STUDY OF SCIENCE LITERACY ABILITY OF CHEMISTRY PRE-SERVICE TEACHERS IN HYDROPONICS PRACTICUM

Evi Sapinatul Bahriah[*1], Siti Suryaningsih[2], Ivan Muhammad Maful[3]

[1,2,3] Chemistry Education, Faculty of Islamic Education and Teacher Training, UIN Syarif Hidayatullah Jakarta

**Corresponding author: evi@uinjkt.ac.id*

Abstract. *The ability of scientific literacy of indonesian student categorized as low. One of the contributing factors is that teachers have not maximized their efforts in building literacy in the learning process. The hydroponics practical in a biotechnology's subject, can be measure the ability of scientific literacy of a student because there is a science process in it. The aim of this reasearch is to determine the ability of scientific literacy of chemisty pre-service Teachers for the knowledge and competency's aspects in a hydroponics topic. The method used in this study was quantitative descriptive. Data were collected with an essay test of 10 questions and given to 50 chemistry pre-service teachers by purposive sampling. Data were analyzed using descriptive analysis techniques. Based on the results of the study, students' scientific literacy abilities in the knowledge aspect were 68.6% (good category) and in the competency aspect were 62.2% (sufficient category). Therefore, it can be concluded that the scientific literacy abilities of prospective chemistry teachers in hydroponic practicums are in the sufficient category and need to be improved further.*

Keywords: *Science Literacy, Knowledge and Competency's Aspects, Hydroponics*

INTRODUCTION

Education is a renewal of meaning and experience who related with people either did puroposively or organized to create the social experience process through escalating how human think [8]. When we talk about education, Indonesia's Education system still lack behind compared with other countries. Based on the reasearch PISA (Programme for International Student Assesment) in 2019, the quality of Indonesia's education system ranked 72nd out of 77 countries in total. And then if we specify to specific aspect like scientific literacy, Indonesia just scored 371 points such a small score compared with other countries. That was an ironic fact, because scientific literacy is very essential. Scientific literacy includes the way the student think scientifically to identify and deal with the social issues that impacts to the betterment of thinking and acting's skill of the student [27].

Based on the PISA's result there must be an evaluation from Indonesia's education system. The equal quality of educators being one of the problems that create the low score of Indonesia's student in terms of scientific literacy. That is proven by the low quality profile of the freshgraduate student and the lacking of educator's skill in scientific literacy [33]. In fact, scientific literacy is one of the 21st century learning challenges that all the teacher should have. 21st century science learning should give the science experience that relevant with the needs of learning without neglecting the objectives of education especially scientific literacy [34]. The scientific literacy itself is the ability to identify and intepret scientific issues in order to be able to conclude the conclusion with the basis of science [20]. The educator should developed the scientific literacy because through scientific literacy, it can gives the positive impacts not only for the teacher itself but also to student. To optimize the function of student's brain [19]. That is why it's really important to identify the scientific literacy's ability of the student in the college.

One of the course that linked with scientific literacy is biotechnology. Nowadays, scientific literacy refers to the functional aspect of science and technology that

correlates with human prosperity, economic development, and the quality of life who build the principal of biotechnology [37]. That is why biotechnology is the right course to determine the scientific ability of the student. When we talk about biotechnology, it will not be separate with hydroponics practicum. Hydroponics is a planting techniqe who's changing the soil as a planting media with some alternatives like tile chips, sand, gravel, grated wood or sterofoam [22]. Hydroponics believed to develop scientific's skill through differences, pattern, initiative, plan, and knowing cause and effect [17]. In addition, hydroponics is able to attract the interest of the youth about science, agricultural bussiness, and the understanding of scientific literacy [7]. The goal of this reasearch is to identify the scientific literacy ability of the student in knowledge and competency aspects in hydroponics practicum.

Knowledge aspect is all about the basic concept from science to help the understanding about the natural phenomenon and its change thorugh human activity [29]. PISA divided this aspect into three sub aspects they are: 1) content knowledge, including theory, idea, information, and fact. This knowledge construct by the past experience and used that as a scientific evidence to solve the issues related with science 2) procedural knowledge, is a knowledge that emphasizes the ability of sorting one information and another to be the intact valid information. Procedural knowledge needed in an activities that need the clear systematic process to get an accurate result during practicum 3) epistemic knowledge emphasizes the student to be able to describe and give a reason towards science issues. Therefore, the knowledge aspect is really important because the student with great knowledge aspect will be able to identify the questions better and also based the conclsion scientifically during the learning process [26].

The competency's aspect or what is commonly referred to as the scientific process is one aspect of scientific literacy which is defined as the process of an individual in answering a question and then processing all scientific information so that he can solve the scientific problems [18]. Practical activities are one method to improve students' understanding and skills [38]. For the competency's aspect, PISA divide into 3 sub aspects they are (1) explaining phonemena scientifically, at this stage it requires a person to recall the concepts or understandings that are in accordance with knowledge according to certain situations and conditions and apply them to be able to explain scientific phenomena that can be explained according to science (2) designing and evaluating scientific reasearch, this competency requires knowledge of aspects in scientific reasearch. For example how to measure a tool correctly, what variables must be added or changed to get the accurate results, or what steps should be taken in order to obtain the valid and accurate data (3) intepreting data and facts scientifically, this competency includes accessing scientific information and generating arguments and conclusions based on scientific theories or facts. The ability in this sub aspect also requires students to be able to read graphs, diagrams, and histograms base on scientific evidence [25]. The importance of competency's aspect is that allows a person to be able to make a decision with the knowledge they have and involved in matters of state, culture, and economic growth [4]. From the description above, reasearcher interested in studying this reasearch.

METHOD

The reasearch method used was descriptive reasearch method. Descriptive method is a method that has the ability to illustrate research but is not followed up to a further conclusion [32]. The reasearch was conducted online through the whatsapp group on June 24–30 2022. The sample in this reasearch was 50 chemistry pre-service teachers who had done the hydroponics practicum. After participating in the practical activities, chemistry pre-service teachers are expected to not only understand the content related to Hydrophonics but also be skilled in applying procedures logically and systematically.

The data collection technique in this reasearch was carried out by utilizing an online platform such as google form. The instrument used in this reasearch was a description test, which consisted of 10 items containing indicators for knowledge and competency's aspect each other five

questions. In the following Table 1, a grid of this reasearch's instrument presented

Table 1. Reasearch's Instrument Grid

Aspects of Scientific Literacy	Sub Aspects	Question Items	Total
Knowledge	Content	1, 2	2
	Procedural	7	1
	Epistemic	6, 8	2
Competence	Explain Phenomena Scientifically	3, 4	2
	Interpret Data and Evidence Scientifically	5, 9	2
	Evaluate and Design Scientific Enquiry	10	1
		Total	**10**

The data obtained is explained descriptively. The percentages obtained were then classified based on the scientific literacy ability category, namely very poor (0-39), poor (40-55), sufficient (56-65), good (66-79), and very good (80-100) [2].

RESULT AND DISCUSSION

The data from the research on the scientific literacy of prospective chemistry teachers in terms of knowledge and competence are shown in the following Table 2.

Table 2. Data of Scientific Literacy

Aspects of Scientific Literacy	Sub Aspects	%Average
Knowledge	Content	65
	Procedural	74
	Epistemic	66,7
	Average	**68,6 (Good)**
Competence	Explain Phenomena Scientifically	64
	Interpret Data and Evidence Scientifically	50,6
	Evaluate and Design Scientific Enquiry	72
	Average	**62,2 (Sufficient)**

Based on Tabel 2 that has been conducted, the percentage of students' overall scientific literacy skills is not much different. For the knowledge aspect, the percentage was 68.6% and for the competency aspect, the percentage was 62.2%. With these results, it can be categorized that the scientific literacy skills of pre-service chemistry teachers on the knowledge and competency indicators regarding the topic of hydroponic practicums are categorized as sufficient [39].

The scientific knowledge aspect refers to the basic concepts of science needed to understand natural phenomena and changes made by nature through human activities [29]. In the knowledge aspect, there are 3 sub-aspects that are assessed, namely the content knowledge sub-aspect, the procedural knowledge sub-aspect, and the epistemic knowledge sub-aspect. The average percentage of the scientific knowledge aspect is 68.6% and is categorized as good. The obtained data can be seen in the graph 1 below.

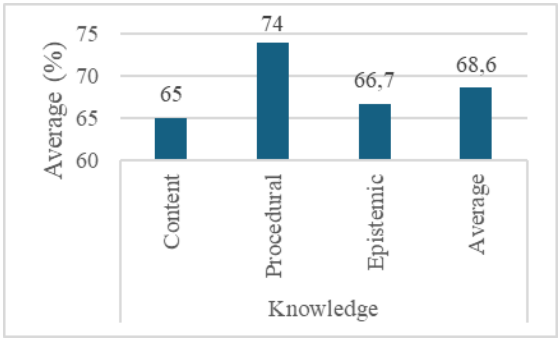

Figure 1. Graph of Scientific Literacy Ability in the Knowledge Aspect

Based on the image above, it is known that the average percentage of scientific knowledge is 68.6 (Good Category). This indicates that chemistry education students are

scientifically literate individuals. This is in accordance with [6] which states that an individual who has good scientific knowledge is called a scientifically literate society.

In the sub aspect of content knowledge, researchers present questions about the ideal humidity and temperature values of plants because the topic of ideal humidity and temperature of plants is a fact and theory that has a fixed fixed value. This is in line with [24] content knowledge is knowledge about theories, ideas, information, and facts.

Based on the results of the research that has been conducted, for the sub-aspect of student science content, a percentage of 65% was obtained or can be categorized as good [23] the percentage of student science literacy in the high content aspect indicates that the individual has mastered the concept of a material which is then driven by scientific literacy-based practicum guidelines. So the content aspect of scientific literacy is related to the understanding of concepts possessed by individuals in order to build a foundation of scientific knowledge that is owned [30]. Furthermore, good content knowledge skills will have a positive impact and are very important for all prospective teachers, this is supported by the theory of [14] which states that good content knowledge from a teacher will have a positive influence on decision making related to teaching activities. This is intended to create a better learning experience. A teacher who has good content knowledge skills will be able to construct material elements simultaneously to his students and will provide a more detailed learning experience for students.

In the sub-aspect of procedural knowledge, researchers asked questions about the topic of hydroponic plant planting period. Given 2 pieces of information related to the type of plant and the hydroponic plant planting period in random order, students are required to make both pieces of information into a single piece of correct and systematic information. This is in line with the results of research conducted by [3] which states that a procedure is a description of the implementation of a process that is structured as steps or instructions to make logical and systematic information.

From the research results, it was found that the percentage of students' scientific literacy skills in the procedural knowledge aspect was greater than the other two sub aspects of knowledge (content knowledge aspect and epistemic knowledge aspect) because students' understanding in the content aspect was already good about the planting period of hydroponic plants. This is in line with the research of [36] which states that understanding of the high scientific knowledge aspect (content knowledge) makes it easier for an individual to master procedural knowledge because they already have the initial understanding needed. As for the research that has been conducted, the percentage of students' procedural knowledge was 74% or can be categorized as good. Although these results are classified as good, these results are still considered less than ideal for a pre-service teachers. This is stated in the research [12] the expected results for the procedural knowledge aspect of a pre-service teachers are above 75%.

In the aspect of epistemic knowledge, researchers provide questions that are intended to hone students' ability to formulate answers to a scientific theory. Epistemic knowledge refers to explaining the difference between scientific theory and hypothesis or scientific fact [22]. This knowledge aims to enable pre-service chemistry teachers to interpret and answer questions and identify whether a scientific claim is justified by data and also show scientific evidence that supports the theory or hypothesis. Based on research data, the percentage of epistemic knowledge aspects was 66.65% (good category). The good category in epistemic knowledge is due to the strong mastery of science content and procedural knowledge. This is in accordance with the theory put forward [10] epistemic knowledge is advanced knowledge which is a reinforcement of the mastery of aspects of science content knowledge and good procedural knowledge aspects. Teachers' epistemic knowledge has an influence on increasing students' understanding of orientation in learning activities [15].

The aspect of scientific competence is one aspect of scientific literacy which is interpreted as the process of an individual in answering a question and then processing all

the scientific information he has to be able to solve scientific problems [18]. In the aspect of scientific competence, it is divided into three sub-aspects of scientific literacy, namely explaining scientific phenomena, interpreting data and proving it scientifically, and evaluating and designing scientific research. The average percentage data on this aspect can be shown in the following graph.

The aspect of scientific competence is one aspect of scientific literacy which is interpreted as the process of an individual in answering a question and then processing all the scientific information he has to be able to solve scientific problems [18]. In the aspect of scientific competence, it is divided into three sub-aspects of scientific literacy, namely explaining scientific phenomena, interpreting data and proving it scientifically, and evaluating and designing scientific research. The average percentage data on this aspect can be shown in the following graph 2.

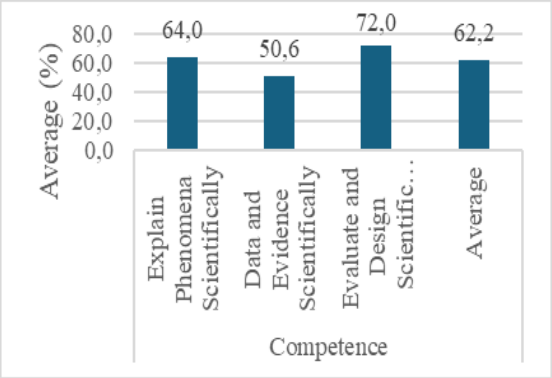

Figure 2. Graph of Scientific Literacy Ability in the Competence Aspect

The average percentage of the science competency aspect is 62.2% or categorized as good. A good competency aspect is an implication that students carry out hydroponic practicum activities well and are able to apply the competencies they have from the practicum activities in answering questions related to hydroponics. [21] said that the high or low science competency or science process skills of students are influenced by their experience in carrying out practicum activities. Through good practicum experiences, students' science process competencies or skills can be improved.

The aspect of explaining scientific phenomena is the competence to describe or explain phenomena, predict changes, and involve appropriate recognition, identification, description, explanation, and prediction [4] In the aspect of explaining scientific phenomena, researchers provide questions that contain the topic of scientific phenomena in the world of plants, especially hydroponics. There are two questions for this sub-aspect, the first question is in question number 3 the researcher asks about the phenomenon of chlorosis/yellow disease in leaves then in question number 4 the researcher asks about the phenomenon of collapsed plants that often occur in hydroponic cultivation. From these questions, students are expected to be able to describe and provide explanations related to the scientific phenomenon and apply this knowledge.

Based on the data, it is known that in the sub-aspect of explaining scientific phenomena, the percentage of students' scientific literacy skills was 64% (sufficient category). This is because awareness of scientific issues that occur in the environment around students is quite good [30] and students' understanding of the content is quite good [11]. The aspect of explaining scientific phenomena is an important aspect for pre-service teachers to master. This is in accordance with what was expressed by [9] a prospective teacher must be able to explain scientific phenomena that occur in the surrounding environment in order to answer students' high curiosity and can increase students' knowledge to a better level. In addition, prospective teachers must also be able to distinguish between facts and opinions so as not to cause misconceptions.

In the aspect of interpreting data and proving scientifically, the researcher gave two questions about the topic of hydroponics, namely regarding hydroponic methods and plant nurseries for hydroponics. In the questions, graphs and diagrams are presented, students are asked to be able to read data from the graphs and diagrams and to be able to provide an explanation of the information obtained from the graphs and diagrams presented and to interpret scientific findings from hydroponic practicum to draw a conclusion. This is in accordance with the theory put forward by [16] in interpreting data and proving scientifically, one of the scientific achievements achieved is being able to have the ability to interpret images, interpret graphs,

and mathematical equations. In addition, in this aspect, students are also required to interpret scientific findings as evidence for a conclusion [4]. In this aspect, it is known that for the question item interpreting graphs (question number 5) the percentage obtained is 40.67% (less) and for the question interpreting diagrams (question number 9) the percentage obtained is 60.67% (sufficient) and if accumulated as a whole, the percentage for the aspect of interpreting data and proving scientifically is 50.6% or categorized as sufficient. Rahmayanti The ability of the scientific literacy aspect that has not reached the good category is influenced by the lack of creative thinking which has an effect on the lack of ability to provide solutions [28]. If narrowed down specifically, these poor results are because students do not yet have the ability to recognize and understand the components in graphs or diagrams or the relationship of each component to the data context [35]. Another factor that causes the low percentage of scientific literacy skills in this aspect and occurs most often in student answers is that students only read the graph trend, namely the increase or decrease, without linking it to scientific phenomena or other information in it [31].

Menguasai sub aspek mengintepretasi data dan membuktikan secara ilmiah pada literasi sains sangatlah penting bagi guru. Mengingat aspek ini adalah aspek yang nantinya harus dimiliki oleh siswa sesuai dengan tuntutan kurikulum [13].

In the sub-aspect of evaluating and designing scientific research, researchers ask questions about materials around us that can be used in assembling the static floating raft hydroponic method. This is intended to explore students' abilities in evaluating what tools are appropriate for the method so that they can produce accurate data/results during hydroponic practicums. This is in accordance with the theory put forward by [24] in the aspect of the competence of evaluating and designing scientific research, this requires knowledge of the key features of scientific practicums, such as what should be done, what materials/ingredients should be used during the practicum, and what actions should be taken so that accurate and precise data can be obtained during scientific research.

From the research results, the percentage of students' scientific literacy skills in this sub-aspect was 72% or can be categorized as good. This shows that students have the ability to conduct experiments and investigations well [5].

Understanding the sub-aspects of evaluating and designing scientific research is a very important aspect, especially for pre-service chemistry teachers because later when teaching, chemistry teachers must be able to guide their students while students are doing practical activities. This is in accordance with the theory put forward by [1] which states that the ability of prospective teacher students to evaluate and design scientific research using practical methods is very useful for students so that they can plan, implement, and evaluate practical work well when they enter the world of schooling.

Based on the research data and discussion above, it can be seen that the scientific literacy skills of pre-service chemistry teachers students in terms of content and competency related to chemistry practical materials are included in the sufficient category.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the results and discussion, it can be concluded that the scientific literacy skills of prospective chemistry teacher students related to hydroponic practicums in the Biotechnology course are in the fairly good category. This is indicated by the average percentage of knowledge aspects of 68.6% (good category) and competency aspects of 62.2% (sufficient category).

Rekomendation

For teachers and lecturers, it is expected to facilitate students in learning, one of which is by maximizing practical activities, both real and virtual practicals, because through practical activities, students' scientific literacy skills can be honed to be better, thus creating competent pre-service chemistry teachers. And for subsequent researchers, in order to perfect this research by exploring other aspects of scientific literacy, such as aspects of context and attitudes in other chemical materials.

REFERENCES

[1] Agustina, P., Putri Kus Sundari, P., & Eri Ardani, D. (2016). Kemampuan Mahasiswa Calon Guru Biologi dalam Merancang Pembelajaran Berbasis Praktikum: Studi Kasus Mahasiswa Pendidikan Biologi FKIP UMS Biology Pre-Service Teacher's Ability in Designing Practice Based Learning: Case Study in Biology Education Students. Biologi, Sains, Lingkungan, Dan Pembelajarannya, *13(1), 536–540*.

[2] Arikunto, S. (2006). *Dasar-dasar Evaluasi Pendidikan Edisi Revisi*. Jakarta: Bumi Aksara.

[3] Badjeber, R., & Mailili, W. H. (2018). Analisis Pengetahuan Prosedural Siswa Kelas Smp Pada Materi Sistem Persamaan Linear Dua Variabel Ditinjau Dari Gaya Kognitif. *Jurnal Penelitian Dan Pembelajaran Matematika, 11(2), 41–54. https://doi.org/10.30870/jppm.v11i2.3753* .

[4] Bahriah, E. S. (2015). Kajian Literasi Sains Calon Guru Kimia Pada Aspek Konteks Aplikasi Dan Proses Sains. *Edusains, 7(1), 11–17*. https://doi.org/10.15408/es.v7i1.1395.

[5] Bahriah, E. S., Suryaningsih, S., & Yuniati, D. (2017). Pembelajaran Berbasis Proyek Pada Konsep Koloid Untuk Pengembangan Keterampilan Proses Sains Siswa. *JTK (Jurnal Tadris Kimiya), 2(2), 145–152. https://doi.org/10.15575/jtk.v2i2.1883.*

[6] Bond, D. (1989). In pursuit of chemical literacy: A place for chemical reactions. *Journal of Chemical Education, 66(2), 157–160. https://doi.org/10.1021/ed066p157*.

[7] Cassidy, S. (2019). Incorporating Hydroponics into academic curriculum to promote education and food security in developing nations. 9–25.

[8] Chambliss, J. J. (2003). John Dewey's Philosophy of Education Before Democracy and Education. Education and Culture, XIX(1), 1–7. http://docs.lib.purdue.edu/eandc/vol19/iss1/art2/

[9] Dwiyanti, A. N., & Rahayuni, G. (2019). Analisis Sikap Literasi Sains Calon Guru SD Berdasarkan Programme for International Student Assesment (PISA). Pancar, 3(1), 226–231.

[10] Fadilah, M., Permanasari, A., Riandi, R., & Maryani, E. (2020). Analisis Karakteristik Kemampuan Literasi Sains Konteks Bencana Gempa Bumi Mahasiswa Pendidikan IPA pada Domain Pengetahuan Prosedural dan Epistemik. *Jurnal IPA & Pembelajaran IPA, 4(1), 103–119. https://doi.org/10.24815/jipi.v4i1.16651*.

[11] Fadlika, R. H., Mulyani, R., & Dewi, T. N. S. (2020). Profil Kemampuan Literasi Sains Berdasarkan Gender di Kelas X. Quagga: *Jurnal Pendidikan Dan Biologi, 12(2), 104. https://doi.org/10.25134/quagga.v12i2.2326.*

[12] Firdaus, H. P. E. (2019). Kelancaran Prosedural Matematis Mahasiswa Dalam Menyelesaikan Masalah Matematika. Konferensi Nasional Penelitian Matematika Dan Pembelajarannya (KNPMP) IV, 1–8.

[13] Hafiyusholeh, M., Budayasa, K., & Siswono, T. Y. E. (2017). Literasi statistik : Siswa SMA dalam membaca , menafsirkan , dan menyimpulkan Data. *Prosiding SI MaNIs (Seminar Nasional Integrasi Matematika Dan Nilai Isami), 1(1), 79–85. http://conferences.uinmalang.ac.id/index.php/SIMANIS/article/view/41*.

[14] Harlen, W. (1997). primary teachers' understanding of concepts of science: impact on confidence and teaching. *International Journal of Education*.

[15] Heikkilä, M., Hermansen, H., Iiskala, T., Mikkilä-Erdmann, M., & Warinowski, A. (2020). Epistemic agency in student teachers' engagement with research skills. *Teaching in Higher Education, 0(0), 1–18. https://doi.org/10.1080/13562517.2020.1821638.*

[16] I Mustain. (2015). Kemampuan Membaca Dan Interpretasi Grafik Dan Data: Studi Kasus Pada Siswa Kelas 8 Smpn.

Scientiae Educatia, 5(2). www.syekhnurjati.ac.id.

[17] Indahwati, M. (2021). Implementasi pembelajaran sains pada anak melalui kegiatan menanam sayur kangkung hidroponik. 1, 72–109.

[18] Jufri, W. (2017). *Belajar dan Pembelajaran Sains Modal Besar Menjadi Guru Profesional.* Pustaka Reka Cipta.

[19] Kimaru, I. (2015). Perspectives on Science Literacy: A comparative study of United States and Kenya. *Educational Research International, 4(2), 25.http://fisherpub.sjfc.edu/chemistry_facpubhttp://libguides.sjfc.edu/citations.*

[20] Kurikulum, P., & Perbukuan, D. A. N. (2017). *Konsep Literasi Sains Dalam Kurikulum 2013 (Issue November).* Pusat Kurikulum dan Perbukuan

[21] Lestari, U. (2020). Deskripsi Keterampilan Proses Sains Mahasiswa Pendidikan Fisika. *Jurnal Universitas Jambi (UNJA), 1–10.*

[22] Lingga, P. (2018). *Hidroponik Bercocok Tanam Tanpa Tanah*. Penebar Swadaya.

[23] Mabsutsah, N. (2022). Jurnal Pendidikan MIPA. *Jurnal Pendidikan MIPA, 20(1), 23–29.*

[24] OCED. (2018). *PISA 2018 for Development Assessment and Analytical Framework. OECD Publishing*. https://www.oecd.org/education/pisa-2018-assessment-and-analytical-framework-b25efab8-en.htm.

[25] OECD. (2015). PISA 2015 Framework. Oecd, March 2015, 52. https://doi.org/10.1177/0022146512469014

[26] Pertiwi, U. D., Atanti, R. D., & Ismawati, R. (2018). Pentingnya Literasi Sains Pada Pembelajaran Ipa Smp Abad 21. *Indonesian Journal of Natural Science Education (IJNSE), 1(1), 24–29. https://doi.org/10.31002/nse.v1i1.173.*

[27] Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. *Jurnal Materi Dan Pembelajaran Fisika (JMPF), 9(1), 34–42.*

[28] Rahmayanti, S. P., Andayani, Y., & Al Idrus, S. W. (2021). Studi Kemampuan Literasi Sains Mahasiswa Pendidikan Kimia Terkait Etnosains Bau Nyale. *Jurnal Pijar Mipa, 16(3), 326–332. https://doi.org/10.29303/jpm.v16i3.2362*.

[29] Rini, C. P., Dwi Hartantri, S., & Amaliyah, A. (2021). Analisis Kemampuan Literasi Sains Pada Aspek Kompetensi Mahasiswa PGSD FKIP Universitas Muhammadiyah Tangerang. *Jurnal Pendidikan Dasar Nusantara, 6(2), 166–179. https://doi.org/10.29407/jpdn.v6i2.15320*.

[30] Sari, R. K., Melati, H. A., Enawaty, E., & Hadi, L. (2022). Profil kemampuan literasi kimia mahasiswa pendidikan kimia universitas tanjungpura. 10 (1).

[31] Subali, B., Rusdiana, D., Firman, H., & Kaniawati, I. (2015). Analisis Kemampuan Interpretasi Grafik Kinematika pada Mahasiswa Calon Guru Fisika. *Prosiding Simposium Nasional Inovasi Dan Pembelajaran Sains 2015, 2015(Snips), 269–272.https://ifory.id/proceedings/2015/z4pZjcJkq/snips_2015_bambang_subali_09f0e760028d437a74c0970183b105d8.pdf.*

[32] Sugiyono. (2005). *Memahami Penelitian Kualitatif*. CV Alfabeta.

[33] Sukasni, A., & Efendy, H. (2017). The Problematic of Education System in Indonesia and Reform Agenda. *International Journal of Education, 9(3), 183. https://doi.org/10.5296/ije.v9i3.11705*.

[34] Suryaningsih, S. (2022). Tantangan guru sekolah luar biasa pada pembelajaran ipa di abad 21. *ALOTROP:Jurnal Pendidikan Dan Ilmu Kimia, 6(1), 43–52*.

[35] Wahyuningrum, A. S. (2021). Analisis Kesalahan Mahasiswa dalam Menyajikan Representasi Visual Data Statistik pada Mata Kuliah Biostatistika. *EduBiologia: Biological Science and Education Journal, 1(1), 30. https://doi.org/10.30998/edubiologia.v1i1.8083.*

[36] Zakaria, M. R., & Rosdiana, L. (2018). Profil Literasi Sains Peserta Didik Kelas VII Pada Topik Pemanasan Global.

Pensa: *Jurnal Pendidikan Sains, 6(2), 170–174.*

[37] Zannati, A. (2019). Literasi “melek” sains dan bioteknologi. *BioTrends, 10(1), 1–.* ← *Journal*

[38] S. Trimayanto, Dian Novita. (2019). The Effectiveness Of Practicum Kit as a A Learning Media To Train Science Prosess Skills (SPS). *Journal of Chemistry Education ResearchVol. 3, No. 2, December 2019 (35-41).*