JPPIPA 8(6) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Students Scientific Literacy Profile of Mathematics Education Study Program in Chemistry Subjects

Natalia Peni[1*], Melania Priska[1], Yosephina Payu Wao[1]

[1]Faculty of Teacher Training and Education, Flores University, Ende, East Nusa Tenggara, Indonesia.

Received: August 19, 2022
Revised: November 22, 2022
Accepted: December 26, 2022
Published: December 31, 2022

Corresponding Author:
Natalia Peni
bpmpuniflor@gmail.com

DOI: 10.29303/jppipa.v8i6.2295

Abstract: This study aims to describe the scientific literacy profile of students in the mathematics education study program in chemistry subjects. The research method is descriptive quantitative research, with the research subject being the second semester students of the Mathematics Education Study Program at the University of Flores in 2021/2022 academic year, totaling 29 peoples. The data resource from the questionnaires, which was based on the aspect of competence. Furthermore, the scientific literacy student competency test questions were tested for validity and reliability, then continued with a final score test to interpret descriptively student learning outcomes. The results of the scientific literacy profile of prospective teachers mathematics at the Faculty of Teacher Training and Education, Flores University consist of 5 indicators, namely, identifying and explaining scientific phenomena, getting a score of 75.45, which is good category; evaluating and designing scientific questions, getting score of 55.75, which is reasonable category; interpreting data and evidence scientifically, getting a score of 62.25 which is reasonable category; creating a good graph, getting a score of 57.55 which is reasonable category; problem-solving skills, getting a score of 60.25 which is reasonable category; understanding and interpreting data, getting a score of 45.00 which is very much less category; and the ability to draw conclusions, getting a score of 77.00 which is good category. These results performed that scientific literacy skills of students are reasonable category.

Keywords: Chemistry subject; Reasonable category; Scientific literacy

Introduction

A viable education system enables the nation to achieve its national goals (Ahmad et al., 2014). In the 21st century, science literacy becomes the focus of science education or natural science, because the development level of a certain nation is determined by the awareness of human resources toward science and technology (Setiawan et al., 2017). Literacy in the 4.0 revolution era is deemed necessary by the Indonesian government to be applied in every education unit. Literacy is needed to improve the soft skills and hard skills of students. Literacy is an important part of practicing reasoning, communication, collaboration, critical thinking, creative and innovative skills (Fitriani et al., 2019). One of the government's efforts to improve the quality of education in college is to design and develop literacy programs, one of which is scientific literacy. Scientific literacy is an ability that must be possessed in learning and exploring new information, relating to events in the natural surroundings, as well as culture in implementing science so that it can draw conclusions based on existing facts (Nudiati et al., 2020). In contrast, 'disciplinary literacy' recognizes that there are specialist conventions within disciplines that need to be appreciated for a full understanding of a source (Fang, 2005; Fang et al., 2013; Goldman et al., 2016; Shanahan et al., 2008; Shanahan et al., 2012; Shanahan et al., 2011; Hubbard, 2021). Disciplinary literacy can be defined as understanding of both disciplinary content and disciplinary habits of mind (i.e. ways of reading, writing, viewing, speaking, thinking, reasoning and critiquing (Fang et al., 2013).

Shepherd et al. (2012) found that undergraduate maths students were not effective readers of textbook materials, being mostly unable to undertake a task based on material they had just read. Reasons for lack of reading effectiveness included displaying a lack of attention to the detail of the text, and having inadequate prior knowledge for comprehension. Mathematics is the mother of the sciences knowledge. Chemistry subjects

How to Cite:
Peni, N., Priska, M., & Wao, Y.P. (2022). Students Scientific Literacy Profile of Mathematics Education Study Program in Chemistry Subjects. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 3050–3054. https://doi.org/10.29303/jppipa.v8i6.2295

are part of the sciences, so that way, prospective mathematics teachers are required to study chemistry. Chemistry applies mathematical calculations. Applications can be in the form of formulations, equations, interpretation of tables and graphs, interpretation of data, and quantitative calculations, using verbal and non-verbal symbols from various mathematical symbols as a basis for studying chemistry. These various applications are an effort by the Indonesian government to prepare prospective teacher students to develop their potential in the era of the industrial revolution 4.0 (Maysaroh et al., 2021).

In the era of the industrial revolution 4.0, prospective teachers are required to have scientific literacy skills to prepare themselves to apply science knowledge in the working world. The challenges for prospective teachers in applying scientific literacy are low high-level thinking skills, low communication and collaboration skills in formulating, describing, interpreting, and calculating, and analyzing data, as well as drawing conclusions. So that way, prospective mathematics teachers are expected to have excellence in implementing science-based learning processes (Syofyan et al., 2019).

Method

This type of research is descriptive quantitative research. The research subjects are second semester students of the Mathematics Education Study Program, Flores University for the academic year 2021/2022, totaling 29 people. The data were sourced from the results of a questionnaire, which was based on the aspect of competence. The questionnaire contains 15 questions, namely: 1) identifying and explaining scientific phenomena; 2) evaluating and designing scientific questions; 3) describing data and evidence scientifically; 4) creating a good graphs based on data; 5) problem solving skills; 6) understanding and interpreting data; and 7) the ability to draw conclusions. Furthermore, the students' scientific literacy competency test questions were tested for validity and reliability using SPSS version 22.

After the validity and reliability tests were carried out, it was continued with the final score test to interpret descriptively the student learning outcomes. The criteria for assessing scientific literacy can be seen in Table 1 (Novitasari, 2018).

Table 1. Criteria for Assessment of Scientific Literacy

Interval	Criteria	Code
0-49	Very much less	VL
50-54	less	L
55-69	reasonable	R
70-84	good	G
85-100	better	B

Result and Discussion

The scientific literacy ability of prospective mathematics teacher is measured using an integration test of scientific literacy indicators consisting of 8 (eight) indicators, where the assessment of test results from 29 prospective mathematics teachers is assigned an assessment score on a scale of 0-100. The results of the scientific literacy test were analyzed using the achievement score equation divided by the maximum score, multiplied by 100. From the results of the analysis, a scientific literacy score was obtained based on student answers. The scientific literacy achievement score of prospective mathematics teacher students can be seen in Table 2.

Table 2. Science Literacy Achievement Score for Prospective Mathematics Teacher

Indicator	Score	Category
Identifying and explaining scientific phenomena	75.45	Good
Evaluating and designing scientific questions	55.75	Reasonable
Describing data and evidence scientifically	62.25	Reasonable
Creating a good graphs based on data	57.55	Reasonable
Problem solving skills	60.25	Reasonable
Understanding and interpreting data	45.00	Very much less
The ability to draw conclusions	77.00	Good

Based on Table 2, the indicator of the ability to identify and explain scientific phenomena with good categories, which is the assessment interval approximately 70-84 with the score of 75.45. The process carried out to obtain these scores is group discussion (Figure 1a) and presenting the results of the discussion (Figure 1b). Identifying scientific phenomena related to natural phenomena around, as evidenced by the individual's ability to recognize natural phenomena and scientifically investigated based on environmental situations, ability to collect information and find keywords, also scientific examination characteristics. For example: classifying, comparing, analyzing, and defining existing phenomena. After identifying, the next step is to explain scientific phenomena. Explaining phenomena scientifically is a competency in applying scientific knowledge in a given situation by describing phenomena, predicting changes, recognizing and identifying, describing, explaining and predicting accordingly. This indicator requires scientific evidence to measure student competence in interpreting scientific phenomena as a means of support for drawing conclusions (Novitasari, 2018).

In the indicator of evaluating and designing scientific questions, it is reasonable category with

interval score approximately 55-69, which is 55.75. Evaluating scientific questions is one of the scientific competencies that includes an understanding of scientific investigations, the ability to interpret scientific data and evidence, identify observational procedures, and ask questions regularly from data with objective explanations. After evaluating, proceed with designing scientific questions. Designing scientific questions aims to practice students assessing scientific investigations, formulating questions, proposing ways to answer questions, practicing experimental activities, linking current contexts to developing question instruments that are equivalent to student scientific literacy, and providing an overview for educators to improve the quality of learning scientific literacy (Kurniasih et al., 2021).

Figure 1. Learning process. a) discussion, and b) presentation process

In the indicator of interpreting data and evidence scientifically, it is reasonable category with an interval score approximately of 55-69, which is 62.25. The ability to interpret data and evidence scientifically is proven by the ability to master the content, procedural, and epistemic knowledge. Interpreting data and evidence scientifically aims to practice the development of scientific knowledge to apply scientific concepts and methods in daily life. The reasonable category for this indicator is influenced by the unfamiliarity of learning science in universities which do not prioritize cognitive aspects, but focus on students' thinking skills (Irwan, 2020). On the other hand, the ability to interpret data and evidence scientifically can have an impact on students' liking for science, the ability to think scientifically and make decisions, identify public discourse, and provide inspiration to deal with challenges in the working world, because they have been practiced to think smart and think creatively, to solve problems and draw conclusions (Pratiwi et al., 2019).

Data representation can be represented into both visual representation and non-visual. Visual representation including graph, table, sketch/figure, and diagram; non visual representation including numerical representation, and mathematical equation or mathematical model (Minarni et al., 2016). The fourth indicator, which is to create a good graph, it is reasonable category with an assessment interval approximately 55-69, namely 57.55. Graphics are paintings with pictures or lines to determine the condition of a data and to provide information, illustrations, and convey complex ideas to readers (Setyowati, 2019). The ability to create a good graphs with reasonable categories was influenced by the difficulties experienced by students in recognizing designs and choosing the right type of graphs to display good data and easy to understand (Bagasta et al., 2018).

Based on table 2, the indicator of problem solving skills is reasonable category, which is 60.25. Based on table 2, the indicator of problem-solving skills is reasonable category, which is 60.25. This is because problem solving skills are not practice since they are in elementary school and senior high school. Untrained students in solving problems cause students to be unable to provide rebuttals in dealing with real-world problems (Cahyani et al., 2017). Problem-based learning happen, if there is an interaction between stimulus and response, so that way, there is a two-way learning relationship with the environment as a learning resource. The environment becomes the center of attention on problems that will be captured by the brain's nervous system, in order to be able to describe aids effectively in solving problems. The low problem-solving skills are also caused by the lack of student understanding of the material presented by the lecturer, in the form of written assignments in the learning process and independent assignments carried out by students (Destalia et al., 2014).

Success in the educational process starts with progressive ideas and knowledge which later will support individual's ability to think (Widiana et al., 2016). Student's creativity data and student's critical thinking data were obtained using the instruments of creativity and critical thinking. Aspects measured in critical thinking consist of the ability to make interpretation, analysis, inference, evaluation, and explanation (Anazifa et al., 2017). Based on table 2, indicators of understanding and interpreting data is very much less category, which is 45.00. Data interpretation is the ability to interpret ideas and data to communicate the interpreter's thoughts. The ability to understand and interpret data is very much less due to

the students' less of understanding the impact of science in daily life, less in making decisions, less in reading and understanding important information about science, having a low critical attitude, and lack of participation in discussions (Hendri et al., 2019). Moreover, the less ability to understand and interpret data is influenced by the lack of habituation of research activities, exercises and data analysis skills, practice questions in the form of stories, graphs, diagrams, and tables; exposure of life phenomena to observe, as well as the lack of time to read, so that in the learning process it is necessary to habituate literacy culture, instill the importance of literacy culture, and add sources of reading material. This is done so that literacy skills become the basis for implementing the 6M program (observing, creating, communicating, interpreting, recording, and exhibiting) (Merta et al., 2020).

In the indicator of the ability to draw conclusions is good category, which is 77.00. Drawing conclusions is the ability to communicate as a process of developing competence from an early on. There are 5 (five) parameters of the ability to draw conclusions, namely making statements containing information, getting trend patterns in an observation of practicum and research results, recognizing patterns or relationships between variables on the overall data, re-examining patterns or relationships between variables and the overall data, and make general conclusions from the observations obtained (Rahmawaty et al., 2020).

Conclusion

Based on the results and discussion, it can be concluded that the scientific literacy profile of prospective mathematics teacher at the Faculty of Teacher Training and Education, Flores University consists of 5 indicators, namely: 1) identifying and explaining scientific phenomena getting a score of 75.45 with a good category; 2) evaluating and designing scientific questions getting a score of 55.75 with reasonable category; 3) interpreting data and evidence scientifically getting a score of 62.25 with reasonbale category; 4) creating a good graph getting a score of 57.55 with reasonable category; 5) problem-solving skills getting a score of 60.25 with reasonable category; 6) understanding and interpreting the data getting a score of 45.00 with very less much category; and 7) the ability to drawing conclusions getting a score of 77.00 with good category. These results indicate that the scientific literacy ability of prospective mathematics teacher is reasonable category.

References

Ahmad, I., Ur Rehman, K., Ali, A., Khan, I., & Khan, F. A. (2014). Critical Analysis of the Problems of Education in Pakistan: Possible Solutions. *International Journal of Evaluation and Research in Education (IJERE)*, *3*(2), 79–84. https://doi.org/10.11591/ijere.v3i2.1805

Anazifa, R. D., & Djukri. (2017). Project- based learning and problem- based learning: Are they effective to improve student's thinking skills? *Jurnal Pendidikan IPA Indonesia*, *6*(2), 346–355. https://doi.org/10.15294/jpii.v6i2.11100

Bagasta, A. R., Rahmawati, D., Dzahra, M. F. Y. M., Wahyuni, I. P., & Prayitno, B. A. (2018). Profile of the Scientific Literacy Ability of Students in One of the State Senior High Schools of Sragen City. Pedagogia. *Jurnal Pendidikan*, *7*(2), 121–129. http://orcid.org/0000-0003-1184-6063.

Cahyani, H., & Setyawati, R. W. (2017). The importance of increasing problem-solving abilities through PBL to prepare a superior generation to face MEA. *PRISMA, Proceedings of the National Mathematics Seminar*, 151–160. https://journal.unnes.ac.id/sju/index.php/prisma/article/view/21635.

Destalia, L., Suratno, & Hariani, S. P. (2014). Improving Problem Solving Skills and Learning Outcomes through the Application of Problem-Based Learning (PBM) with Experimental Methods on Environmental Pollution Materials. *Pancaran*, *3*(4), 213–224. https://jurnal.unej.ac.id/index.php/pancaran/article/view/1003.

Fang, Z. (2005). Scientific literacy: A systemic functional linguistics perspective. *Science Education*, *89*(2), 335–347. https://doi.org/10.1002/sce.20050

Fang, Z., & Coatoam, S. (2013). Disciplinary literacy: What you want to know about it. *Journal of Adolescent and Adult Literacy*, *56*(8), 627–632. https://doi.org/10.1002/JAAL.190

Fitriani, Y., & Azis, I. A. (2019). Literacy Era of the Industrial Revolution 4.0. *Proceedings of SENASBASA (Seminar Nasional Bahasa Dan Sastra*, 100–104. https://doi.org/10.22219/.v3i1.2592.

Goldman, S. R., Britt, M. A., Brown, W., Cribb, G., George, M. A., Greenleaf, C., Lee, C. D., & Shanahan, C. (2016). Disciplinary Literacies and Learning to Read for Understanding: A Conceptual Framework for Disciplinary Literacy. *Educational Psychologist*, *51*(2), 219–246. https://doi.org/10.1080/00461520.2016.1168741

Hendri, S., & M, H. (2019). Identifikasi Literasi Sains Mahasiswa (Studi Kasus Mahasiswa STISIP Amal Ilmiah Yapis Wamena). *Journal of Natural Science and Integration*, *2*(1), 95. https://doi.org/10.24014/jnsi.v2i1.7117

Hubbard, K. (2021). Disciplinary literacies in STEM: what do undergraduates read, how do they read it, and can we teach scientific reading more

effectively? *Higher Education Pedagogies*, *6*(1), 41–65. https://doi.org/10.1080/23752696.2021.1882326

Irwan, A. P. (2020). Analisis Kemampuan Literasi Sains Pesrta Didik Ditinjau Dari Kemampuan Menyelesaikan Soal Fisika Di Sman 2 Bulukumba. *Jurnal Sains Dan Pendidikan Fisika*, *15*(3), 17–24. https://doi.org/10.35580/jspf.v15i3.13494

Kurniasih, W., Wulan, A. R., & Nuraeni, E. (2021). *Initial Profile of 21st Century Competencies of High School Students in Skills in Evaluating and Designing Scientific Investigations on Covid-19 Content*. Prosiding Seminar Nasional Sains dan Entrepreneurshiip VII Tahun 2021, 57-62. http://conference.upgris.ac.id/index.php/snse/article/view/2077.

Maysaroh, S., Luliani, E., & Wulandari, A. (2021). The Relationship of Understanding Mathematical Concepts to Chemistry Learning Outcomes. In *Prosiding Seminar Nasional Pendidikan STKIP Kusuma Negara III* (pp. 214–221). https://jurnal.stkipkusumanegara.ac.id/index.php/semnara2020/article/view/1138.

Merta, I. W., Artayasa, I. P., Kusmiyati, K., Lestari, N., & Setiadi, D. (2020). Profil Literasi Sains dan Model Pembelajaran dapat Meningkatkan Kemampuan Literasi Sains. *Jurnal Pijar Mipa*, *15*(3), 223–228. https://doi.org/10.29303/jpm.v15i3.1889

Minarni, A., Napitupulu, E. E., & Husein, R. (2016). Mathematical understanding and representation ability of public junior high school in North Sumatra. *Journal on Mathematics Education*, *7*(1), 43–56. https://doi.org/10.22342/jme.7.1.2816.43-56

Novitasari, N. (2018). Profil Kemampuan Literasi Sains Mahasiswa Calon Guru Biologi. *Biosfer : Jurnal Tadris Biologi*, *9*(1), 36. https://doi.org/10.24042/biosf.v9i1.2877

Nudiati, D., & Sudiapermana, E. (2020). Literacy as a 21st Century Life Skill in Students. *Indonesian Journal of Learning Education and Counseling*, *3*(1), 34–40. https://journal.ilininstitute.com/index.php/IJoLEC.

Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). 21st Century Science Learning With Students' Scientific Literacy. *Journal of Materials and Learning Physics (JMPF)*, *9*(1), 34–42. https://doi.org/10.20961/jmpf.v9i1.31612.

Rahmawaty, S., Nurhayati, & Arsyad, M. (2020). Kemampuan Menarik Kesimpulan Peserta Didik yang Menggunakan LKPD Pertanyaan Pengarah Kelas XI MIA 2 SMAN 11 Makassar. *Prosiding Seminar Nasional Fisika PPs UNM*, *2*, 33–36. https://ojs.unm.ac.id/semnasfisika/issue/view/983

Setiawan, B., Innatesari, D. K., Sabtiawan, W. B., & Sudarmin, S. (2017). The development of local wisdom-based natural science module to improve science literation of students. *Jurnal Pendidikan IPA Indonesia*, *6*(1), 49–54. https://doi.org/10.15294/jpii.v6i1.9595

Setyowati, D. (2019). Training in Making Graphs in Microsoft Excel for Data Processing and Presentation. *Jurnal Dharma Bakti-LPPM IST AKPRIND Yogyakarta*, *2*(2), 101–112. https://doi.org/10.34151/dharma.v2i2.2031.

Shanahan, C., Shanahan, T., & Misischia, C. (2011). Analysis of Expert Readers in Three Disciplines: History, Mathematics, and Chemistry. *Journal of Literacy Research*, *43*(4), 393–429. https://doi.org/10.1177/1086296X11424071

Shanahan, T., & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review*, *78*(1), 40–59. https://doi.org/10.17763/haer.78.1.v62444321p602101

Shanahan, T., & Shanahan, C. (2012). What Is Disciplinary Literacy and Why Does It Matter? *Topics in Language Disorders*, *32*(1), 7–18. https://doi.org/10.1097/TLD.0b013e318244557a

Shepherd, M. D., Selden, A., & Selden, J. (2012). University Students' Reading of Their First-Year Mathematics Textbooks. *Mathematical Thinking and Learning*, *14*(3), 226–256. https://doi.org/10.1080/10986065.2012.682959

Syofyan, H., & Amir, T. L. (2019). Application of Science Literacy in Science Learning for Prospective Elementary Teachers. *Journal Pendidikan Dasar*, *10*(2), 35–43. https://doi.org/10.21009/10.21009/JPD.081

Widiana, I. W., & Jampel, I. N. (2016). Improving Students' Creative Thinking and Achievement through The Implementation of Multiple Intelligence Approach with Mind Mapping. *International Journal of Evaluation and Research in Education (IJERE)*, *5*(3), 246. https://doi.org/10.11591/ijere.v5i3.4546