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Abstract. Science literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence, in order to understand and make decisions regarding the nature and make the changes to the nature through human activities. This study aims to determine the ability level of biology science literacy of JuniorHighSchool students in South Sulawesi, Indonesia. This research is a survey with the sample of researchchoosed by progressive random sampling with stratification. The sample of this research was third grade of students at junior high school, i.e. SMP 6 Makassar, SMP 26 Makassar, SMPN 4 Sinjai and SMPN 2 Maroswith total students, 220 students. The instrument used to measure the ability of students' biology science literacy was the multiple choice questions consisting of 13 numbers with indicators of scientific literacy, namely: (1) identifying valid scientific opinions; (2) searching for effective literature searches; (3) understanding the elements of research design and how they affect the findings/conclusions; (4) making a precise graph of the data; (5) solving problems using quantitative skills, including basic statistics; (6) understanding and interpreting basic statistics; (7) making inference, prediction and conclusion based on quantitative data. The research data were analyzed descriptively. The results showed that from 220 students, there were no students had a score of biology science literacy in either good or excellent category. The data obtained 25.45% are in the poor category and 74% are in the failure category. It means that teachers need to apply a learning model that can improve students' scientific literacy skills as one of 21st century skills.

Keywords: Science literacy, biology teaching, 21st century skills

1. Introduction

Science literacy is the ability to use scientific knowledge, identify questions, and draw conclusions based on the evidence, in order to understand and make decisions regarding the nature and make changes to nature through human activities [1]. Literacy ability is a fundamentally needed by students in facing the global era to be able to meet the needs of life in various situations. Science literacy is the ability to understand science, communicate science, and apply the ability of science to solve problems. The effort to improve the ability of scientific literacy, and moreover to enhancing students' motivation, teachers also need to consider learning strategies that fitted with the conditions and

potential of students which focuses on providing direct experience and the application of the science nature during learning process [2].

According to Zuriyani (2013) in [3], the reasons of the importance of the scientific literacy for students, namely: (1) understanding of science offers fulfillment of personal needs, can be shared with anyone; and (2) countries in the world are faced with questions in their lives that require scientific information and scientific thinking to make decisions and the interests of many people that need to be informed, such as air, water and forests.

Science literacy and critical thinking are key components of science education that aims to prepare future generations to function as citizens who are responsible for the world progress influenced by science and technology and to understand their impact. Science literacy is the main goal of scientific education. The purpose of science literacy education is to build a society that is scientifically literate, people who understand science and its relationship with social problems. Thus, the importance is not only the mastery of scientific concepts but also the ability to think. Scientific literacy involves a lot of thought and uses scientific methods to identify and overcome social problems [4].

Chiapettain [5] suggested that, scientific literacy are characterized by four categories, namely: 1) science as the body of knowledge; 2) science as the investigative of nature; 3) science as a way of thinking; 4) interaction of science, environment, technology, and society. Science literacy not only able to change learning goals which initially only reach the knowledge aspect (cognitive), attitude (affective) and skills (psychomotor), but rather to the application of these three goals (cognitive, affective, and psychomotor) in daily life, so that what is learned has a usefulness, both for oneself, others, and society. Swartz, et al. (2006) in [5] stated that in the concept of scientific literacy students can develop an understanding of what is learned into a conceptual scheme and connect between these schemes with their general understanding, procedural abilities, and the use of technology are also included in scientific literacy.

Gormally et al. (2012) in [6] suggested that seven indicators of scientific literacy, namely: (1) identifying valid scientific opinions; (2) searching for effective literature searches; (3) understanding the elements of research design and how they affect the findings/conclusions; (4) making a precise graph of the data; (5) solving problems using quantitative skills, including basic statistics; (6) understanding and interpreting basic statistics; (7) making inference, prediction and conclusion based on quantitative data.

Generally, scientific literacy is divided into 3 dimensions, namely scientific concepts, scientific situations and scientific processes. Dimensions of scientific concepts are needed to understand natural phenomenons and natural changes due to human activities. The assessment of scientific concepts was choosen from three fields of application, namely life and health sciences, earth and environmental sciences and technology science. Then scientific processes, centered on the ability to obtain, interpret and act on evidence. While scientific situations that emphasize people's daily lifes and not from the practice of science in school or laboratory classes, or the work of professional scientists [7] .

Assessed from the learning point of view, according to [7] there are two things that need to be considered in science literacy based learning, firstly learning scientific literacy must have an impact on students about why it is necessary or important to learn science. This will build students' perceptions about the usefulness, meaningfulness, needs, and importance of learning science. The second point of view is to build student motivation and participation in learning science, so students want to act and learn, therefore it is necessary to create a comprehensive science learning situation referring to the ideas and ideas of scientific literacy.

Science literacy is a 21st century life skill. Science literacy is a skill to live in an era where scientific knowledge is the basic of everyday life. Science literacy views the importance of thinking and acting skills which involves mastering thinking and using scientific thinking in recognizing and responding to social issues. Science literacy develops in line with the development of life skills, namely the need for reasoning and scientific thinking skills in social contexts and emphasizes that scientific literacy is intended for all people, not only those who choose a career in science and technology [4] .

The ability of scientific literacy of Indonesian students is still low. This condition was proven by the results of research conducted by PISA (Program for International Student Assessment) organized by the OECD (Organization for Economic Cooperation and Development) in 2006 the scientific literacy ability of Indonesian students was at the 50th level of 57 countries [8] then in 2009 Indonesia was ranked 60th out of 65 countries, in 2012 Indonesia was ranked 64th out of 65 countries, and the most recent PISA results namely 2015 Indonesian students ranked 69th out of 79 countries.

In the reform of science education, [9] stated that there were two views about literacy in science, namely science literacy and scientific literacy. Science literacy assumes that the main component of scientific literacy is an understanding of the basic concepts of science. Scientific literacy, seen as thinking and acting skills that involves mastering thinking and using scientific thinking in identifying and overcoming social problems. Therefore, it is natural that scientific literacy grows in line with the development of life skills, namely the need for scientific reasoning and thinking skills in a social context and emphasizes that scientific literacy is aimed at everyone, not just those who choose a career in science and technology.

As biology have been developing, demands for the ability to master biological literacy are increasing. Biological literacy is the development of scientific literacy in a biological context. Biological literacy is the ability to use scientific inquiry to understand and recognize biological problems in society and integrate these ideas into decision making and communicating results to others. In other words, biological literacy focuses on the use of key concepts in biology to make decisions in solving problems through scientific inquiry [4] .

The results of discussions conducted by the IPN (InstitütfürPädagogik der Naturwiscenschaft) German Kiel in [10] produce what should be and can be expected from the concept of scientific literacy. One of the conclusions of this discussion is the schematic model, as shown in Figure 1, which indicates that scientific literacy should contain various competencies, one of which is subject matter. Subject matter, however important as part of scientific literacy, is only one part and not the whole.

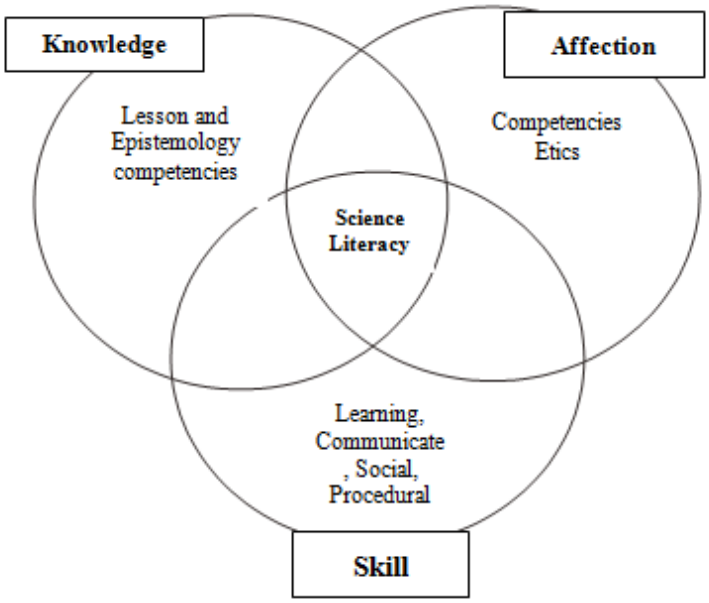

Figure 1. Schematic Model Indicating that Science Literacy Contains Various Competencies

The indicators of inquiry competence of science literacy issued according to [4] in Table 1 as follows.

Table 1. Indicators of Science Literacy

No	Scientific Competences of Science Literacy	Indicators
1	Identifying scientific issues (problems)	1. Identify valid scientific opinions (e.g. opinions / theories to support hypotheses) 2. Carry out effective literature searches (e.g. evaluating source validity and distinguishing between types of sources) 3. Understand the elements in research design 4. Accurate data analysis
2	Explaining scientific phenomena	1. Develop accurate charts based on relevant data 2. Solve problems using quantitative skills, including basic statistics (eg calculating average, probability, percentage, frequency) 3. Understand and interpret the results of statistical analysis
3	Using scientific evidence	1. Draw inferences and make predictions based on quantitative data 2. Evaluate scientific information

2. Methods

This research design was a survey research by collecting quantitative data, adding data using scientific literacy-based test instruments and then analyzing the data to describe trends about the answers to research questions. This procedure also interprets the meaning of the data obtained. The samples of research was a progressive random sampling with stratification which was a sampling technique with consider to a level on the population element.

Researchers conducted research in 3 districts in South Sulawesi, Indonesia: Makassar, Sinjai and Maros. The selected schools are schools that implement the 2013 curriculum. The selected schools were SMPN 6 Makassar, SMPN 26 Makassar, SMPN 2 Maros, and SMPN 4 Sinjai. The subjects of this study were 220 students in four schools. Students are chosen randomly. Each of these schools represented the upper grade, medium grade, and lower grade schools in South Sulawesi.

The instrument used in this study is scientific literacy test which consists of 13 numbers of essay test that have been validated by experts, referring to scientific literacy indicators: (1) identifying valid scientific opinions; (2) searching for effective literature; (3) understanding the elements of research design and how they affect the findings/conclusions; (4) making graph of the dataprecisely; (5) solving problems using quantitative skills, including basic statistics; (6) understanding and interpreting basic statistics; (7) making inferences, predictions, and conclusions based on quantitative data. Each student's answers are grouped and given percentage to see the level of scientific literacy based on existing indicators. While students worked for the tests, students was conditioned by each teachers of school for not doing cheating. After obtaining student's score, the scores are grouped according to the criteria of learning outcome by Arikunto (2007): 80-100 (very good), 66-79 (good), 56-65 (enough), 40-55 (poor), < 39 (failed).

3. Results and discussions

The results of analysistowards 220 students's responseswhich are the subject of this study, can be seen in the Table 2.

Table 2. Science Literacy Scores of Students at SMPN 26 Makassar

Score Interval	Category	Student's amount	Percentage
80 – 100	Very good	0	0%
60-79	Good	0	0%
56-65	Enough	0	0%
40-55	Poor	7	13%
< 39	Failed	46	86%
Total		53	

Based on Table 2 above, it was seen that the student scoreof SMPN 26 Makassar with total samples are 53 students that the majority of student score is in the failure category (86%) and the poor category (13%). While the category of Very Good, Good, and Enough, there are no students in this category. This figure is very alarming because SMPN 26 Makassar is one of the schools in big cities with medium criteria although not as a favorite school. This figure confirms that learning in schools still cannot improve students' ability to apply concepts in solving task or problem. This figure shows the very low scientific literacy ability of SMPN 26 Makassar. The findings of this study are inherently with the results of the PISA research in 2000 and 2003 which showing that the literacy of Indonesian students is allegedly only at the stage of remembering scientific knowledge based on simple facts [11].

Table3.Student score at SMPN 6 Makassar

Score interval	Category	Student's Amount	Percentage
80 – 100	Very Good	0	0%
60-79	Good	0	0%
56-65	Enough	0	0%
40-55	Poor	27	39%
30 – 39	Failed	41	60,29%
Total		68	

Table 3 shows that the student's score of SMPN 6 Makassar is quite alarming results. The contrast is very distinct because the acquisition of students score are only in the poorcategory, which is 39% and the failure category is 60.29%. These results are not too different from those obtained at SMPN 26 Makassar. However, the acquisition of student at SMPN 6 Makassar is better because of the percentage of students in the failure category is not as much as in SMPN 26 Makassar. This makes sense due to SMPN 6 Makassar status asfavorite school in Makassar. But even so, the acquisition score are still very low. This figure also confirms that the learning process implemented in schools has not been effective in improving students' scientific literacy abilities.

Table 4 shows the score of students' answers at SMPN 2 Maros. The data obtained is also very alarming. The result shows 88% of students in the failure category and only 11% in the poorcategory. The rest of it are nothing in the category of very good, good and enough. This value indicates that the learning process at SMPN 2 Maros has not been effective in improving students' scientific literacy skills. As has been stated by [12] that the traditional learning model, in memorizing this is not effective, and there must be an effective development of learning methods to help students stop learning by memorizing and starting meaningful learning.

Table 4. Student's score at SMPN 2 Maros

Score Interval	Category	Student's Amount	Percentage
80 – 100	Very Good	0	0%
60-79	Good	0	0%
56-65	Enough	0	0%
40-55	Poor	7	11%
30 – 39	Failed	53	88%
Total		60	

Table 5. Student score at SMPN 4 Sinjai

Score Interval	Category	Student's Amount	Percentage
80 - 100	Very Good	0	0%
60-79	Good	0	0%
56-65	Enough	1	0,02%
40-55	Poor	15	38%
30 – 39	Failed	23	58%
Total		39	

Table 5 showed the acquisition scores of studentsanswer of SMPN 4 Sinjai, mostlydistributed in the failure category (58%) and the poor category (38%). This number reiterates that the learning process that occurs in schools has not been effective in improving students' scientific literacy abilities. For this reason, it is necessary to apply more creative learning methods or models to support the improvement of scientific literacy skills.

Table 6.Cumulative student scorefrom four school

Score Interval	Category	Student's Amount	Percentage
80 - 100	Very Good	0	0%
60-79	Good	0	0%
56-65	Enough	1	0.45%
40-55	Poor	56	25.45%
30 – 39	Failed	163	74%
Total		220	

Table 6 shows the acquisition of overall student scores from four schools. Generally, it seems that the failure category still dominates with 74% and less with 25% in poor category.For the very good and good category, there are no students who reach this category. Ingeneral, it can be said that the learning process applied in schools has not been effective in improving students' scientific literacy skills.

According to [13] when we looked facts of students in Indonesia, they are tend to be very good at memorizing but are less skilled in applying the knowledge they have. This is also because it is familiarized by the teacher. [14] asserts that this may be related to the tendency of using rote learning to master knowledge, not the ability to think. It seems that science education in Indonesia more

emphasis on abstract concepts and less develops active experiments, while in fact they should be proportionally balanced.

According to [15] science learning conducted by teachers should be like scientists. Scientists work systematically, diligently, thoroughly and highlydiscipline with scientific methods such as those developed by Bacon. The way of learning science using process skills will bring students closer to a more complete learning experience and not get caught up in rote learning. Operationally, scientific education in learning that emphasizes process skills, includes activities: observing, classifying, interpreting, estimating, asking questions, and identifying variables. With this learning mechanism students in learning will "find" the knowledge by themselves.

The teacher should not be calm if students can merely apply what students know after they have quoted correctly the definition or understanding of the textbook because the results of students' conceptual literacy answers showed that many students are unable to answer questions in the form of analysis, whereas students should be able to complete the task and solve their own problems after going through the learning process at school [16]

The fact that is happening now is that education is still dominated by the view that knowledge is a set of facts that must be memorized. Most students only memorize concepts and lack of ability to relate what they have learned with their application to new situations. Students generally consider the subject matter which is full of procedural and rules to be memorized so that it is easier to answer the exam [17]. Psychological burden in formal education is students have to memorize and it brings boredom which is precisely the result of making students just trying to get good grades rather than mastering their knowledge.

The inability of students to analyze texts or articles is a picturization that the thinking ability of Indonesian students is very weak. According to [18] the thinking ability critically is based on the thought process to analyze arguments and bring insight to each meaning of a problem. Critical thinking is a systematic process that allows students to formulate and evaluate their own beliefs and opinions.

4. Conclusion and suggestion

Based on the results and discussion, it can be concluded that the literacy ability of students in South Sulawesi is still relatively low. The learning process that occurs in general in the high school in South Sulawesi has not been effective in improving students' scientific literacy skills. From the data obtained showed that most students failed to solve problems based on scientific literacy (low category) and there is no in the very good and good category.

Based on these findings, it is necessary for the teacher to implement an effective science learning process in increasing students' scientific literacy. The learning process so far is still too much emphasis on the mastery of theory and rote learning in science that causes students' learning abilities in less development. The learning model that is applied when it is too teacher-centered tends to ignore the rights, needs,growths and development of children. Therefore, it is necessary to always apply the learning process that is centered on students who are fun, smart, joyful, and encourage students' thinking abilities.

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References

[1] OECD. Program For International Student Assessment (PISA) Result PISA 2015. In: Oecd. 2016. p. 1–8
[2] Yuliati Y. Literasi Sains Dalam Pembelajaran IPA. J Cakrawala Pendas. 3 (2):p-ISSN: 2442-7470 e-ISSN: 2579-4442.
[3] Huryah F, Sumarmin R EJ. ANALISIS CAPAIAN LITERASI SAINS BIOLOGI SISWA SMA KELAS X SEKOTA PADANG. J EKSAKTA Pendidik. 2017;1 (2):72–9.
[4] Suwono, H., Pratiwi, H. E., Susanto, H., & Susilo H. Enhancement of Students' Biological Literacy and Critical Thinking of Biology through Socio-Biological Case-Based Learning. J Pendidik IPA Indones. 2017;6 (2).
[5] Azimi., Ani Rusilowati S. Pengembangan Media Pembelajaran IPA Berbasis Literasi Sains untuk Siswa Sekolah Dasar Pancasakti. Sci Educ J PSEJ. 2017;2 Nomor 2:145.
[6] Winata, A., Cacik, S dan R.W, Ita S. Kemampuan Awal Literasi Sains Peserta Didik Kelas V SDN Sidorejo I Tuban Pada Materi Daur Air. JTIEE. 2018;2 (1).
[7] Holbrook, J., & Rannikmae M. The Meaning of Scientific Literacy. . Int J Environ Sci Educ. 2009;15.
[8] OECD. Survey International Program for International Student Assessment (PISA) [Internet]. Online. 2013. Available from: http: // www.oecd.org/pisa
[9] Suwono, H, Mahmudah, A., & Maulidiah L. Scientific Literacy Of A Third Year Biology Student Teachers: Exploration Study. In: The 4th International Conference on Language, Society, and Culture in Asian Context KnE Social Sciences. p. 1 (3).
[10] Nentwig, P., Parchmann, I., Demuth, R., Grasel, C., & Ralle B. Chemie im Context-from Situated Learning in Relevant Contexts to a Systematic Development of Basic Chemical Concepts. In: Makalah Simposium Internasional IPN-UYSEG. Kiel Jerman; 2002.
[11] Rustaman NY. Penilaian Otentik (Authentic Assesment) dan Penerapannya dalam Pendidikan Sains. 2006;
[12] Ozmen, H., A.Y.A.S A. ÖZMEN H, Alipaşa AY. STUDENTS'DIFFICULTIES IN UNDERSTANDING OF THE CONSERVATION OF MATTER IN OPEN AND CLOSED-SYSTEM CHEMICAL REACTIONS. Chem Educ Res Pract. 2003;4 (3):279-290.
[13] Mujib A SE. Upaya Mengatasi Kesulitan Siswa dalam Operasi Perkalian dengan Metode Latis. In: Seminar Nasional Matematika dan Pendidikan Matematika. 2013.
[14] Darliana. Pendekatan Fenomena Mengatasi kelemahan Pembelajaran IPA [Internet]. 2011. Available from: http://www.p4tkipa.org/
[15] Sujarwanta A. Natural Science Learning Conditional with Saintific Approach. J Nuansa Kependidikan. 2012;
[16] Danim S KH. Pedagogi, Andragogi, dan Heutagogi. Bandung: Alfabeta; 2010.
[17] JF H. The effects of a framework for procedural understanding on college algebra students' procedural skill and understanding. Montana State University-Bozeman,; 2006.
[18] Johnson S SH. Teaching Thinking Skills. Bloomsbury Publishing; 2010.