The role of students science literacy in Indonesia

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Abstract. Education through learning science, especially biology, is expected to be a literate of science. This is one of the objectives of the current curriculum in Indonesia. The scientific literacy in question is the ability to use scientific knowledge, such as identifying problems and concluding based on evidence in order to understand and make decisions about nature and its changes through human activities. The purpose of this study was to see how the role of scientific literacy in learning to improve students' reasoning and abilities in science learning. The method used is a meta-analysis, using 18 significant data and applying statistical methods to complement other objectives. This article shows that the important role of scientific literacy in science (biology) learning is the process of reasoning and understanding in making decisions about nature and is able to optimize the opportunities of learning models to be used optimally and able to organize the load of students' cognitive theory according to their level.

1. Introduction

Scientific literacy began to be known in the late 1950s, but the terms put forward regarding the meaning were not always the same [1,2]. Literally, literacy means "literate", while science means natural knowledge. PISA defines scientific literacy as the ability to engage with scientific knowledge, scientific ideas so that it can explain, interpret and evaluate data through scientific inquiry and make decisions regarding nature and its changes due to human activities and technology [3].

Today, scientific literacy is being discussed in the world of education. For example, in America, the American standard document "Benchmark for Scientific Literacy" was created. America explicitly writes scientific literacy as the goal of the science curriculum. Several other countries, including Indonesia, have also included scientific literacy in the curriculum and learning objectives both explicitly and implicitly, including character, literacy and competence. In line with this when we refer to 21st century skills consisting of four main domains, namely: literacy, inventive thinking, effective communication and high productivity [4], based on this, the purpose of this paper is to help clarify scientific literacy in the science curriculum and how the role of scientific literacy in learning for science (Biology) on students' reasoning and understanding processes.

Based on the above review, this paper will look at the role of science literacy in learning, with the following research questions: 1) What is scientific literacy? What is the application of scientific literacy to learning in school?; 3) What are the opportunities for applying scientific literacy to learning?

2. Research Methods

The research method uses a meta-analysis method, using a large amount of data and the application of statistical methods by practicing and organizing a number of information derived from large samples.
and functioning to complement other purposes [5]. In other words, this study uses figures and statistical methods from several research results to gather information, organizing to analyze for specific purposes. The database used is from the ERIC Institute of Education Sciences, Portal Garuda, Researchgate, and manual search. The articles used as data were obtained from 2013 to 2017. The first phase of the search used keywords of scientific literacy in 274 articles, but with scientific literacy descriptors in the focus of biology education, chemical education, and physics education collected around 100 articles. Then narrowed down only to schools in Indonesia so that the data was directed to 18 articles discussed.

3. Results
Based on the research questions proposed, the authors try to describe the results and discuss the research questions one by one, starting from the first question.

3.1 Science Literacy
Understanding according to some experts about scientific literacy varies, it is as explained below. PISA (Program International for Student Assessment) a program that attempts to measure scientific literacy in countries around the world defines scientific literacy as the ability to use scientific knowledge, identify questions, and draw conclusions based on evidence in order to understand and make decisions regarding nature and changes due to human activities [6].

Deboer states that "scientific literacy is to provide a broad understanding of science and the rapidly developing scientific enterprise whether one is to become a scientist or not". That is, scientific literacy is intended for the whole. Based on that understanding, the emphasis on scientific literacy is not only knowledge and understanding of scientific concepts and processes but also directed at how one can make decisions and participate in social life, culture, and economic growth in daily life. Besides that, [7] defines scientific literacy as knowledge and understanding of events and events in the environment. Scientific literacy is defined as PISA's capacity to use scientific knowledge, identify questions and to draw conclusions based on evidence in order to understand and help make decisions about the natural world and human and natural interactions [8].

PISA mentions scientific literacy refers to Scientific knowledge and use of knowledge to identify questions, acquire new knowledge, explain science, phenomena and draw evidence-based conclusions about issues related to science; Understanding the characteristics of science as a form of human knowledge and investigation; Awareness of how science and technology shape our material, intellectual and cultural environment; Willingness to engage in issues related to science, and with the idea of science, as reflective citizens [3].

The Science Literacy Component includes four parts, namely content, context processes and competencies show in Figure 1.
as context, life and health, Earth and environment, and technology, but for aspects of the scientific literacy assessment framework for PISA 2015 includes [9].

Table 1. Scientific literacy assessment framework for PISA 2015

| Contexts | Knowledge | Competencies | Attitude |
|----------|-----------|--------------|----------|
| National and global issues, both current and historical, which demand some understanding of science and technology. | An understanding of the major facts, concepts and explanatory theories that form the basis of scientific knowledge. Such knowledge includes knowledge of both the natural world and technological artefacts (content knowledge), knowledge of how such ideas are produced (procedural knowledge), and an understanding of the underlying rationale for these procedures and the justification for their use (epistemic knowledge). | The ability to explain phenomena scientifically, interpret data and evidence scientifically, and evaluate and design scientific enquiry. | A set of attitudes towards science indicated by an interest in science and technology, valuing scientific approaches to enquiry where appropriate, and a perception and awareness of environmental issues. |

Whereas [10] categorize students’ abilities according to the level of scientific literacy in the form of nominal, functional, conceptual, and dimensional. The level descriptions according to Holbrook and Rannikmae are: nominal, students agree with what is stated by others without their own ideas. Students write scientific terms, but are unable to justify the term or experience misconceptions. Functionally, students are able to remember information from textbooks, for example writing basic facts, but are unable to justify their own opinions based on the text or graph provided. Students even know the concept of interdisciplinary science but are unable to describe the relationship between these concepts. Conceptually, students utilize interdisciplinary concepts and demonstrate interconnected understanding. Students have an understanding of the problem, utilize various concepts and demonstrate the ability to connect these concepts with everyday life. But there are several levels to measure the level of literacy level. The following is also presented in the form of a table on the level of literacy levels mentioned by the OECD.

3.2 Application of Science Literacy in Learning in Schools

A description of scientific literacy shows that when students learn scientific literacy, students can use scientific knowledge, identify questions and to draw conclusions based on evidence in order to understand and help make decisions about the natural world and human interaction with the environment in their lives.

The application of scientific literacy in learning based on research articles analyzed shows that out of 18 articles from research in Indonesia the tendency to use learning models / methods ranks highest in the list of 11, followed by research on the development of materials and tools in learning scientific literacy, then the least is about the profile of student literacy skills.

Table 2 is an article analysis which is divided into several categories below:

| Needs | frequency |
|-------|-----------|
| Profile of scientific literacy abilities | 3 |
| Use of certain learning models / methods for scientific literacy | 11 |
| Development of materials / tools for learning scientific literacy | 4 |
Based on the identification of 18 articles analyzed, it shows that among capability profiles, the use of models / methods, and the development of materials / tools for learning scientific literacy. Research on the profile of literacy ability is considered to be at least the frequency in the study that is equal to 3 while the most is the use of the model or method of learning scientific literacy is the most frequency is equal to 11.

3.3 The research objective was analyzed
The research objective identified about scientific literacy research from 18 articles focused on the success of scientific literacy in the field of content, even though it exists for the context and process, because scientific literacy cannot be separated from the context and process as well.

3.4 Research Methods in Analysis
Research on scientific literacy which was analyzed from 18 articles shows that there are 5 variations of research methodology (Table 3). Overall, of these 18 articles, there were 7 studies that were dominated by quasi-experimental research.

| Methodology     | Frequency |
|-----------------|-----------|
| Experiment      | 2         |
| Development     | 4         |
| Action research | 1         |
| Descriptive     | 4         |
| Quasi Experiment| 7         |

3.5 Collecting research data in Analysis
Data collection was analyzed based on article data, in the tendency to see results in students using the test format. This can be seen from Table 4, that the frequency to measure student outcomes is 12.

| Data Coletion Tools         | Frequency |
|-----------------------------|-----------|
| Questionnaire (linkert type)| 10        |
| Interview                   | 8         |
| Document analysis           | 7         |
| Observation                 | 9         |
| Rubric                      | 10        |
| Worksheet                   | 11        |
| Essay                       | 12        |
| Multiple choice             | 1         |
| Recording Video             | 7         |

3.6 Sample
The sample in this study (Table 5) is in the range of elementary school students to students, the authors did not find data for elementary students. The sample used is mostly in high school students, even though the instruments performed by PISA are for students up to 15 years old, which means that in Indonesia is a junior high school. The reason why many use high school samples can be due to the fact that according to PISA research data Indonesian students always have a low scientific literacy value. This
might be intended for a retest whether there is relevance of literacy mastery as they age, which is expected to increase there was also the addition of mindset and showed an increase in scientific literacy.

Table 5. Research Samples

| data collection tools   | Frequency |
|------------------------|-----------|
| Primary school         | 2         |
| Junior high school     | 7         |
| Senior High School     | 8         |
| College student        | 1         |

3.7 Opportunities for Application of Science Literacy for Students in Indonesia

Researches on the learning process of scientific literacy make it possible to use a variety of methodologies, sampling, and also the realm for research subjects may still be explored further. Research-studies that are analyzed show quite varied results for the learning process. The impact of the learning process based on analysis can also be concluded that the opportunities for using models / methods in scientific literacy learning enable students to experience increased knowledge in midwife content, context and competencies to be able to deal with problems and interact with the environment.

Based on the descriptions above, it can be assumed that the opportunities we can do for research in biological education are: first, the use of media in the process of learning scientific literacy for better learning outcomes, because the purpose of designing multimedia learning media is to reduce processing of extraneous cognitive loads, regulate the processing of intrinsic cognitive load, and help develop processing of cognitive load on germane [11] so that students' scientific literacy abilities are expected to increase.

Second, referring to the 2013 curriculum objectives that apply in Indonesia at this time, the expected curriculum objectives include character, literacy, and competence. So with studies that have been discussed the opportunity to be able to develop a learning process based on the context of problems in biology and during the learning process using relevant media, is expected to be able to improve the scientific literacy skills of Indonesian students.

4. Conclusions

Analysis of studies that have been carried out shows many opportunities that can be developed during the learning process to improve scientific literacy skills, especially biology. Among other things by developing learning media that are tailored to the content, context and competencies desired in the ability of literacy, the most advanced research possible based on this study is the development of learning media for students' literacy skills.

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