JPPIPA 9(5) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Science Literacy of Elementary School Students through Science Practical Work Learning Method

Isti Rokhiyah[1], Mestika Sekarwinahyu[2], Amalia Sapriati[1*]

[1] Basic Education Program, Universitas Terbuka, Indonesia.
[2] Biology Education Program, Universitas Terbuka, Indonesia.

Received: March 30, 2023
Revised: May 26, 2023
Accepted: May 29, 2023
Published: May 31, 2023

Corresponding Author:
Amalia Sapriati
lia@ecampus.ut.ac.id

DOI: 10.29303/jppipa.v9i5.3761

Abstract: This study describes the science literacy of elementary school students who are taught using the science practical work method. The research was conducted on grade 4 and grade 5 students at six public and private elementary schools in South Tangerang City, Banten. Data collection was carried out using tests, observation sheets, student activity sheets, and questionnaires. The results showed that students had good understandings, good performance, high interest, and high self-confidence. Moreover, students indicated good scientific attitudes and positive attitudes towards science. The conclusion is that learning science using the science practical work method can provide elementary school students fourth grades and fifth grades showed science literacy characteristics

Keywords: Science Literacy; Practical Work; Performance Skills; Science Assessment

Introduction

The success of science education influences daily activities, complex life, and success at work in the future (Aldredge et al., 2022; Atkinson et al., 2020; Darling-Hammond & Cook-Harvey, 2018; Latifah et al., 2022). Science deals with living things and the natural world around them through active processes, various experiments, observations and investigations using physical skills, imagination and creativity (Akuma & Callaghan, 2019; Darmaji et al., 2019; Ecevit & Kingir, 2022; Kleickmann et al., 2020; Latifah et al., 2022). In learning science, students need to be trained to have scientific attitudes, such as curiosity, work based on evidence/data, skepticism about the results of investigations, accepting ambiguity, being cooperative, and having a positive attitude towards failure, interest and confidence in learning science (Contant et al., 2018; Ecevit & Kingir, 2022; Kelana et al., 2022; Sharpe & Abrahams, 2020).

Science practical work, experimentation, observation, investigation, and implementation of process skills in seeking knowledge about nature and life are activities that are frequently used and have important roles in learning science (Huong et al., 2021; Keller et al., 2018; Manz et al., 2020; Mulyeni et al., 2019; Shana & Abulibdeh, 2020; Tsybulsky & Muchnik-Rozanov, 2021). Science practical work must be as a bridge between observable domains and knowledge domains, link experience with the material being studied, and foster appreciation, perception, behavior as part of learning (Chirikure, 2020; Huong et al., 2021; Idris et al., 2022; Mulyeni et al., 2019). Science practical work can be a means to develop problem-solving skills, motor skills, creativity, communication, scientific attitude, interest, and self-confidence (Letina, 2020; Sharpe & Abrahams, 2020)

Science literacy is an important aspect to be able to understand the environment and problems that exist in modern society, which arise as the result of the use of science and technology and the increasing complexity of life (Lestari et al., 2020; Sharon & Baram-Tsabari, 2020). Science literacy refers to the ability to think scientifically; apply scientific knowledge and understand of concepts,

How to Cite:
Rokhiyah, I., Sekarwinahyu, M., & Sapriati, A. (2023). Science Literacy of Elementary School Students through Science Practical Work Learning Method. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 3986–3991. https://doi.org/10.29303/jppipa.v9i5.3761

work ethic of scientists, the interrelationships of science and society and the humanities; understand science and technology and desire to use it in life in society; identify issues in science and explain phenomena scientifically supported by evidence; process competence and cognitive abilities (Elhai, 2023; Fortus et al., 2022; Husna et al., 2022; Lestari et al., 2020).

The educational and assessment framework in science is designed to involve aspects consisting of science learning objectives, content-behavior, product-processes that are commonly used by scientists, competencies that are measured, and science practice. These science learning goals can be in the form of knowledge and understanding, inquiry processes, laboratory and manual skills, attitudes, and behavior (Elfrida et al., 2021; Hartina et al., 2020; Letina, 2020; Queiruga-Dios et al., 2020). Content-behavior refers to students' cognition with knowledge, such as understanding concepts, analysis, and reasoning (Elfrida et al., 2021; Hartina et al., 2020; Teig et al., 2022). Examples of thinking and/or methods commonly used during investigations are asking questions, identifying and interpreting evidence, drawing conclusions, predicting phenomena, and understanding conducting investigations (Elfrida et al., 2021; Hartina et al., 2020). Competence is the demonstrated success of a task or activity, for example identifying issues and using scientific evidence. The science practice is behavior in the scientific community that is governed by social and epistemic criteria, for example using scientific inquiry, using technological designs (Furtak & Penuel, 2019; Gong et al., 2020; Hartina et al., 2020).

Considering the importance of science learning and science practical work as well as science literacy, it is necessary to conduct a study to examine how elementary school students are scientifically literate after learning science through the practicum method. The objectives of this study were to analyze students understanding, performance, attitudes, interest, self-confident, and scientific attitudes of in science and science practical.

Method

The dimensions of scientific literacy in this study include cognitive understanding, science practical work and process skill performances, and attitudes, interests, self-confidence, and scientific attitudes. The indicators and instruments used in the study are listed in Table 1.

Table 1. Indicator, Instruments, and Data Sources

Indicators	Instrument	Source
Explaining and applying students' understanding of science and science practical work	Test (T)	Student
Science practical work and process skills performance	Observation (O), Student Activity (S)	Student
Scientific attitude (curiosity, work on evidence, cooperative, accept uncertainty, positive about failure)	Questionnaire (Q)	Student
Attitude towards science and doing science practical work	Questionnaire (Q)	Student
Interest in learning science and doing science practical work	Questionnaire (Q)	Student
Confidence in learning science and doing science practical work	Questionnaire (Q)	Student

The research used a quantitative descriptive method and was carried out in six public and private elementary schools in the city of South Tangerang. The research was carried out jointly with grade 4 and 5 teachers at the research school. Research procedures include developing science practical work learning materials that are in accordance with the curriculum and data collection instruments, equating research perceptions and data collection with teachers, collecting data on interests, attitudes, and confidence in learning science and science practical work as well as pre and post-test of content dan science practical work, carrying out learning, and collecting science practical work performance data, post-testing scientific understanding and science practical work, as well as perceptions of scientific attitudes.

Data were analyzed descriptively. The results of data analysis are interpreted to classify the level or quality of attitude, interest, confident and science practical work performances as listed in the following Table 2.

Table 2. Level of Attitude, Interest, Confidence, Scientific Attitude

Score	Criteria
5.00 - 4.21	Very-positive/Very-interested/Very - Confident/Very good
4.20 - 3.41	Positive/Interested/Confident/ Good
3.40 - 2.61	Moderate/Enough
2.60 - 1.81	Less/Poor
1.80 - 1.00	Very Less/Very poor

Table 3. Level of Understanding and Performances of Science and Science Practical Work

Score	Criteria
> 84	Very good
70 - 84	Good
55 - 69	Enough
40 - 54	Poor
< 40	Very Poor

Result and Discussion

The results of the analysis of the initial test for understanding (explaining and applying students' understanding of science and science practical work) showed that the test results of the fourth-grade students are in the criteria of being quite good, while the fifth-grade students feel the criteria are poor. The results are consistent with relevant previous research reports (Akuma & Callaghan, 2019; Aldredge et al., 2022; Atkinson et al., 2020; Darling-Hammond & Cook-Harvey, 2018; Kleickmann et al., 2020).

Table 4. Pre- and Post- Test of Science Practical Work

Material/Science practical work	Pre-Test	Post-Test
Grade 4: Function of the roots (Steps after cutting the roots of the sprouts and concluding the observations). (N-Student 95)	60 (Moderate)	68 (Moderate)
Grade 5: Adaptation (Materials/plant adaptation experiment steps, Observation of the characteristics of the kangkong stem, Observation of the characteristics of cactus leaves). (N-Student 87)	52 (Poor)	86 (Very Good)
Grade 5: Protecting Yourself (Materials/steps for experimenting how to protect yourself in plants, Results of observing how to protect yourself in bitter gourd, snake fruit, cabbage) (N-Student 87)	46 (Poor)	76 (Good)

The results of the analysis of pre-test can also be interpreted as the readiness of students to conduct practical science work. Furthermore, the results of the post- test showed that the fourth-grade students' understanding was in the fairly good, while the fifth-grade students' understanding was in the good and very good criteria. The results shown are very interesting, and this situation require further study to understand the factors that contribute to these results.

This study shows that science practical work is a learning method that can develop understanding, problem-solving skills, and scientific skills and attitudes in accordance with previous research for example (Darmaji et al., 2019; Ecevit & Kingir, 2022; Yusra et al., 2021). Science practical work may be able to connect between observable domains and knowledge domains and between experience and the material being studied (Chirikure, 2020).

The performance of students conducting science practical work and making reports on activity sheets were assessed by the teachers using a check list of observation sheets. The performance of students in conducting science practical work and making reports has shown good criteria. These results are consistent with previous research reports that learning using the science practical work method trains scientific thinking skills, process skills, laboratory work skills (Contant et al., 2018; Manz et al., 2020). The results of the analysis showing how the performance of students doing science practical work and making reports are listed in Table 5.

The results of the analysis show that the elementary school students have attitudes, interests, and self-confidence with criteria between good enough and very good in learning science and doing science practical work. The results indicate that science practical work can train students' attitudes, interests, and self-confidence. These results are relevant to previous research opinions and reports (Contant et al., 2018; Ecevit & Kingir, 2022; Sharpe & Abrahams, 2020). The results of the analysis are showed in Table 6.

Table 5. Student Performance in Science Practical Work

Science practical work Component	Description
Root Roles	
Identifying the tools and materials	70 (Good)
Work procedures	66 (Good Enough)
Observing	73 (Good)
Average	70 (Good)
Adaptation	
Identifying the tools and materials	60 (Good Enough)
Work procedures	85 (Very Good)
Observing	72 (Good)
Average	72 (Good)
Plant Protection	
Identifying the tools and materials	82 (Very Good)
Work procedures	64 (Good Enough)
Observing	73 (Good)
Average	73 (Good)

Table 6. Student Attitudes, Interests, Confidence towards Learning Science and Science Practical Work

Aspect	Fourth Grade	Fifth Grade
Attitude	3.49 (Positive)	3.83 (Positive)
Interest	2.49 (Less interested)	3.23 (Interested enough)
Self Confident	2.39 (Less self-confidence)	2.87 (Interested enough)

Regarding scientific attitudes, the results of the analysis show that these elementary school students perceive themselves as having an attitude with the criteria of good enough to very good for indicators of curiosity, work based on evidence, being able to accept uncertainty, can work cooperatively, and can be positive about failure. The results of this study indicate that the science practical work method can be used to teach and familiarize scientific attitudes. The results are in accordance with what has been presented by Contant et al. (2018); Ecevit & Kingir (2022); Husna et al. (2022);

Letina (2020). The results of the analysis show in Table 7.

Table 7. Student Scientific Attitudes

Aspect	Fourth Grade	Fifth Grade
Curiosity	3.79 (Good)	4.21 (Very good)
Work based on evidence	3.38 (Good Enough)	3.98 (Good)
Being able to accept uncertainty	3.31 (Good Enough)	3.40 (Good Enough)
Can work cooperatively	3.41 (Good)	4.03 (Good)
Can be positive about failure	3.25 (Good Enough)	3.35 (Good Enough)

Conclusion

The conclusion that can be drawn from the results of the data analysis is that learning science using the science practical work method can provide elementary school students fourth grades and fifth grades showed science literacy characteristics. This conclusion is based on findings which show that students had good understandings in science and science practical work. Furthermore, students indicated between good enough and good performance and good positive attitudes towards science and science practical work. Moreover, students showed between moderate and high interest and between moderate and high confidence in learning and science practical work. In addition, students showed between good enough and good perceptions of scientific attitudes.

Acknowledgments
We respectfully express our gratitude to the honorable the Head of the Institute for Research and Community Service, the Dean of the Faculty of Teaching and Education, and the Director of Postgraduate Studies Universitas Terbuka, for the opportunity, support and funding to carry out this study.

Author Contributions
Conceptualization, I.R., M.S. and A.S.; methodology, A.S.; validation, I.R. and M.S.; formal analysis, A.S.; investigation, I.R., M.S. and A.S.; resources, I.R. and A.S.; data curation, A.S.; writing—original draft preparation, I.R. and M.S.; writing—review and editing, A.S..; visualization, M.S. and A.S..; supervision, I.R..; project administration, M.S..; funding acquisition, I.R. and A.S. All authors have read and agreed to the published version of the manuscript.

Funding
This research was funded by the Institute for Research and Community Service Universitas Terbuka. Furthermore, the study carried out additional data collection and received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Akuma, F. V, & Callaghan, R. (2019). A systematic review characterizing and clarifying intrinsic teaching challenges linked to inquiry-based practical work. *Journal of Research in Science Teaching*, *56*(5), 619–648. https://doi.org/10.1002/tea.21516

Aldredge, M., Lee, S., & Klein, J. (2022). Science, Society, and Self. *Journal of College Science Teaching*, *51*(6), 16–22. Retrieved from https://www.nsta.org/journal-college-science-teaching/journal-college-science-teaching-julyaugust-2022/science-society

Atkinson, L., Dunlop, L., Bennett, J., Fairhurst, P., & Moore, A. (2020). Best Evidence Science Teaching: research evidence in action. *School Science Review*, 55–63. Retrieved from https://eprints.whiterose.ac.uk/155599/3/SSR_December_2020_055_063_Atkinson.pdf

Chirikure, T. (2020). Upper-secondary school students'approaches to science experiments in an examination driven curriculum context. *Journal of Baltic Science Education*, *19*(4), 523–535. https://doi.org/10.33225/jbse/20.19.523

Contant, T. L., Tweed, A. L., Bass, J. E., & Carin, A. A. (2018). *Teaching science through inquiry-based instruction*. Pearson.

Darling-Hammond, L., & Cook-Harvey, C. M. (2018). *Educating the whole child: Improving school climate to support student success*. Learning Policy Institute. Retrieved from https://learningpolicyinstitute.org/product/educating-whole-child.

Darmaji, D., Kurniawan, D. A., & Irdianti, I. (2019). Physics education students' science process skills. *Int. J. Eval. & Res. Educ*, *8*(2), 293–298. https://doi.org/10.11591/ijere.v8i2.28646

Ecevit, T., & Kingir, S. (2022). Primary Student Teachers' Teaching-Learning Conceptions, Attitudes and Self-Efficacy Beliefs toward Science Teaching. *Journal of Turkish Science Education*, *19*(3), 773–785. https://doi.org/10.36681/tused.2022.149

Elfrida, E., Nursamsu, N., & Ariska, R. N. (2021). Development of Performance Assessment Instruments Through Practical Learning to Improve Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *7*. https://doi.org/10.29303/jppipa.v7iSpecialIssue.867

Elhai, J. (2023). Science Literacy: a More Fundamental Meaning. *Journal of Microbiology & Biology Education*, *24*(1). https://doi.org/10.1128/jmbe.00212-22

Fortus, D., Lin, J., Neumann, K., & Sadler, T. D. (2022). The role of affect in science literacy for all. *International Journal of Science Education*, *44*(4), 535–

555. https://doi.org/10.1080/09500693.2022.2036384

Furtak, E. M., & Penuel, W. R. (2019). Coming to terms: Addressing the persistence of "hands-on" and other reform terminology in the era of science as practice. *Science Education*, *103*(1), 167–186. https://doi.org/10.1002/sce.21488

Gong, T., Shuai, L., Arslan, B., & Jiang, Y. J. (2020). *Process Based Analysis on Scientific Inquiry Tasks Using Large-Scale National Assessment Dataset*. International Educational Data Mining Society. Retrieved from https://files.eric.ed.gov/fulltext/ED608072.pdf

Hartina, L., Rosidin, U., & Suyatna, A. (2020). Pengaruh Penerapan Instrumen Performance Assessment pada Pembelajaran IPA Berbasis Laboratorium Real terhadap Hasil Belajar Siswa. *Jurnal Penelitian Pendidikan IPA (JPPIPA*, *6*(1), 25–31. https://doi.org/10.29303/jppipa.v6i1.299

Huong, P. T., My, N. T., Nga, N. T. H., & Van, P. D. (2021). Current situation of natural sciences laboratories and factors affecting the frequency of natural science laboratory teaching at some lower secondary schools in the north central region of vietnam. *Journal of Management Information and Decision Sciences*, *24*(3), 1–14. Retrieved from https://www.proquest.com/docview/2517259597/fulltextPDF/B06502A08D472CPQ/1?accountid=62722

Husna, N., Halim, A., Evendi, E., Syukri, M., Nur, S., Elisa, E., & Khaldun, I. (2022). Impact of Science Process Skills on Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 1827–1833. https://doi.org/10.29303/jppipa.v8i4.1887

Idris, N., Talib, O., & Razali, F. (2022). Strategies in Mastering Science Process Skills in Science Experiments: A Systematic Literature Review. *Jurnal Pendidikan IPA Indonesia*, *11*(1), 155–170. https://doi.org/10.15294/jpii.v11i1.32969

Kelana, J. B., Robandi, B., & Widodo, A. (2022). Inquiry Model: How to Improve the Ability of the Nature of Science and Its Aspects in Elementary School? *International Journal of Elementary Education*, *6*(2), 325–332. https://doi.org/10.23887/ijee.v6i2.45611

Keller, C., Hendrix, T., Xu, N., Porter-Morgan, H., & Brashears, A. (2018). A Foundation for STEM Success: A Simple and Successful Microscope Intervention in a General Biology Course at an Urban Community College. *Journal of College Science Teaching*, *48*(1), 15–23. Retrieved from https://static1.squarespace.com/static/57e95df4d1758efd39919e0d/t/5bb91566e79c70e0435f9c74/1538856297299/Keller+et+al+%282018%29.pdf

Kleickmann, T., Steffensky, M., & Praetorius, A. K. (2020). Quality of teaching in science education. More than three basic dimensions? In *Empirische Forschung zu Unterrichtsqualität. Theoretische Grundfragen und quantitative Modellierungen*, 37–55. Retrieved from https://www.pedocs.de/volltexte/2023/25862/pdf/Kleickmann_et_al_2020_Quality_of_teaching.pdf

Latifah, Y., Jumadi, J., & Sultini, S. (2022). Analysis of 2013 Curriculum Character Values in Science Learning. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2008–2011. https://doi.org/10.29303/jppipa.v8i4.1277

Lestari, H., Setiawan, W., & Siskandar, R. (2020). Science Literacy Ability of Elementary Students Through Nature of Science-based Learning with the Utilization of the Ministry of Education and Culture's. *Learning House". Jurnal Penelitian Pendidikan IPA*, *6*(2), 215–220. https://doi.org/10.29303/jppipa.v6i2.410

Letina, A. (2020). Development of students' learning to learn competence in primary science. *Education Sciences*, *10*(11), 325. https://doi.org/10.3390/educsci10110325

Manz, E., Lehrer, R., & Schauble, L. (2020). Rethinking the classroom science investigation. *Journal of Research in Science Teaching*, *57*(7), 1148–1174. https://doi.org/10.1002/tea.21625

Mulyeni, T., Jamaris, M., & Supriyati, Y. (2019). Improving basic science process skills through inquiry-based approach in learning science for early elementary students. *Journal of Turkish Science Education*, *16*(2), 187–201. https://doi.org/10.12973/tused.10274a

Queiruga-Dios, M. Á., López-Iñesta, E., Diez-Ojeda, M., Sáiz-Manzanares, M. C., & Vazquez Dorrio, J. B. (2020). Citizen science for scientific literacy and the attainment of sustainable development goals in formal education. *Sustainability*, *12*(10), 4283. https://doi.org/10.3390/su12104283

Shana, Z., & Abulibdeh, E. S. (2020). Science practical work and its impact on high students' academic achievement. *JOTSE*, *10*(2), 199–215. https://doi.org/10.3926/jotse.888

Sharon, A. J., & Baram-Tsabari, A. (2020). Can science literacy help individuals identify misinformation in everyday life? *Science Education*, *104*(5), 873–894. https://doi.org/10.1002/sce.21581

Sharpe, R., & Abrahams, I. (2020). Secondary school students' attitudes to practical work in biology, chemistry and physics in England. *Research in Science & Technological Education*, *38*(1), 84–104. https://doi.org/10.1080/02635143.2019.1597696

Teig, N., Scherer, R., & Olsen, R. V. (2022). A systematic review of studies investigating science teaching and learning: over two decades of TIMSS and PISA. *International Journal of Science Education*, *44*(12), 2035–2058.

https://doi.org/10.1080/09500693.2022.2109075

Tsybulsky, D., & Muchnik-Rozanov, Y. (2021). Project-based learning in science-teacher pedagogical practicum: the role of emotional experiences in building preservice teachers' competencies. *Disciplinary and Interdisciplinary Science Education Research*, *3*(1), 1–12. https://doi.org/10.1186/s43031-021-00037-8

Yusra, Y., Nurmaliah, C., & Sarong, M. A. (2021). Application of Inquiry-Based Learning Module to Improve Science Process Skills and Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *7*. https://doi.org/10.29303/jppipa.v7iSpecialIssue.864