific competence explaining the phenomenon scientifically. This issue tells about the increase in earth

temperature caused by the increase of carbon dioxide gas emissions, the conclusion was put forward by Andre. The conclusion is questioned by Jenne, Jenne considers there are other factors that affect the Greenhouse Effect apart from carbon dioxide gas emissions. Another factor other than the carbon dioxide gas emissions is what is being asked to be explained in this issue. Overall, the average student in each school found it difficult to answer the question, marked by the percentage of students who answered the question was low, i.e. 2.2%. Problems have been provided narratives and images that support the reasoning of students to answer this problem, this problem requires high-level reasoning to answer it, this is one reason why students difficulty answer it, many students who empty the answer sheet caused by insufficient time and students say already tried to answer the problem, so for this last question is not solved well by the students. The average of all schools get very low percentage that is below 10% even there are 3 schools that percentage 0.

The next question that has the lowest score is a matter of unit number 4.2, is a matter of essay format themed insecticide resistance (flies immunity and pest control) including into scientific competence explain the phenomenon scientifically. Very few students are able to work on this problem, the overall percentage of average students who answered the question is very low that is equal to 4.3%, even three schools not one student is able to answer this problem.

In this case students are required to bring up the reason of the problem raised is, why insecticides have decreased in killing flies. Students' answers are directed at flies resistance to insecticides and improper spraying by farmers. In this problem students are required to think more deeply when answering the matter, this question also requires high-level reasoning. This is what causes students have difficulty to answer it.

1.2. Total Score

Analysis of test results describes the results of science literacy achievement of State Junior High School at Solok Town. The assessment of literacy achievement of science is not only a measurement of the level of understanding of science knowledge, but also the understanding of various aspects of the science process and the ability to apply knowledge in everyday life.

The percentage of students' science literacy on the PISA biology test of State Junior High School at Solok Town based on total score can be seen in Table 3.

Table 3. Total Scores of Literacy of Student Science On PISA Biology Test of State Junior High School at Solok Town.

No	School	Score Average	Percentage	Criteria
1	State Junior High School 1 at Solok Town	43,62	60,58	Medium
2	State Junior High School 2 at Solok Town	33,41	46,40	Low Once
3	State Junior High School 3 at Solok Town	31,25	43,40	Low Once
4	State Junior High School 4 at Solok Town	30,59	42,49	Low Once
5	State Junior High School 5 at Solok Town	37,29	51,79	Medium
6	State Junior High School 6 at Solok Town	26,56	36,89	Low Once
	Average	33,79	46,93	Low Once

Evaluate (From table 3 it can be seen that the category of research results show the achievement of science literacy PISA biology of students of SMP Negeri Kota Solok very low. Purwanto (2009: 40), student science literacy is categorized as very good or high with achievement of 86-100%, categorized either with achievement of 76-85%, categorized enough or moderate with achievement of 60-75%, categorized less or low with achievement 55 -59% and categorized very low with achievements below 54%. The results obtained by junior high school students in Solok are 46.93%. The score indicates the low ability of students in answering about the science literacy of PISA biology.

According to students about the science literacy of PISA biology is difficult to do, the difficulties felt by students due to the low reasoning that students have. The low reasoning of students makes the students cannot think critically in solving the given problem. Based on the results of research and data analysis was the achievement of students on the competence aspects of science, themes and format questions are still low than expected.

V. DISCUSSION

The low literacy result of PISA biology of students is caused by the low reasoning and high-order thinking ability of the students. Though it is one of the demands in the

Competency Standards Graduation (SKL). It is in accordance with BSNP (2006: 351) in SKL SMP aspects of science and technology mentioned that at the level of educational unit, students are expected to: (a) seek and apply logically, critically and creatively; (b) demonstrate the ability to think logically, critically and innovatively; (c) demonstrate the ability to learn independently according to the potential possessed; (d) show the ability to analyze and solve problems in everyday life. It proves that high-order thinking is important in the junior high school level.

The low ability of students thinking is caused by teachers and students themselves. Teachers have not yet attempted to develop students' abilities by providing questions that require students to think at a high level. This resulted in students feeling awkward when faced with a biological science literacy test given PISA. The test consists of questions that are different from the usual problems that teachers provide in the evaluation of the learning process.

In addition, the low literacy results of PISA biology of students are also influenced by the students' own habits. Habits of students who are lazy to read and memorize the lesson when going to the exam. The habits of students who memorize the lessons make the students do not understand a material and cannot apply it to everyday life, whereas according to BSNP (2006: 452) one of the objectives of biology learning is to apply the concepts and principles of biology to produce works related to human needs.

Based on the factors that influence the achievement of biology science literacy students can be made efforts to increase the literature of biological science that is, cultivate students' interest in biology by way of understanding to the students that the biology lessons are directly related to the student's self and the student's daily life, so that many benefits obtained by students if they know a lot about biology, familiarize students with problems such as on the science literacy test of PISA biology. Problems that require analysis and reasoning in answering, so that analytical skills, high-level thinking and student reasoning continue to grow, increase reading interest by providing students with discourse and drawings. Teachers use different forms of questions to evaluate learning and train teachers to be accustomed to making high-level thinking-oriented test questions and requiring reasoning in answering them.

Based on the above, it can be interpreted that many factors influence the achievement of students' biology literacy. According Ekohariadi (2009: 37), high-low literacy science students are also influenced by the background, interest, intensity of learning and attitudes of students to science. In addition, learning done in schools also affects the level of student science literacy. One of the causes of the low achievement of Indonesian science literacy is due to the lack of learning involving scientific processes such as formulating scientific questions in the investigation, using the knowledge it possesses to explain natural phenomena as well as drawing inferences based on facts obtained through investigation (Word 2007: 3).

Many efforts can be made to improve the achievement of students' biology literacy. According Sudiatmika (2010: 6) one of the ways done to change the learning outcome is to increase motivation and change learning habits. According to Rahayu (2014: 17), the 2013 curriculum gives hope in education in Indonesia to realize a science-oriented society, where the learning model used does not require students to memorize only the material but emphasizes the understanding. According to Wenning (2007: 94), there are important principles that must exist in a learning that aims to train the ability of science literacy in students. These principles are: (a) Making learning more conceptual, so students are able to integrate concepts with everyday life. Once students understand the concept, students are led to see applications of concepts that have been learned in everyday life; (b) In order for students to be more motivated in learning, teachers should be able to provide interactive learning; (c) Make learning more conceptual, students are always exposed to the latest information and events that occur with regard to learned concepts; (d) Make the topic studied has something to do with the social issues that are being discussed; (e) Students are invited to understand the topics in more depth so that students really understand from concept to application on the topic in everyday life.

VI. CONCLUSION

Based on the result of the whole discussion, it can be concluded that the mastery of science literacy of junior high school students in Solok city is "very low". The results obtained by junior high school students in Solok are 46.93%. The score indicates the low ability of students in answering about the science literacy of PISA biology.

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