Analysis of Indonesian Students Scientific Literacy Ability in Chemistry Learning: A Systematic Literature Review

Adek Diah Murti*, Hernani, Soja Siti Fatimah

Departement of Chemistry, Indonesia University of Education, Bandung, 40153, Indonesia

ARTICLE INFO

* Corresponding author.
E-mail: adekdiah@upi.edu

A B S T R A C T

This study aims to examine the results of the analysis of scientific literacy abilities of Indonesian students in chemistry learning. The method used is Systematic Literature Review (SLR), which consists of five stages, namely question formulation, locating studies, study selection and evaluation, analysis and synthesis, reporting and using the results. Based on a study of 15 reputable journals indexed scopus (International Journal) and sinta (National Journal), the scientific literacy abilities of Indonesian students at the high school level and the education of prospective teachers are in the sufficient category, but there are still many who are in the low category. This is because students are not familiar with scientific literacy questions and learning which rarely trains individuals to make arguments based on observations or investigations, making it difficult for them to work on questions that require an analysis of existing scientific evidence or facts. Therefore, it is necessary to make efforts to improve scientific literacy skills through the application of learning models that train the ability to apply scientific knowledge that has been obtained in solving problems in everyday life. Problem-based learning models, ethnoscience-based learning, contextual-based guided inquiry learning, and also project-based learning.

1. Introduction

Currently scientific literacy has become one of the main goals of contemporary science education that must be improved. The development of scientific literacy is very important because it can contribute to social and economic life, as well as improve decision-making skills personally and also in society. Scientific literacy is actually not a new thing in the world of education. However, since the last two decades, scientific literacy has become the main topic in every conversation regarding the goals of science education in schools. Lederman et al (2014) stated that the literature in the field of science education also shows that scientific literacy is increasingly being accepted and valued by educators as an expected learning outcome.

Scientific literacy is one of the competencies assessed by the Program for International Student Assessment

(PISA). Based on the results of an analysis of the results of the 2018 PISA study organized by the Organization of Economic Cooperation and Development (OECD) it shows that Indonesia is in the bottom 10 of the 79 participating countries (OECD, 2019). The ability of Indonesian students to be scientifically literate (scientific literacy) from the PISA results from 2000 to 2018 is still in the low category because the scores obtained are below the average PISA mastery score. This indicates that Indonesian students have not been able to understand the concepts and processes of science and have not been able to apply the scientific knowledge they have learned in everyday life (Sutrisna, 2021).

Scientific literacy is defined 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 made to nature through human activities. The level of one's scientific literacy ability greatly determines how that person makes decisions about the conditions he faces in society. Scientific literacy ability is used by someone to understand environmental conditions and social problems faced by society in this modern era, especially those that rely on the role of science and technology development (Turiman, et al, 2012). Someone who has scientific literacy skills can apply scientific concepts in their interactions with the environment and use scientific processes in solving problems and making decisions in everyday life based on scientific evidence.

Scientific literacy in PISA has a domain that is developed into four aspects, namely content knowledge, context, competence, and attitudes (OECD, 2017). Content knowledge is described as an understanding of most of the facts, concepts, and theoretical explanations that form the basis of scientific knowledge. Context is described as personal, local, national and global, historical and current issues, which require an understanding of science and technology. Competence is described as the ability to scientifically explain phenomena, evaluate and design scientific research, and interpret scientific data and evidence. Attitudes are described as characterized by an interest in science and technology, valuing scientific approaches to research and awareness of environmental issues (OECD, 2017).

A brief review of the literature shows that scientific literacy skills have become a special concern because scientific literacy is one of the important pillars in improving the quality of human resources, especially in the world of education so that students are expected to have higher competitiveness in global competence. Various efforts can be made to develop students' scientific literacy abilities, especially in chemistry learning. Based on this, a study is needed regarding efforts that can be made to develop students' scientific literacy skills. The purpose of this article is to review the scientific literacy skills of high school students and college students in chemistry learning.

2. Methodology

Systematic literature review (SLR) method was used in this study to analyze Indonesian students' scientific literacy ability in chemistry learning. SLR research is the process of identifying, evaluating and analyzing all information in the literature/references to discuss the parameters to be studied (Xiao & Watson, 2019). The data sources in this study were articles from various journals in the last 5 years about analysis of Indonesian students' scientific literacy ability in chemistry learning with the parameters identified which can be seen in Table 1.

Table 1. Parameters Studied

Parameter	Description
The results of the analysis of the scientific literacy profile of high school students in chemistry learning	To see the scientific literacy skills of high school students in chemistry learning
The results of the analysis of the scientific literacy profile of pre-service teacher in chemistry learning	To see the scientific literacy skills of pre-service teacher in chemistry learning

This SLR adopts the five-step guideline from (Denyer & Tranfield, 2009) (Figure 1), which has also been reported to have been used by other authors such as (Han et al., 2020) and (Husamah et al., 2022).

Step 1: Question Formulation

This first step is to determine the scope for developing a clear research focus. This study proposes and attempts to answer questions based on the needs of the chosen topic, namely:

1. How is the scientific literacy ability of high school students in chemistry learning?
2. How is the scientific literacy ability of pre-service teacher in chemistry learning?

Step 2: Locating Studies

The second step of the SLR is finding, selecting, assessing, and listing the core contributions related to the review questions. The target of this research is the theme "Analysis of Indonesian Students Scientific Literacy Ability in Chemistry Learning". These keywords are used to track related/appropriate articles published by national and international journals from 2018 to 2022. The search process uses the search menu on the Google Scholar platform (https://scholar.google.com) with the keyword "Analysis of Indonesian Students Scientific Literacy Ability in Chemistry Learning". Obtained articles are saved in PDF format which are then synchronized with Mendeley.
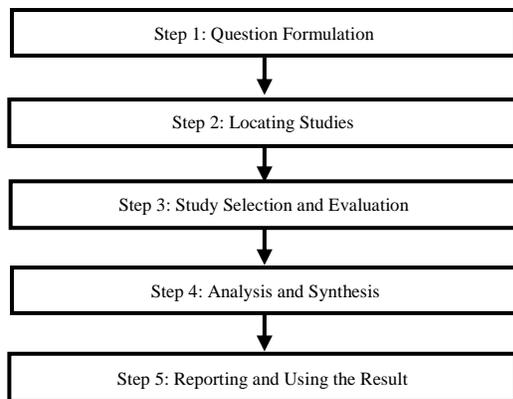

Figure 1. Five Steps of SLR, adapted from Denyer & Tranfield (2009)

Step 3: Study Selection and Evaluation

This stage is carried out to ensure that the data obtained is suitable for use in SLR research or not. The study standards that meet the requirements are as follows: (i) the data used is from the year of publication 2018-2022; (ii) articles published in English and Indonesian; (ii) the full article is accessible; (iv) related to the theme "Analysis of Indonesian Students Scientific Literacy Ability in Chemistry Learning"; and (v) only types of research report articles.

A search for publications using the keyword Analysis of Indonesian Students Scientific Literacy Ability in Chemistry Learning resulted in 100 related publications. Selection of publications that are potential and relevant to the topic, namely those that examine the results of analyzing the scientific literacy abilities of Indonesian students in chemistry learning and 15 publication titles are obtained from this process.
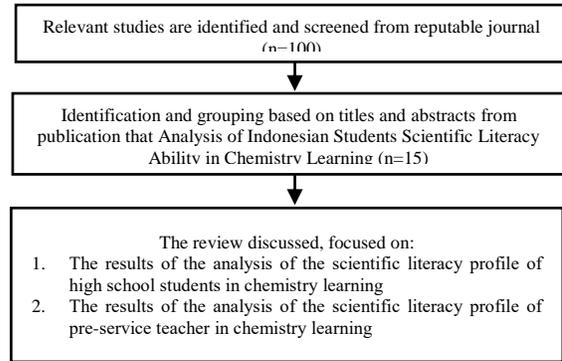

Figure 2. The Systematic Literature Review Scheme

Step 4: Analysis and Synthesis

After selecting articles, the next step is to synthesize data with the aim of analyzing and evaluating research results from various literatures according to the parameters to be discussed, namely the results of analyzing the scientific literacy skills of Indonesian students in learning chemistry. The data synthesis carried out in this study is in the form of a narrative.

Step 5: Reporting and Using The Result

The reporting stage is the final stage in systematic literature review. This stage includes writing the results of a systematic literature review in written form according to a predetermined format.

3.   Results and Discussion

This study aims to analyze the scientific literacy profile of high school students and prospective teachers in chemistry learning. The complex and fast changing world is one of the reasons various educational practices focus on improving students' scientific literacy skills. Scientific literacy focuses on the importance of being able to understand and explain phenomena using clear language, the ability to read and write to evaluate information, communicate ideas to others, apply scientific knowledge and think critically in everyday life. Most scientific literacy can develop through curriculum, learning materials, and assessment practices, so that when science content and teaching is facilitated with these competencies, scientific literacy skills can be developed.

Profile of Scientific Literacy of High School Students in Chemistry Learning

In the era of the 21st century, one of the basic skills that everyone needs to have, one of which is literacy and scientific literacy is an important part of science

education goals. With good scientific literacy skills, people can apply the knowledge they have so that they can solve problems in everyday life. The importance of scientific literacy relates to how students are able to appreciate nature by utilizing the science and technology they have mastered. The low scientific/chemical literacy ability of students is evident from the results of the Program for International Students Assessment (PISA) survey from 2000 to 2018 which shows that the level of scientific literacy achievement of Indonesian students is still at a low level. Several studies in Indonesia have analyzed the scientific literacy abilities of high school students, uncovered the causes of low scientific literacy, and provided efforts to develop the scientific literacy skills of high school students in Indonesia.

Based on the results of Permatasari & Fitriza (2019) research, the average results of students' scientific literacy in the content aspect were 34.03% and classified as the "very poor" category. Students' scientific literacy in the context aspect is 30.53% and belongs to the "very poor" category. Students' scientific literacy in the competency aspect is 30.26% and belongs to the "very poor" category. The average scientific literacy ability of students in the cognitive domain is 33.11% and is included in the "very poor" category.

One of the reasons for the low results of students' scientific literacy is that students are not familiar with scientific literacy questions. The dense curriculum load also affects the level of scientific literacy of students at school. Too much material that the curriculum demands for students to master makes teachers often only introduce and go straight into the subject matter due to time constraints in studying a material. From research conducted by Anggraeni et al (2020)in two class X MIPA of SMA Islam Sudirman Ambarawa, it can be concluded that the profile of students' chemical literacy skills in electrolyte and non-electrolyte solutions can be improved through guided inquiry learning , with the achievement of knowledge aspects in the experimental class of 73%, context aspect 66%, competency aspect 76%, and attitude aspect 68%.

Meanwhile, the percentage of achievement in the control class for the knowledge aspect was 63%, the context aspect was 55%, the competency aspect was 66%, and the attitude aspect was 64%. Based on the results of this study, Anggraeni et al (2020) concluded that contextual-based guided inquiry learning is better at increasing students' chemical literacy ability profiles in the aspects of context, knowledge, competence, and attitudes.

The results of the Wibowo & Ariyatun (2020) research show that the average science literacy competency score of class XI MIPA SMAN 1 Kendal students after learning ethnoscience-based chemistry in the experimental and control classes consecutively got 72% with a high category and 65% with a medium category. So ethnoscience-based chemistry learning is suitable for use in chemistry learning to develop students' chemical literacy skills. The result of the research analysis of Imansari et al (2018) that the science literacy ability of students in class XI IPA Negeri SMA Banyumas Regency through the application of the ethnoscience-laden inquiry learning model on salt hydrolysis material in terms of content, context, and competence is in the low category, while for the aspect of attitude students towards chemistry in the very good category.

The results of Ihsan (2021) research on 60 students in class X MIA at one of the high schools in Lombok showed that the average N-gain science literacy score of experimental class students was 78.5 with high criteria, the average score The N-gain of the experimental class is 67.3 with moderate criteria. So Ihsan (2021) concluded that interactive multimedia based on blended learning on oxidation-reduction reaction material has an effect on improving students' science literacy skills.

The results of research by Sumarni et al (2017) show that the average content aspect of students' chemical literacy achievement of 31.8% is included in the low category. Similarly, for the science literacy achievement score in the process domain, the indicators identify scientific questions 3.20, evaluate and plan scientific research 2.26 and identify scientific evidence 2.95 out of a maximum score of 5.0. This student's chemical literacy achievement is also in accordance with the results of the analysis of the student's explanations on selected chemical concepts which are mostly seen in the partially correct answer category. Based on the analysis of several research results, it was found that there is still a low science literacy ability of students, one of which is because students are not used to science literacy questions and also the dense curriculum burden also affects the level of science literacy of students in school.

Therefore, it is necessary to improve the quality of learning that explicitly integrates the aspects needed to improve students' chemical literacy, such as applying ethnoscience-based chemical learning and chemical learning using a contextual-based guided inquiry model. In addition, the project based learning model can also be used to develop science literacy skills in chemistry learning such as the research done

by Utami (2021). Some of the analyzed articles can be seen in Table 1.

Table 1. Article on Scientific Literacy Skills of High School Students in Chemistry Learning

No	Research Title	Reference
1	Analysis of Scientific Literacy of High School Students on Content, Context, and Competence Material Aspects of Buffer Solutions	(Permatasari & Fitriza, 2019)
2	Profile of Increasing Students' Chemical Literacy Through Contextual-Based Guided Inquiry Learning	(Anggraeni et al., 2020)
3	Scientific Literacy Ability in High School Students Using Ethnoscience-Based Chemistry Learning	(Wibowo & Ariyatun, 2020)
4	Analysis of Students' Chemical Literacy Through Ethnoscience-Based Guided Inquiry Learning	(Imansari et al., 2018)
5	Analysis of Students' Scientific Literacy Ability in Chemistry Learning Using Interactive Multimedia Based on Blended Learning	(Ihsan, 2021)
6	Chemical literacy of teaching candidates studying the integrated food chemistry ethnosciences course	(Sumarni et al., 2017)

Scientific Literacy Profile of Preservice Teacher in Chemistry Learning

The low level of scientific or chemical literacy in Indonesia can be improved by improvements in education. The field of education is indeed a beacon of hope for improving the quality of human resources (HR) in Indonesia. Prospective educators are an important component in the field of education because prospective educators are the forerunners of teachers who will help students develop chemical literacy. Prospective educators must have the ability to apply chemical literacy with several learning approaches or models, and develop questions and evaluation instruments that can improve students' chemical literacy skills. To find out the development of students' chemical literacy skills, it is necessary to know in advance how the literacy skills they already have.

Based on the results of a survey from Putri et al (2022), the average acquisition of scientific literacy abilities of Chemistry Education students at the Faculty of Teacher Training and Education, Tanjungpura University class of 2021 in the aspect of content knowledge with the competence to identify scientific questions is 39.62% in the medium category, aspects of procedural knowledge with the competence to explain scientific phenomena of 26.38% are in the low category, and aspects of epistemic knowledge with competence in using scientific evidence are 23.33% in the low category.

The cause of the low ability of students in this aspect is due to the learning process which is only limited to theory and rote concepts without the support of meaningful learning, so that it does not train thinking skills to make conclusions or give reasons based on the results of their understanding. Lessons that rarely train individuals to make arguments based on the

results of observations or investigations, make it difficult to work on questions that require an analysis of existing scientific evidence or facts. Putri et al (2022) suggest making efforts to improve scientific literacy skills through learning models that train the ability to apply scientific knowledge that has been obtained in solving problems in everyday life. One of the learning models that can be used is the problem-based learning model. With this learning model, it will train students to solve problems using the knowledge they already have.

The research results of Febriyanti et al (2021) revealed that the scientific literacy skills of Chemistry Education students at Tanjungpura University were summarized in three aspects, namely: 1) The knowledge aspect was classified as in the low category with an average score of 43 including a content knowledge score of 57 (moderate), knowledge 43 (low) procedural knowledge, and 28 (low) epistemic knowledge. 2) The competency aspect is in the low category with an average score of 38, including a score of the ability to explain scientific phenomena 34 (low), evaluating and designing scientific inquiry 52 (low), and interpreting scientific data and evidence 27 (low). 3) The attitude aspect belongs to the medium category with an average percentage of achievement of 75%, including indicators of interest in natural sciences of 68% (moderate), an assessment of the scientific approach to inquiry of 82% (high), and environmental awareness of 75% (low). Febriyanti et al (2021) suggest efforts to increase students' scientific literacy skills in aspects of knowledge and competence that can be applied through integrating scientific literacy in the learning process and learning media, such as implementing ethnoscience-based learning and utilizing the Science Technology Society (STS) learning model.

El Islami & Nuangchalerm (2020) in their research revealed that the science literacy of Thai novice science teacher students had slightly better scores than Indonesian novice science teacher students, but there was no significant difference between Thai and Indonesian novice science teacher students in science literacy statistically. Based on the research results of Enawaty & Erlina (2021)Overall, the scientific literacy skills of chemistry education students are in the low category (70%), only 15% are in the medium category and 15% are in the high category. The highest literacy aspect is in the content section, while the lowest is in the process and context section.

Enawaty & Erlina (2021) suggest that to improve chemical literacy skills for high school students or university students, it is better to use problem solving strategies and also Nature of Science (NOS) based learning. Based on the research results of Sumanik et al (2021) profiles of scientific literacy abilities of chemistry education teacher candidates in terms of knowledge at Musamus University semesters 3 and 5, it can be concluded that students' scientific literacy abilities in terms of content knowledge are moderate (N-gain 0.37), procedural aspects low (N-gain -0.10) and low epistemic aspect (N-gain 0.24). Overall, the knowledge aspect is classified as low (N-gain 0.228). Sumanik et al (2021) revealed that factors that affect low scientific literacy include factors of interest in learning, curiosity, study habits, learning styles, interest in reading and teaching techniques of a teacher or lecturer. The effort to overcome this low scientific literacy is to teach science literacy in a sustainable manner, organize the scope of the material and plan the learning process with the right learning model.

Muntholib et al (2020) explained the results of his research on the results of the chemical literacy test, the average score of first year students from lowest to highest was epistemic knowledge (52.33), knowledge of chemical content (56.00), explaining phenomena scientifically (56.00), interpret scientific data and evidence scientifically (59.75), evaluate and design scientific inquiry (66.67), and procedural knowledge (72.21). These results indicate that for selected students, low and medium cognitive demands (understanding and applying scientific knowledge) are more difficult than high cognitive demands (analyzing complex information or reasoning). The results of Laksono (2018) research, revealed that the results of the chemical literacy skills of 50 chemistry

education students at UIN Raden Fatah who had received laboratory management courses showed that the chemical literacy ability of chemistry education students was 73.33%. These results indicate that the chemical literacy skills of chemistry education students in waste management materials are moderate.

The results of Sumarni (2018) research showed that the scientific literacy abilities of 40 prospective chemistry education teacher students after receiving ethnoscience-based chemistry learning showed that their abilities were in the medium and high categories. Sumarni (2018) found that the application of ethnoscience-based learning in chemistry subjects could increase students' chemical literacy, especially at moderate to high levels in all student groups. The results of research by Dewi et al (2021)stated that the scientific literacy abilities of 31 chemistry education students at UNDIKMA Mataram through ethnoscience-based contextual collaboration learning showed that the overall achievement of the content, processes, and attitudes of science students experienced an increase in the moderate category.

Based on the analysis of several research results, it was found that the cause of the low ability of students' scientific literacy was due to the learning process which was only limited to rote theories and concepts without the support of meaningful learning, so that they did not train their thinking skills to make conclusions or give reasons based on the results of their understanding. Lessons that rarely train individuals to make arguments based on the results of observations or investigations, make it difficult to work on questions that require an analysis of existing scientific evidence or facts.

Other factors that cause low scientific literacy in students are interest in learning, curiosity, study habits, learning styles, and also interest in reading. Therefore, it is necessary to make efforts to improve scientific literacy skills through the application of learning models that train the ability to apply scientific knowledge that has been obtained in solving problems in everyday life. Problem- based learning models, ethnoscience-based learning, Science Technology Society (STS) learning models, and Nature of Science (NOS)-based learning. Some of the articles analyzed can be seen in Table 2.

Table 2. Article on The Scientific Literacy Skills of Preservice Teacher in Chemistry Learning

No	Research Title	Reference
1	Comparative study of scientific literacy: Indonesian and Thai pre-service science teachers report	(El Islami & Nuangchalerm, 2020)
2	Analysis of Science Literacy Ability of Chemistry Education Students at Tanjungpura University	(Putri et al., 2022)
3	Analysis of Science Literacy Skill of Chemistry Education Students of Tanjungpura University	(Febriyanti et al., 2021)
4	Analysis of Science Literacy Skills of Chemistry Education Students in Acid-Base Topics	(Enawaty & Erlina, 2021)
5	Analysis of Scientific Literacy Ability Profile of Chemistry Education Preservice Teacher	(Sumanik et al., 2021)
6	Chemical literacy: Performance of first year chemistry students on chemical kinetics	(Muntholib et al., 2020)
7	Study of Chemical Literacy Ability of Chemistry Education Students on Waste Management Material	(Laksono, 2018)
8	The Influence Of Ethnoscience-Based Learning On Chemistry To The Chemistry's Literacy Rate of The Prospective Teachers	(Sumarni, 2018)
9	Effect of Contextual Collaborative Learning Based Ethnoscience to Increase Student's Scientific Literacy Ability	(Dewi et al., 2021)

4. Conclusion

Scientific literacy is defined 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 made to nature through human activities. Through scientific literacy skills, students can apply science concepts in their interactions with the environment and use scientific processes in solving problems and making decisions in everyday life based on scientific evidence. However, until now based on the articles that have been analyzed, many Indonesian students' scientific literacy abilities are still in the low category.

One of the causes is the learning process which is only limited to rote theories and concepts without the support of meaningful learning, so that it does not train thinking skills to make conclusions or give reasons based on the results of their understanding. Lessons that rarely train individuals to make arguments based on the results of observations or investigations, make it difficult to work on questions that require an analysis of existing scientific evidence or facts.

Therefore it is necessary to make efforts to improve the scientific literacy skills of Indonesian students, such as applying problem-based learning models, ethnoscience-based learning, Science Technology Society (STS) learning, Nature of Science (NOS)-based learning and project-based learning. Some of these learning models are suitable for application in chemistry learning as an effort to improve the 8scientific literacy skills of Indonesian students.

References

Anggraeni, A. Y., Sri, W., & Nurul, H. A. (2020). Profil Peningkatan Kemampuan Literasi Kimia Siswa Melalui Pembelajaran Inkuiri Terbimbing Berbasis Kontekstual. *Jurnal Inovasi Pendidikan Kimia*, *14*(1), 2512–2523.

Denyer, D., & Tranfield, D. (2009). Producing a Systematic Review. In *The SAGE Handbook of Organizational Research Methods* (pp. 671–689).

Dewi, C. A., Erna, M., Martini, Haris, I., & Kundera, I. N. (2021). Effect of Contextual Collaborative Learning Based Ethnoscience to Increase Student's Scientific Literacy Ability. *Journal of Turkish Science Education*, *18*(3), 525–541. https://doi.org/10.36681/tused.2021.88

El Islami, R. A. Z., & Nuangchalerm, P. (2020). Comparative study of Scientific Literacy: Indonesian and Thai Pre-Service Science Teachers Report. *International Journal of Evaluation and Research in Education*, *9*(2), 261–268. https://doi.org/10.11591/ijere.v9i2.20355

Enawaty, E., & Erlina, E. (2021). Analysis of Science Literacy Skills of Chemistry Education

Students in Acid-Base Topics. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *10*(1), 8–15. https://doi.org/10.23960/jppk.v10.i1.2021.02

Febriyanti, R., Melati, H. A., Erlina, Sahputra, R., & Ulfah, M. (2021). Analysis of Science Literacy Skill of Chemistry Education Students of Tanjungpura University. *Jurnal Pendidikan Dan Pembelajaran Kimia*, *10*(3), 77–98. https://doi.org/10.23960/jppk.v10.i3.2021.09

Han, Y., Chong, W. K., & Li, D. (2020). A systematic literature review of the capabilities and performance metrics of supply chain resilience. *International Journal of Production Research*, *0*(0), 4541–4566. https://doi.org/10.1080/00207543.2020.1785034

Husamah, H., Suwono, H., Nur, H., & Dharmawan, A. (2022). Sustainable development research in Eurasia Journal of Mathematics, Science and Technology Education: A systematic literature review. *Eurasia Journal of Mathematics, Science and Technology Education*, *18*(5). https://doi.org/10.29333/ejmste/11965

Ihsan, M. S., & Jannah, S. W. (2021). Analisis Kemampuan Literasi Sains Peserta Didik dalam Pembelajaran Kimia Menggunakan Multimedia Interaktif Berbasis Blended Learning. *EduMatSains: Jurnal Pendidikan, Matematika Dan Sains*, *6*(1), 197-206. https://doi.org/10.33541/edumatsains.v6i1.2934

Imansari, M., Sumarni, W., & Sudarmin. (2018). Analisis Literasi Kimia Peserta Didik Melalui Pembelajaran Inkuiri Terbimbing Bermuatan Etnosains. *Jurnal Inovasi Pendidikan Kimia*, *12*(2), 2201–2211.

Laksono, P. J. (2018). Studi Kemampuan Literasi Kimia Mahasiswa Pendidikan Kimia Pada Materi Pengelolaan Limbah. *Orbital: Jurnal Pendidikan Kimia*, *2*(1), 1–12. https://doi.org/10.19109/ojpk.v2i1.2093

Lederman, J. S., Lederman, N. G., Bartos, S. A., Bartels, S. L., Meyer, A. A., & Schwartz, R. S. (2014). Meaningful Assessment of Learners' Understandings about Scientific Inquiry - The Views About Scientific Inquiry (VASI) questionnaire. *Journal of Research in Science Teaching*, *51*(1), 65–83. https://doi.org/10.1002/tea.21125

Muntholib, Ibnu, S., Rahayu, S., Fajaroh, F., Kusairi, S., & Kuswandi, B. (2020). Chemical literacy: Performance of first year chemistry students on chemical kinetics. *Indonesian Journal of Chemistry*, *20*(2), 468–482. https://doi.org/10.22146/ijc.43651

OECD. (2017). PISA 2015 assessment and analytical framework: science, reading, mathematic, financial literacy and collaborative problem solving (revised edition). In *OECD Publishing*.

OECD. (2019). PISA 2018 Assessment and Analytical Framework. In *OECD Publishing*. https://doi.org/10.1787/b25efab8-en

Permatasari, P., & Fitriza, Z. (2019). Analisis Literasi Sains Siswa Madrasah Aliyah pada Aspek Konten, Konteks, dan Kompetensi Materi Larutan Penyangga. *EduKimia*, *1*(1), 53–59. https://doi.org/10.24036/ekj.v1i1.104087

Putri, T. R., Masriani*, M., Rasmawan, R., Hairida, H., & Erlina, E. (2022). Analisis Kemampuan Literasi Sains Mahasiswa Pendidikan Kimia di Universitas Tanjungpura. *Jurnal IPA & Pembelajaran IPA*, *6*(2), 164–179. https://doi.org/10.24815/jipi.v6i2.25460

Sumanik, N. B., Nurvitasari, E., & Siregar, L. F. (2021). Analisis Profil Kemampuan Literasi Sains Mahasiswa Calon Guru Pendidikan Kimia. *Quantum: Jurnal Inovasi Pendidikan Sains*, *12*(1), 22. https://doi.org/10.20527/quantum.v12i1.10215

Sumarni, W. (2018). The Influence Of Ethnoscience-Based Learning On Chemistry To The Chemistry's Literacy Rate Of The Prospective Teachers. *Unnes Science Education Journal*, *7*(2), 198–205.

Sumarni, W., Sudarmin, Wiyanto, Rusilowati, A., & Susilaningsih, E. (2017). Chemical literacy of teaching candidates studying the integrated food chemistry ethnosciences course. *Journal of Turkish Science Education*, *14*(3), 60–72. https://doi.org/10.12973/tused.10204a

Sutrisna, N. (2021). Analisis Kemampuan Literasi Sains Peserta Didik SMA di Kota Sungai Penuh. *Jurnal Inovasi Penelitian*, *1*(12), 2683.

Turiman, P., Omar, J., Daud, A. M., & Osman, K. (2012). Fostering the 21st century skills through scientific literacy and science process skills. *Procedia-Social and Behavioral Sciences*, *59*, 110-116. https://doi.org/10.1016/j.sbspro.2012.09.253

Utami, G. N. (2021). *Implementation of Project*

Based Learning Model for Enhancing Students ' Practical Skill and Scientific Literacy. *10*(2), 103–112. https://doi.org/10.23960/jppk.v10.i2.2021.08

Wibowo, T., & Ariyatun, A. (2020). Kemampuan Literasi Sains Pada Siswa Sma Menggunakan Pembelajaran Kimia Berbasis Etnosains. *Edusains*, *12*(2), 214–222. https://doi.org/10.15408/es.v12i2.16382

Xiao, Y., & Watson, M. (2019). Guidance on Conducting a Systematic Literature Review. *Journal of Planning Education and Research*, *39*(1), 93–112. https://doi.org/10.1177/0739456X17723971.