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Profile of scientific literacy skills of biology students

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ABSTRACT

Scientific literacy skills are very important skills to be mastered in learning activities in the 21st century. The objective of this study is to analyse the profile of scientific literacy skills of biology students. This study is quantitative descriptive research. The respondents of the research were biology students in Endocrinology class,. The data were collected by conducting tests in the form of multiple-choice questions which were developed based on Test of Scientific Literacy Skills (TOSL) indicators that have been validated by material experts as well as empirical validation. The results showed that the literacy level of 25 7th biology students is still in the category of far below on five indicators with detail of the average scores, namely: identifying valid arguments with a mean value of 32; evaluating the use and misuse of information with a mean value of 16; justify inferences, predictions, and conclusions based on quantitative data with a mean value of 16; solving problems using quantitative skills including probability and statistics with a mean value of 44; understanding and interpreting basic statistics with a mean value of 24. In the other four indicators, the 25 biology students had a good level of scientific literacy, namely on indicators of understanding the design elements of research and how it affects scientific findings or conclusions with a mean value of 76; creating a graphical representation of the data with a mean value of 72; reading and interpreting graphical representations of data with a mean value of 80; and evaluating the validity of the source with a mean value of 80.

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INTRODUCTION

Education aims to make learners become human beings who have literacy or often called literate, which is an important thing needed in the 21st century (Suwono et al., 2017). Competencies that must be acquired by a literate in the 21st century include 3 general skills, namely skills related to information and communication, thinking and problem-solving skills, and interpersonal skills or self-regulating skills (Lemke, 2003). Other references detail these skills into several things, namely academic ability, thinking skills, reasoning skills, collaboration skills, and competence in the field of technology (Lemke, 2003).

Scientific literacy comes as one of the important things in order to become a literate (Choi et al., 2011). This skill began to be widely known since the publication by Paul Hurd (Laugksch, 2000). A clearer definition of scientific literacy is the ability to think scientifically and critically and use scientific knowledge in developing decision-making or problem-solving skills (Abrahams & Millar, 2008; Holbrook & Rannikmae, 2008; Lederman et al., 2008). This skill became one of the focuses for various circles (Cavas et al., 2012) to be further improved (DeBoer, 2000). The focus arises because everyone has an obligation to participate in solving problems that arise around them through an understanding of science and technology with the provision of mastery of mathematics, physics, chemistry, biology, and environmental sciences (Cardwell, 2005).

Scientific literacy can not only be studied and mastered by those who have a career in science and technology, but also by those who have a career in other fields (Salganik & Rychen, 2003). Scientific literacy skill is closely related to socio-scientific issues, because it applies the process of reason and thinking scientifically in social life, which means that everyone has a responsibility in trying to overcome social problems by applying science and technology (Gormally et al., 2012). A person who has scientific literacy skill is certainly able to use the concept of science in an effort to overcome problems in everyday life because they understand the relationship of science, technology, society and socioeconomic development (Laugksch, 2000; OECD, 2014).

PISA survey as a benchmark for the level of scientific literacy in Indonesia showed unsatisfactory results. This survey was conducted on students aged 15 years in various countries. In 2000, Indonesia was in the bottom four, in 2003 it was in the bottom three, in 2006 it was fifth bottom, in 2009 it was in the bottom three, and in 2012 Indonesia was in the bottom two (OECD, 2013). There was no significant change in the results of the survey that was held again in 2018, where Indonesia still got a score below the average score set (OECD, 2018).

Low levels of scientific literacy also occur among students. The results of research on students majoring in biology education showed a less satisfactory level of scientific literacy (Novitasari, 2018; Suwono, 2016; Suwono et al., 2017). In this study, the writer wanted to know the level of scientific literacy of students majoring in pure biology. The objective of this study is to find out the overview or profile of scientific literacy skills of students majoring in pure biology.

RESEARCH METHODS

Research Design

This research is a quantitative descriptive study using a survey technique that aimed to provide an overview of population. The overview that wanted to know in this research is the level of scientific literacy skills of biology students in the 7th semester State University of Malang. The survey was conducted by giving test to the selected sample using purposive sampling technique. The analytical technique used in this study is to look at the mean value (average value) to be interpreted according to the category of scientific literacy assessment listed in Table 1.

Population and Samples

The population of this study were biology students of State University of Malang class of 2017 which amounted to 92 people. The sample of this study were biology students of the

Endocrinology class of Malang State University class of 2017 which amounted to 25 people. The sampling was done using purposive sampling techniques since Endocrinology course is an elective course that consist of only one class.

Instruments

The instrument used in this study was a multiple choice consisting of 25 questions. The questions were based on the Test of Scientific Literacy Skills (TOSLS) indicator on Endocrinology materials with the sub-chapters of insulin and glucagon hormones. Logical validation of the problem was done by material experts with the results that must reach 100% so that it is suitable for use. Empirical validation of the problem was done by conducting test trials on 28 biology students in the 7th semester who have studied Endocrinology. Furthermore, the results of the trial were analysed using ANATES. Empirical validation results showed the correlation value X to Y was 0.83 which means valid and the reliability value was 0.91 which means the reliability of the problem was high. Of the 25 questions tested, there were 15 questions that were feasible to use, namely questions number 2,3,5,7,9,11,12,14,15,17,18,19,21,23, and 24.

Procedures

The research was conducted in three stages which include preparation stage, implementation stage, and data analysis. Research flow chart according to figure 1.

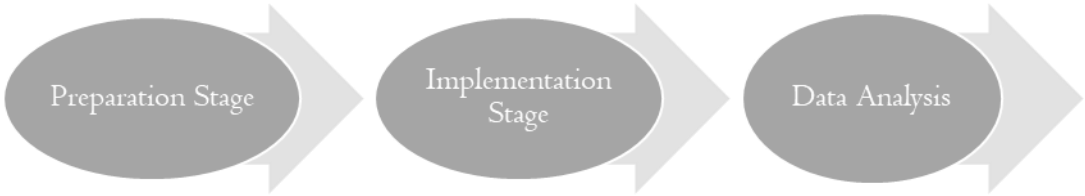

Figure 1. Research flow chart

The preparation stage include samples, developed questions, and tested the validity and reliability of questions. The implementation stage is carried out by giving a test in the form of multiple-choice questions that have been tested for validity and reliability to biology students in the 2017 class of Endocrinology, on February 21, 2020. The multiple-choice questions contain materials related to insulin and glucagon hormones and were made according to the Test of Scientific Literacy Skills (TOSL). The analysis phase is carried out by analysed the test using Microsoft Excel to find out the mean value of each scientific literacy indicator.

Data Analysis

Data in the form of values were obtained by calculating the average value or mean value for each TOSL indicator. The data were then analysed by quantitative descriptive method. The rating scale is from 0-100 with the rating category according to Table 1.

Table 1. Scientific literacy assesment category

No	Interval	Kategori
1	85-100	Excellent
2	70-84	Good
3	55-69	Fair
4	50-54	Poor
5	0-49	Bad

Source: (Sudijono, 2006)

RESULTS

The test results from the students were the analyzed to find out the mean. The mean value of each indicator scientific literacy can be seen in the Table 2.

Table 2. The result of the mean (average) value of each TOSLS indicator

No	Indicators	Mean	Category
1	Identifying valid arguments	32	Bad
2	Evaluating the use and misuse of information	16	Bad
3	Justify inferences, predictions and conclusions based on quantitative data	16	Bad
4	Understand the elements of research design and how they affect scientific findings or conclusions	76	Good
5	Solve problems using quantitative skills, including probability and statistics	44	Bad
6	Create a graphical representation of the data	72	Good
7	Read and interpret graphical representation of the data	80	Good
8	Understand and interpret basic statistics	24	Bad
9	Evaluate source validity	80	Good

Based on the data in Table 2, it is known that the students' scientific literacy level on indicator identify valid arguments still belongs to the bad category, with a mean value of 32. Students' ability to evaluate the use and misuse of information is also still bad, with a mean value of 16. The same results also occurred in indicators justify inference, prediction, and conclusions based on quantitative data; solve problems using quantitative skills including probability and statistics; as well as understand and interpret basic statistics with the mean value of each indicator 16; 44; and 24. Good level of scientific literacy occurred in indicators of understanding research design elements and how they affect scientific findings or conclusions; making graphic representations of data; reading and interpreting graphic representations of data; and evaluating source validity, with the mean value of each indicator respectively being 76, 72, 80 and 80

DISCUSSION

The results showed that the science literacy level of biology students in the 7TH semester is still at the poor category, namely with the average value of all indicators is 48.88. Based on the review of each indicator, it is known that there are five indicators that are still very poorly mastered by the students, namely identifying valid arguments; evaluate the use and misuse of information; justify inferences, predictions, and conclusions based on quantitative data; solving problems using quantitative skills including probability and statistics; understanding and interpreting basic statistics. The average value with category "good" obtained by students on the following indicators: understanding the elements of research design and how they affect scientific findings or conclusions; create a graphical representation of the data; read and interpret graphical representations of data; and evaluate the validity of the source.

In this study, the writer had difficulty in finding references related to the scientific literacy profile of biology students. Many previous studies have discussed the profile of scientific literacy skills of elementary, junior high, high school students and students majoring in biology education, but rarely discussed the profile of scientific literacy skills of students majoring in pure biology. The studies explain that the level of scientific literacy skills of elementary and middle school students is still low or less (Agustina & Rahmawati, 2021; Rohana, 2020), while in high school students the literacy level is very poor (Diana et al., 2015), just like in prospective biology teacher students,

where the level of science literacy is also low (Suwono, 2016; Suwono et al., 2017). Other research shows that the level of science literacy of prospective biology teachers is still at a fair level (Novitasari, 2018).

The importance of this research is based on the idea that everyone is obliged to participate in solving problems around them by utilizing science and technology (Cardwell, 2005). Based on this idea, it is concluded that everyone should have scientific literacy skills (Salganik & Rychen, 2003). The underlying of this research is also related to the formulation of CPMK in the biology study program of State University of Malang which states that students must understand the concept, be able to design investigations, and be able to apply technology and science(Cavas et al., 2012) in problem solving efforts (RPS, 2017).

There are several factors that affect the poor level of science literacy, namely poor curriculum and education system (Cavas et al., 2013) as well as the selection of learning models that are less suitable. The learning model applied to students should be able to encourage students to elaborate learning activities with real life. Some studies mention that learning activities based on real or authentic circumstances can develop students' science literacy skills (Rahmawati et al., 2021; Suwono et al., 2015).

Authentic learning materials can be taken from socio-scientific issues of the surrounding environment. These issues can include conservation and sustainable use of biodiversity, global warming (Paraskeva-Hadjichambi et al., 2015) and the issue of sustainability in the SDGs (Ermalena, 2017). The approach of these issues in learning activities is known to improve the science literacy skills of students effectively (Suwono et al., 2015; Zeidler et al., 2009).

CONCLUSION

Scientific literacy skill is important to be mastered by everyone as a form of responsibility to participate in solving problems that occur in the surrounding environment. The level of scientific literacy of biology students in the 7th semester of State University of Malang is still in the bad category on several indicators such as identifying valid arguments; evaluate the use and misuse of information; justify inferences, predictions, and conclusions based on quantitative data; solving problems using quantitative skills including probability and statistics; understanding and interpreting basic statistics. Nonetheless, some indicators have been well mastered by students i.e., on indicators of understanding the design elements of research and how they affect scientific findings or conclusions; create a graphical representation of the data; read and interpret graphical representations of data; and evaluate the validity of the source. This research still has weaknesses because it was only done in one class.

REFERENCES

Abrahams, I., & Millar, R. (2008). Does practical work really work? a study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education*, *30*(14), 1945–1969. Retrieved from https://doi.org/10.1080/09500690701749305

Agustina, D. A., & Rahmawati, L. (2021). Analisis keterampilan literasi sains mahasiswa dengan tosls. *Elementary School: Jurnal Pendidikan dan Pembelajaran ke-SD-an*, *8*(1). Retrieved from https://doi.org/10.31316/esjurnal.v8i1.1041

Cardwell, V. B. (2005). *Literacy: what level for food, land, natural resources, and environment? 34, 112–117*, 6. Retrieved from https://www.agronomy.org/files/jnrlse/issues/2005/e05-0014k.pdf

Cavas, P. H., Ozdem, Y., Cavas, B., Cakiroglu, J., & Ertepinar, H. (2012). *Turkish pre-service elementary science teachers' scientific literacy level and attitudes toward science*. 19. Retrieved from https://files.eric.ed.gov/fulltext/EJ1022326.pdf

Cavas, P. H., Ozdem, Y., Cavas, B., Cakiroglu, J., & Ertepinar, H. (2013). Turkish pre-service elementary science teachers' scientific literacy level and attitudes toward science. *Science Education International, 24(4), 383–401*. Retrieved from https://files.eric.ed.gov/fulltext/EJ1022326.pdf

Choi, K., Lee, H., Shin, N., Kim, S.-W., & Krajcik, J. (2011). Re-conceptualization of scientific literacy in South Korea for the 21st century. *Journal of Research in Science Teaching, 48*(6), 670–697. Retrieved from https://doi.org/10.1002/tea.20424

DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching, 37(6), 582–601*. Retrieved from http://doi.org/10.1002/1098-2736(200008)37:6<582::AID-TEA5>3.0.CO;2-L

Diana, S., Rachmatulloh, A., & Rahmawati, E. S. (2015). *Profil kemampuan literasi sains siswa sma berdasarkan instrumen scientific literacy assesments (sla)*. 7. Retrieved from https://web.archive.org/web/20180515212928id_/http://www.jurnal.fkip.uns.ac.id/index.php/prosbio/article/viewFile/7101/4881

Ermalena. (2017). *Indikator kesehatan sdgs di indonesia. diskusi panel pengendalian tembakau dan tujuan pembangunan indonesia the 4th ictoh.*

Gormally, C., Brickman, P., & Lutz, M. (2012). Developing a test of scientific literacy skills (tosls): measuring undergraduates' evaluation of scientific information and arguments. *CBE—Life Sciences Education, 11*(4), 364–377. Retrieved from https://doi.org/10.1187/cbe.12-03-0026

Holbrook, J., & Rannikmae, M. (2008). *The meaning of scientific literacy*. 15. Laugksch, R. (2000). *Scientific literacy: A conceptual overview. Science Education. 84(1), 71–94.* Retrieved from http:// doi.org/10.1002/(SICI)1098-237X(200001)84: 1<71::AID-SCE6>3.0. CO;2-C.

Lederman, N. G., Lederman, J. S., & Antink, A. (2008). Nature of science and scientific inquiry as contexts for the learning of science and achievement of scientific literacy. *International Journal of Education in Mathematics, Science and Technology, 1(3), 138–147*, 11. Retrieved from https://ijemst.net/index.php/ijemst/article/viewFile/19/19

Lemke, C. (2003). *engauge 21st century skills: literacy in the digital age*. Metiri Group. Retrieved from http://pict.sdsu.edu/engauge21st.pdf

Novitasari, N. (2018). Profil kemampuan literasi sains mahasiswa calon guru biologi. *Biosfer : Jurnal Tadris Biologi, 9*(1), 36. Retrieved from https://doi.org/10.24042/biosf.v9i1.2877

OECD. (2013). *PISA 2015 draft science framework*. OECD Publishing.

OECD. (2014). *Education at a Glance 2014: OECD Indicators*. OECD. Retrieved from https://doi.org/10.1787/eag-2014-en

OECD. (2018). *PISA 2018 results combined executive summaries volume I, II, & III.*

Paraskeva-Hadjichambi, D., Hadjichambis, A. C., & Korfiatis, K. (2015). How students' values are intertwined with decisions in a socio-scientific issue. *International Journal of Environmental and Science*. Retrieved from https://files.eric.ed.gov/fulltext/EJ1069264.pdf

Rahmawati, J. M., Lestari, S. R., & Susilo, H. (2021). *Implementation of e-module endocrine system based on problem based learning (PBL) to improve scientific literacy and cognitive learning outcome*. 030024. Retrieved from https://doi.org/10.1063/5.0043175

Rohana. (2020). *Profil kemampuan literasi sains peserta didik berdasarkan instrumen scientific literacy assesment (sla). 3(2): 176-185.* Retrieved from https://doi.org/10.31539/bioedusains.v3i2.1848

RPS. (2017). *Biologi Universitas Negeri Malang*. Salganik, L. H., & Rychen, D. S. (Eds.). (2003). *Key competencies for a successful life and a well-functioning society*. Hogrefe & Huber.

Sudijono, A. (2006). *Pengantar evaluasi pendidikan*. Raja Grafindo Persada.

Suwono, H. (2016). *The scientific literacy level of first and third year biology student teachers: a comparative study.proceeding of the 4th international conference of science education and teachers (ISET).* 10. Retrieved from https://www.researchgate.net/publication/310832614_THE_SCIENTIFIC_LITERACY_LEVEL_OF_FIRST_AND_THIRD_YEAR_BIOLOGY_STUDENT_TEACHERS_A_COMPARATIVE_STUDY

Suwono, H., Mahmudah, A., & Maulidiah, L. (2017). Scientific literacy of a third year biology student teachers: exploration study. *KnE Social Sciences*, *1*(3), 269. Retrieved from https://doi.org/10.18502/kss.v1i3.747

Suwono, H., Rizkita, L., & Susilo, H. (2015). Peningkatan literasi saintifik siswa sma melalui pembelajaran biologi berbasis masalah sosiosains. *Jurnal Ilmu Pendidikan, 21(2): 136-144.*, 9. Retrieved from http://dx.doi.org/10.17977/jip.v21i2.8367

Zeidler, D. L., Sadler, T. D., Applebaum, S., & Callahan, B. E. (2009). Advancing reflective judgment through Socioscientific Issues. *Journal of Research in Science Teaching*, *46*(1), 74–101. Retrieved from https://doi.org/10.1002/tea.20281