IJORER : International Journal of Recent Educational Research
Homepage : https://journal.ia-education.com/index.php/ijorer
Email : ijorer@ia-education.com

p-ISSN : 2721-852X ; e-ISSN : 2721-7965
IJORER, Vol. 4, No. 4, July 2023
Page 457-468

Validity of Inquiry-Based Textbooks on Scientific Literacy Skills

Dian Roudlotul Jannah[1*], Sifak Indana[2], Fida Rachmadiarti[3]
[1,2,3] Universitas Negeri Surabaya, Surabaya, Indonesia

Check for updates OPEN ACCESS

DOI: https://doi.org/10.46245/ijorer.v4i4.313

Sections Info

Article history:
Submitted: January 22, 2023
Final Revised: May 13, 2023
Accepted: May 20, 2023
Published: July 7, 2023

Keywords:
Biology;
Inquiry;
Scientific literacy;
Textbooks;
Validity.

ABSTRACT

Objective: This study describes the validity of inquiry-based environmental change textbooks used to train students' scientific literacy skills. The validity of the developed inquiry-based textbooks is viewed from the aspects of content feasibility, presentation feasibility, linguistic feasibility, inquiry suitability, and scientific literacy. **Method:** This study used the development method with the 4D model (define, design, and develop), which was modified and implemented in the Science Education Postgraduate Program at Surabaya State University. The data collection technique was carried out using the textbook validation method. The assessment instrument used was a textbook validation sheet that two biology lecturers validated as validators. Data analysis was carried out quantitatively and descriptively. **Results:** The research results are in the form of validation of inquiry-based textbooks, with an average score of 94.88% in the very valid category. **Novelty:** The novelty of this research is that there are inquiry-based features in textbooks about environmental change that can improve students' scientific literacy skills. Based on the data analysis, the developed inquiry-based textbooks are valid and suitable for learning.

INTRODUCTION

Education in the 21st century has heavy demands, so the community or students must have extensive knowledge to become a quality society (Wijaya, 2016). Students are facing significant changes in all aspects of life (Fitriani, 2022). Several skills must be possessed by students in 21st-century education, namely critical thinking, communication, collaboration, and creativity, or what is known as the 4C (Septikasari, 2018). These skills are very necessary so that students are ready and able to keep up with the demands of the times and achieve one of the goals of 21st-century education, which is to increase students' scientific literacy skills (Sutrisna, 2021), in line with Simmamora (2020), which states that scientific literacy skills are one of the skills needed by students to deal with every aspect of global life in the 21st century.

Scientific literacy is an individual's ability to use their knowledge to identify problems, acquire new knowledge, explain scientific phenomena, and draw conclusions based on evidence related to scientific issues (Wulandari, 2016). This is supported by Probosari's (2016) finding that scientific literacy skills are needed in everyday life to help solve problems. Literacy is focused on reading and writing and other activities such as observing, asking, trying, reasoning, and communicating (Djamahar, 2018). Someone who has good scientific literacy skills will be able to survive in the 21st century. Factors that can increase scientific literacy skills are science-related literacy problems related to identifying, analyzing, and making decisions to solve problems (Winarni, 2019). Students with scientific literacy skills can use scientific knowledge, identify questions, and draw conclusions based on facts about issues related to nature and technology through their activities. Students can solve problems using scientific

concepts obtained in the educational aspect to be creative in creating technology so that students can make the right decisions in solving problems (Saraswati, 2021).

Scientific literacy consists of scientific knowledge and skills individuals must master in decision-making. Turiman (2012) Therefore, strengthening scientific literacy in each student is very important. Based on the PISA (Program for International Student Assessment) results from 2000 to 2018, Indonesia is ranked 70 out of 78 countries (OECD, 2018). it shows that the level of scientific literacy of students in Indonesia is still in the low category because the scores obtained are still below the average PISA mastery score (Sutrisna, 2021). One way to train scientific literacy can be done through inquiry-based textbooks, in line with Hanum's (2021) statement that using the guided inquiry learning model can improve the science literacy skills of tenth-grade high school students.

Guided inquiry is a learning model in which students search for various sources of information to increase their understanding of problems, topics, or issues in learning. Student-centered learning methods have the advantage of adding depth to understanding knowledge (Hanewicz, 2017). In addition, guided inquiry applications can also improve long-term memory, critical and creative thinking skills, motivation to learn science, and cognitive learning outcomes in science (Sulistyani, 2022). Learning with the inquiry method provides opportunities for authentic learning, not just learning to accept (Ha & Kim, 2019). Learning using the inquiry method has also proven effective in improving student learning outcomes, based on Jannah et al.'s research (2020), because through the inquiry method, students are more active in acquiring their knowledge directly, making it easier to remember and interpret. Guided inquiry is also a learning model that can help students carry out extensive independent experiments to observe what is happening, explore what they are doing, ask questions, find answers, and connect one discovery to another (Zhai, 2021).

Accordance with Saraswati (2021) states that using appropriate learning methods can improve scientific literacy skills in students. Based on Merta et al.'s research (2020), it is stated that the use of the guided discovery learning model can improve scientific literacy skills in students; this is supported by Fitriyani & Munzil's research (2016), which shows that learning using the guided inquiry method can increase scientific literacy in science lessons. So, there is some compatibility between the guided inquiry learning method and scientific literacy. The application of guided inquiry has several areas for improvement, namely related to a more extended time allocation, where students need a long time to search and collect data or information during the investigation, compared to conventional methods (Sukariasih et al., 2019).

The learning material used in this study is environmental change material related to everyday life. In the matter of environmental change, students are required to analyze data on environmental change and the impact of environmental change on life and solve environmental problems so that they can apply their understanding in everyday life. Students require problem-solving abilities in order to solve problems that arise in their lives (Muwaffaqoh, 2021). Presentation of contextual problems through the learning process can also be one way to train students' scientific literacy (Afriana, 2022). One way to achieve this is through inquiry-based textbooks implemented during learning. Scientific literacy skills are developed through learning activities using inquiry-based textbooks, so inquiry-based textbooks are needed to achieve the basic content charge on environmental change material in class X. So it is necessary to validate textbooks developed by Lestari's research (2022), which indicates that valid,

practical, and effective textbooks are one of the main factors influencing research results. This research aims to validate inquiry-based textbooks in terms of content feasibility, presentation feasibility, and language proficiency.

RESEARCH METHOD

This research is a quantitative descriptive study using the 4D model (define, design, and develop), which was adapted from Thiagarajan et al. (1974) in Ibrahim (2002). This study's trial design was a pre-experiment (one group pretest-posttest design). This study aimed to produce an inquiry-based textbook on environmental change to train high school students in science literacy skills that are valid and theoretically feasible. This textbook can be used as a supplement to the Environmental Change chapter in Biology for Class X SHS. Textbook development will be done in June 2022 at the Surabaya State University Postgraduate Program. Figure 1 is the research procedure.

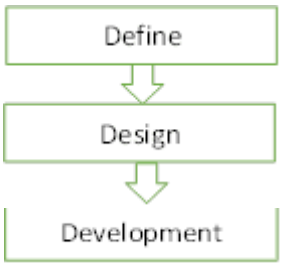

Figure 1. Research procedure.

The textbooks developed are inquiry-based textbooks that are validated based on content feasibility, presentation feasibility, linguistic feasibility, suitability with inquiry, and suitability with scientific literacy. The textbook was then reviewed and validated by two validators.

Instrument and Procedure

The theoretical feasibility data collection technique uses the review and validation method. The research instrument used in this study was a textbook validation sheet. The eligibility of textbooks will be measured based on the assessment by two (two) validators on validation sheets consisting of media expert lecturers and subject matter expert lecturers. The formulation of the questions on the validation sheet was adapted based on the National Education Unit Agency (NEUA), with adjustments made according to the needs of researchers. The questions consist of three aspects, namely: (1) the content feasibility component; (2) the presentation feasibility component; (3) the language feasibility component; (4) the suitability of textbooks with guided inquiry; and (5) the suitability of textbooks with scientific literacy. The range of values given on this validation assessment sheet starts from 1 to 4. A textbook is declared valid with a minimum average value of 2.6. The textbook validation procedure starts with problem analysis, gathering information, textbook preparation, and textbook validation by the validator.

Data analysis

Data analysis of textbook validation results was carried out by calculating the average value obtained from validators 1 and 2 to determine the quality of the developed

textbooks. A textbook is declared valid if it has a minimum average value of 2.60, as can be seen in Table 1.

Table 1. Criteria for data validation results

Average score	Category
1,00 -1,75	Less valid
1,76 - 2,50	Quite valid
2,60 – 3,25	Valid
3,26 -4,00	Very valid

(Adapted from Ridwan, 2013)

After obtaining the results of the textbook validity value, its reliability will be calculated. The percentage of textbook reliability is calculated using the formula:

$$R = \left(1 - \frac{A-B}{A+B}\right) x\ 100\%$$

Information:
R: Instrument reliability (Percentage of Agreement)
A: Higher score than the validator
B: Score lower than the validator
Learning device reliability is considered valid if the reliability value is ≥ 0.60 or ≥60.00% (Ghozali, 2016; Prahani et al., 2020).

RESULTS AND DISCUSSION

Results

The research results are in the form of validation of inquiry-based textbooks that have been reviewed by the Unesa biology lecturer as a validator. The components of the validation assessment are validating aspects of content eligibility, presentation eligibility aspects, language feasibility aspects, conformity aspects with inquiry, and suitability aspects with scientific literacy. The results of validating student textbooks on the eligibility aspects of the contents developed are presented in Table 3.

Table 3. The results of Textbook Validation are based on the content feasibility aspect.

Assessment Aspects	**Average score**	**Percentage**	**Interpretation**
Material coverage	3.00	75.00%	Valid
Material accuracy	3.00	75.00%	Valid
Update	3.50	87.50%	Very Valid
Average	3.16	79.10%	Valid

Based on Table 3, the average percentage of content feasibility obtained is 79.10% and is categorized as valid. This is because the textbook has proper material coverage, good material accuracy, and is up-to-date. Each material in the textbook is prepared by adjusting the material to the determined BC and indicators. Good material coverage and accuracy will help students better understand the discussed material. This is consistent with Dewi's (2021) claim that textbooks are one of the media that can improve students' scientific literacy skills.

Table 4. Textbook validation results based on presentation feasibility aspects.

Assessment Aspects	Average score	Percentage	Interpretation
Serving Technique	3.75	93.75%	Very Valid
Supporting the presentation of the material	4.00	100.00%	Very Valid
Presentation of Learning	4.00	100.00%	Very Valid
There is a description of scientific literacy indicators	4.00	100.00%	Very Valid
Average	3.93	98.43%	Very Valid

Based on Table 4, the average presentation feasibility percentage obtained is 98.43 percent and is categorized as very valid. This is because the textbook has a colorful display quality accompanied by consistent pictures and presentation systems, as well as the presentation of student-centered learning. The preparation of each content item in the textbook is arranged with a neat layout composition, image content, and concept sequences appropriate to the context of the material, accompanied by indicators of scientific literacy so that the textbook is engaging. Good presentation quality will help students understand the discussed material (Agustina et al., 2021).

Table 5. Textbook validation results based on language feasibility aspect.

Assessment Aspects	Average score	Percentage	Interpretation
Language Use	3.75	93.75%	Very Valid
sentence use	4.00	100.00%	Very Valid
Average	3.87	96.87%	Very Valid

Based on Table 5, the average percentage of language eligibility obtained is 96.87% and is categorized as "very valid." The use of language in textbooks is adjusted to the spelling rules that are refined and use simple, easy-to-understand, and unambiguous sentences by the writing rules in the BNSP, namely having an educational category aligned with the cognitive level of students and following and using the correct terms (Welter et al., 2022).

Table 6. Validation of textbooks based on suitability with inquiry and compatibility with scientific literacy.

Assessment Aspects	Average score	Percentage	Interpretation
Compatibility with inquiry	4.00	100.00%	Very Valid
Compatibility with scientific literacy	4.00	100.00%	Very Valid
Average	4.00	100.00%	Very Valid

Based on Table 6, the average percentage of eligibility based on aspects of conformity with inquiry and aspects of conformity with scientific literacy obtained is 100% and is categorized as "very valid." Inquiry-based learning can positively influence learning outcomes because of its benefits in increasing students' scientific literacy (Simmamora et al., 2020). The inquiry method used in developing this textbook includes (1) identifying problems, (2) formulating problems, (3) formulating hypotheses, (4) designing experiments, (5) collecting data and analyzing data, and (6) concluding (Tangkas, 2012). This can be realized by involving students in being active in learning; one of the activities carried out by students with the inquiry method is scientific investigation, and scientific investigation activities can improve students' conceptual understanding. Through inquiry-based learning activities, students practice identifying,

analyzing, and developing their skills for solving problems in their environment. This is in line with the indicators of scientific literacy, namely identification, acquisition of new knowledge, explaining scientific phenomena, and drawing conclusions based on facts (Wulandari, 2016)

Discussions

Textbooks contain descriptions of material about specific subjects or fields of study, which are arranged systematically and selected based on specific goals, learning orientation, and student development to be assimilated. One of the efforts to improve student learning outcomes is developing correct textbooks according to student needs. So that books must also equip students with activities that guide students to work on scientific processes in a systematic manner (Elvionita et al., 2019).

The developed textbook aims to make it easier for students to obtain information related to environmental change material and train their scientific literacy skills. The developed textbook contains steps of the inquiry learning model: identifying problems, formulating problems, formulating hypotheses, designing experiments, collecting and analyzing data, and drawing conclusions with teacher guidance (Hera et al., 2014; Tangkas, 2014). Environmental pollution material in this textbook is divided into three topics: air pollution, water pollution, and soil pollution. The description of the developed textbook is presented in Figure 2.

(a)

(b)

(c) (d)

Figure 2. (a) Initial view of the textbook, (b) air pollution sub-material, (c) water pollution sub-material, (d) soil pollution sub-material.

To use the inquiry method and train students' scientific literacy, textbooks are equipped with features that support student activities. A description of the features in the textbook is in Table 2.

Table 2. Description of the features in the textbook

Growth Activity Science literation	Feature	Information
Activity 1. Identification		This can make it easier for students to identify environmental pollution problems.
Activity 2. Acquire new knowledge		This can facilitate students in making experimental designs
Activity 3. Explain scientific phenomena		This can make it easier for students to guess about environmental problems temporarily.
Activity 4. Science in life		This can make it easier for students to solve problems and relate to everyday life.

In the air pollution sub-material, the first activity is observation. Students identify the initial concepts or information needed to formulate efforts to tackle air pollution through the Let's Learn feature. Furthermore, students were asked to answer several questions related to article information through the Let's Think feature. Furthermore, students carry out experimental activities in the "let us try" feature found in textbooks related to the effect of the presence of plants on air temperature. After experimenting, students were asked to make a report on the results of the practicum that had been

carried out. Furthermore, students draw conclusions based on facts and link air pollution with everyday life through scientific features in life by carrying out independent tasks, namely making conclusions regarding the relationship between the existence of trees and air temperature and carrying out independent tasks of planting trees as a form of concern for the environment in Figure 3.

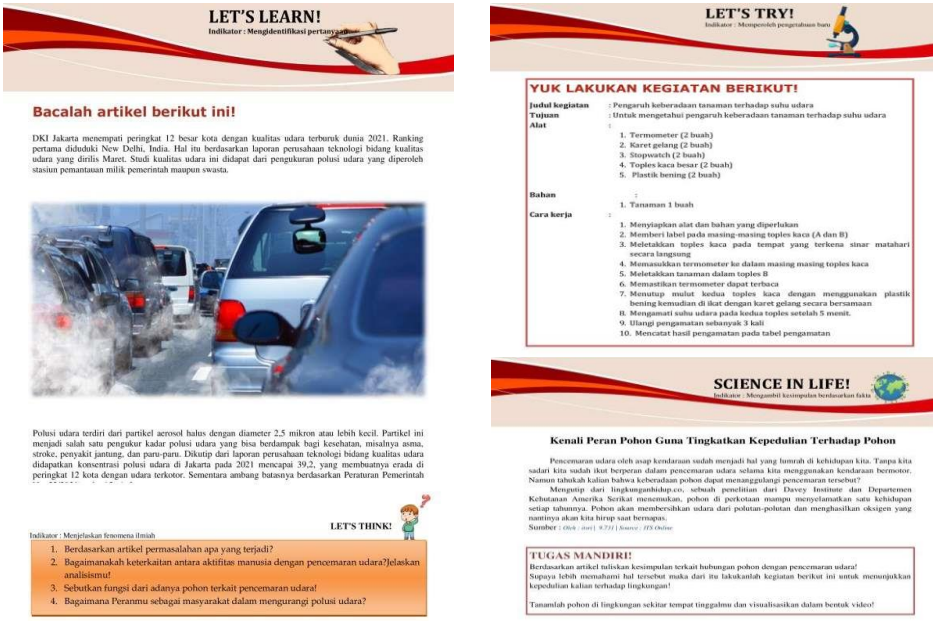

Figure 3. Inquiry features in the sub-material textbook on air pollution.

In the water pollution sub-material, the first activity is observation. Students identify the initial concepts or information needed to formulate efforts to tackle water pollution through the Let's Learn feature. Furthermore, students were asked to answer several questions related to article identification through the Let's Think feature. Furthermore, students carry out experimental activities in the "let us try" feature found in textbooks related to the effect of detergent concentration on the frequency of opening and closing the operculum in fish. After experimenting, students were asked to make a report per the results of the practicum that had been carried out. Furthermore, students draw conclusions based on facts, link the importance of clean water in the lives of living things through the science in life feature, and carry out independent tasks, namely making posters to reduce water pollution in Figure 4.

Figure 4. Inquiry features in the sub-material textbook on water pollution.

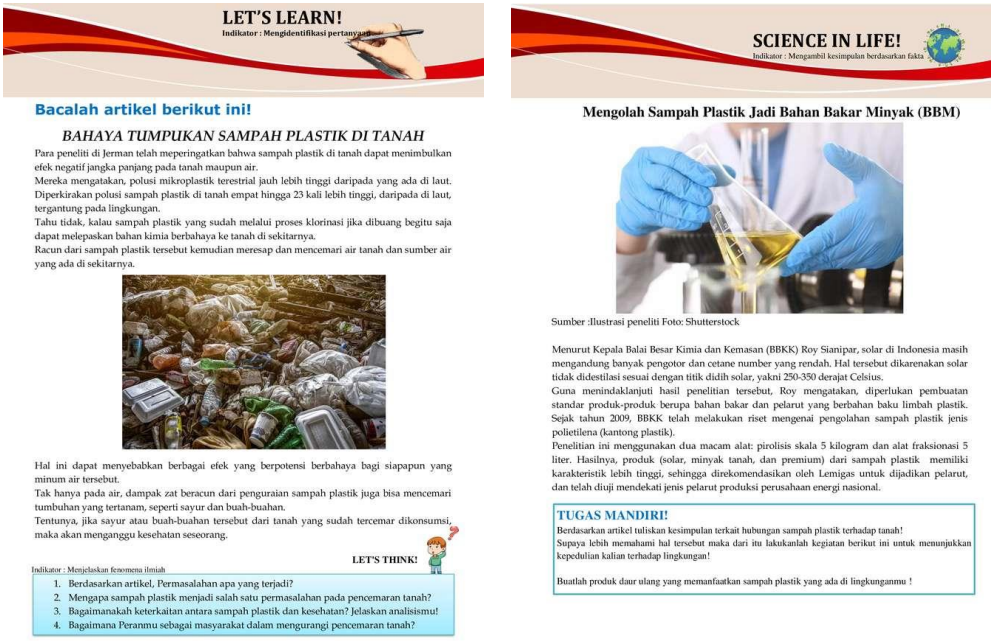

Figure 5. Inquiry features in textbooks on soil pollution sub-materials.

Furthermore, students draw conclusions based on facts, conclude the relationship between plastic waste and soil pollution through the science in life feature, and carry out independent tasks, namely making recycled products from plastic waste in Figure 5. In the soil pollution sub-material, the first activity is observation. Students identify the initial concepts or information needed to formulate efforts to tackle soil pollution through the Let's Learn feature. Furthermore, students were asked to answer several questions related to article identification through the Let's Think feature. Furthermore, students are required to write a report based on their practicum results (Ranti et al., 2020).

CONCLUSION

Fundamental FIndings : In this study were in the feasibility of inquiry-based environmental change textbooks to train students' scientific literacy skills that had been developed and declared fit for use in learning. The validation assessment was conducted from content feasibility presentation feasibility of 98.43%, language feasibility of 96.87%, and suitability of inquiry-based textbooks with scientific literacy of 100.00%. This research implies a few difficulties when determining indicators of scientific literacy. **Limitation** of this research is that it only developed inquiry-based textbooks to train scientific literacy on environmental pollution material. **Future Research** : Inquiry-based textbooks will likely be developed to train scientific literacy skills in other materials.

REFERENCES

Afriana, J. (2022). Pengaruh PjBL STEM terhadap literasi sains dan problem solving siswa SMP. *Jurnal Didaktika Pendidikan Dasar, 6*(2), 627-638. https://doi.org/10.26811/didaktika.v6i2.551

Agustina, D. I., Rachmadiarti, F., & Kuntjoro, S. (2021). Development of environmental pollution handling flipbook based on surabaya local wisdom to train students' ethno-conservation. *International Journal of Recent Educational Research*, *3*(4), 16-30. https://doi.org/10.46245/ijorer.v4i1.268

Dewi, V. C., Susantini, E., & Poedjiastoeti, S. (2021) The use of biology textbook based on collaborative learning model to improve scientific literacy skill. *International Journal of Recent Educational Reseach, 2*(4), 444-454. https://doi.org/10.46245/ijorer.v2i4.130

Djamahar, R., Ristanto, R. H., Sartono, N., & Ichsan, I. Z. (2018). CIRSA: Designing instructional kits to empower 21st century skill. *Educational Process: International Journal*, 7(3), 200-208. http://dx.doi.org/10.22521/edupij.2018.73.4.

Elvionita, S., Ratnawulan, R., & Fauzi, A. (2019). Evaluating the validity of integrated science textbook on the theme of tsunami using webbed model based on polya problem solving to enhance students' preparedness toward disaster. *Journal of Physics Conference Series*, *1185*(1), 1-10. http://doi.org/10.1088/1742-6596/1185/1/012062

Fitriani H., Samsuri, T., Rachmadiarti, F., Raharjo, R., & Mantlana, C. D. (2022). Development of evaluative-process learning tools integrated with conceptual problem-based learning models: Study of its validity and effectiveness to train critical thinking. *International Journal of Essential Competencies in Education*, *1*(1), 27-37. https://doi.org/10.36312/ijece.v1i1.736

Fitriyanti, I., & Munzil, M. (2016). Penerapan strategi pembelajaran inkuiri terbimbing berbantuan media untuk meningkatkan ketrampilan berpikir ilmiah siswa pada pembelajaran IPA SMP. *Jurnal Penelitian Pendidikan IPA, 1*(1), 1-6. https://doi.org/10.26740/jppipa.v1n1.p1-6

Ghozali, G. (2016). *Aplikasi analisis multivariete dengan program IBM SPSS*. Badan Penerbit Universitas Diponegoro.

Ha, H., & Kim, H. B. (2019). A theoretical investigation on agency to facilitate the understanding of student-centered learning communities in science classrooms. *Journal of the Korean Association for Science Education*, 39(1), 101-113. https://doi.org/10.14697/jkase.2020.40.6.631

Hanewicz, C., Platt, A., & Arendt, A. (2017). Creating a learner-centered teaching environment using student choice in assignments. *Distance Education*, *38*, 273–287. https://doi.org/10.1080/01587919.2017.1369349

Hanum, W. (2021). Pengaruh model pembelajaran inkuiri terbimbing terhadap kemampuan literasi sains siswa pada materi keanekaragaman hayati di kelas X SMA Negeri 1 gandapura. *Jurnal edukasi dan sains Biologi*, *10*(2), 1-10.

Hera, R., Khairil, & Hasanuddin, H. (2014). Pengembangan handout pembelajaran embriologi berbasis kontekstual pada perkuliahan perkembangan hewan untuk meningkatkan pemahaman konsep mahasiswa di universitas muhammadiyah banda aceh. *Jurnal EduBio Tropika, 2*(2), 187-250.

Ibrahim, M. (2002). *Pengembangan perangkat pembelajaran*. Depdiknas.

Jannah, M., Supardi, Z. A. I., & Prabowo, P. (2020). Guided inquiry model with the REACT strategy learning materials to improve the students' learning achievement. *IJORER : International Journal of Recent Educational Research, 1*(2), 156-168. https://doi.org/10.46245/ijorer.v1i2.45

Lestari, E. P., Wasis, W., & Purnomo, T. (2022). Science learning materials in integrated PBL scientific literacy model to improve problem solving ability of junior high school students. *IJORER : International Journal of Recent Educational Research, 3*(4), 464-477. https://doi.org/10.46245/ijorer.v3i4.230

Merta, I. A., 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

Muwaffaqoh, D., Kirana, T., & Rachmadiarti, F. (2021). The development of e-book based on project based learning on the plant anatomy structure material. *International Journal of Recent Educational Research*, *2*(4), 416-431. https://doi.org/10.46245/ijorer.v2i4.127

OECD. (2018). *Programme for international student assesment (PISA) result PISA 2018*. OECD Publishing

Prahani, B. K., Jatmiko, B., Hariadi, B., Sunarto, D., Sagirani, T., Amelia, T., & Lemantara, J. (2020). Blended web mobile learning (BWML) model to improve students' higher order thinking skills. *International Journal of Emerging Technologies in Learning*, *15*(11), 42–55. https://doi.org/10.3991/IJET.V15I11.12853

Probosari R., Sajidan, S., Suranto, S., & Prayitno, B. A. (2016). Dampak inkuiri berjenjang terhadap dimensi literasi sains calon guru biologi. *Proceeding Biology Education Conference*, *13*(1), 450-454.

Ranti, N.F., Koes, S., & Mahanal, S. (2020). Pengaruh model pembelajaran inkuiri terbimbing terhadap literasi sains siswa kelas V SD. *Jurnal pendidikan, 4*(12), 1704—1710. http://dx.doi.org/10.17977/jptpp.v4i12.13096

Riduwan, R. (2013). *Dasar-dasar Statistika*. Alfabeta.

Saraswati, Y., Indana, S., & Sudibyo, E. (2021). Science literacy profile of junior high school students based on knowledge, competence, cognitive, and context aspects. *International Journal of Recent Educational Research*, *2*(3), 329-341. https://doi.org/10.46245/ijorer.v2i3.118

Septikasari, R., & Frasandy, R. N. (2018). Keterampilan 4C abad 21 dalam pembelajaran pendidikan dasar. *Tarbiyah Al-Awlad*, *8*(2), 107–117. https://doi.org/10.15548/alawlad.v8i2.1597

Simamora, A, B, Wahono, W., & Sanjaya, I. G. M. (2020). Innovative learning model: Improving the students' scientific literacy of junior high school. *International Journal of Recent Educational Research*, 1(3), 271-285. https://doi.org/10.46245/ijorer.v1i3.55

Sukariasih, L., Saputra, I. G. P. E., Ikhsan, F. A., Sejati, A. E., & Nisa, K. (2019). Improving the learning outcomes of knowledge and inquiry skill domain of third grade students at SMP negeri 14 kendari using guided inquiry learning model assisted by science kit. *Jurnal Geosfera Indonesia*, *4*(2), 175-187. https://doi.org/10.19184/geosi.v4i2.10097.

Sulistyani, K., Indana, S., & Sudibyo, E. (2022). The analysis effectiveness of guided inquiry implementation to improve students' science process skills. *International Journal of Recent Educational Research*, *3*(6), 672-687. https://doi.org/10.46245/ijorer.v3i6.258

Sutrisna, N. (2021). Analisis kemampuan literasi sains peserta didik SMA di kota sungai penuh. *Jurnal Inovasi Penelitian*, *1*(12), 2683-2694. https://doi.org/10.47492/jip.v1i12.530

Tangkas, I. M. (2012). Pengaruh implementasi model pembelajaran inkuiri terbimbing terhadap kemampuan pemahaman konsep dan keterampilan proses sains siswa kelas x SMAN 3 amlapura. *Jurnal Pendidikan IPA Ganesha*, *15*(1). 18-31.

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

Welter, V., Emmerichs, L., & Schluter, K. (2022). What do the relationships between pre-service biology teachers' personality and professional knowledge reveal about their innovativeness an exploratory study using canonical correlation analysis. *Education Sciences*, *12*(396), 1-10. https://doi.org/10.21831/jipi.v2i1.8804

Wijaya, E. Y., Sudjimat, D. A., & Nyoto, A. (2016). Transformasi pendidikan abad 21 sebagai tuntunan pengembangan sumber daya manusia di era global. *Prosiding Seminar Nasional Pendidikan Matematika, 1*(26), 263-278.

Winarni, E. W., Hambali, D., & Purwandari, E. P. (2020). Analysis of language and scientific literacy skills for 4th grade elementary school students through discovery learning and ICT media. *International Journal of Instruction*, *13*(2), 213–222. https://doi.org/10.29333/iji.2020.13215a

Wulandari, N., & Sholihin, H. (2016). Analisis kemampuan literasi sains pada aspek pengetahuan dan kompetensi sains siswa SMP pada materi kalor. *Edusains*, *8*(1), 66-73. https://doi.org/10.15408/es.v8il.1762

Zhai, X. (2021). Advancing automatic guidance in virtual science inquiry: From ease of use to personalization. *Educational Technology Research and Development*, *69*(1), 255-258. https://doi.org/10.1007/s11423-020-09917-8

*__Dian Roudlotul Jannah, M.Pd. (Corresponding Author)__
Postgraduate Programme, Science Education Study Program, Continuing Program Development,
J Universitas Negeri Surabaya,
l. Unesa Lidah Wetan, Surabaya, 60213, East Java, Indonesia.
Email: dianroudlotul9@gmail.com

Dr. Sifak Indana, M.Pd.
Universitas Negeri Surabaya,
Jl. Unesa Lidah Wetan, Surabaya, 60213, East Java, Indonesia.
Email: sifakindana@unesa.ac.id

Prof. Dr. Fida Rachmadiarti, M.Kes.
Universitas Negeri Surabaya,
Jl. Unesa Lidah Wetan, Surabaya, 60213, East Java, Indonesia.
Email: fidarachmadiarti@unesa.ac.id