JPPIPA 10(9) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

The Effectiveness of Scientific Literacy Based Learning Device to Improve Junior High School Students Scientific Literacy

Muhammad Novaldy Nur Dwinanda Wahab[1*], Wasis[2], Yuliani[2]

[1] Graduated Students of Master Program Science Education, Universitas Negeri Surabaya, Indonesia.
[2] Faculty of Mathematics and Natural Science, Universitas Negeri Surabaya, Indonesia.

Received: May 11, 2024
Revised: July 18, 2024
Accepted: September 25, 2024
Published: September 30, 2024

Corresponding Author:
Muhammad Novaldy Nur Dwinanda Wahab
muhammad.novaldy.ndw@gmail.com

DOI: 10.29303/jppipa.v10i9.8573

Abstract: The researcher's goal in this study is to investigate the efficiency of the scientific literacy-based learning device model learning cycle 7E in improving student scientific literacy skills. This research used Research and development, with one group pretest-posttest design and two replications. The research sample was VII-grade junior high school students. To gather data about students' scientific literacy, the researcher used a scientific literacy-based test. The data on students' scientific literacy will be evaluated to determine their level and skills before and after treatment with the development product. Based on research analysis and findings after using a scientific literacy-based learning device, the students' scientific literacy increased. It can be seen from the n-gain value average obtained in junior high school 2, which has a value of 0.72 and is categorized as high. Meanwhile, the trial class of junior high school 2, was also categorized as high, with a value of 0.71. The results of a statistical test using two independent t-tests showed no significant difference between the n-gain values of the two trial classes. Based on these findings, it can be stated that the scientific literacy-based learning device model learning cycle 7E, helps increase students' scientific literacy.

Keywords: Effectiveness; Learning cycle 7E; Research and development; Scientific literacy; Scientific literacy level

Introduction

The rapid development of the era in the 21st-century paradigm requires each individual to compete globally. In 21st century education development, one of the most crucial main focuses is developing students' thinking skills, especially in science learning (Fortus et al., 2022; Moiyo et al., 2024). Nowadays, scientific literacy is critical because these skills can help students develop a deep understanding of what is more meaningful about learning science. Scientific literacy is also one of the foundations of science learning which is very helpful if the students have a high level of scientific literacy (Astuti et al., 2022; Bahtiar et al., 2022). A deep understanding about science is a key to develop solid scientific literacy. In this term, it means the students can applied their knowledge about science in various concept and process in daily life. It also not quite hard to applied the science knowledge to explain many phenomena in daily life, but the problem is there's a lot of students that doesn't aware about it (Tegeh et al., 2021; Yani et al., 2020).

Students with a higher level of scientific literacy mostly had better academic performance, explained some phenomena scientifically, evaluated, and also made an interpretation scientifically (Almeida et al., 2023; Toharudin et al., 2011; Ustun et al., 2022). However, according to recent research, there are a lot of challenges that students face in developing their scientific literacy (Jamaluddin et al., 2019; Merta et al., 2020; Saraswati et al., 2021). Recent research stated that, in Indonesian science learning textbooks there's much

How to Cite:
Wahab, M. N. N. D., Wasis, & Yuliani. (2024). The Effectiveness of Scientific Literacy Based Learning Device to Improve Junior High School Students Scientific Literacy. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6405–6414. https://doi.org/10.29303/jppipa.v10i9.8573

content on it. But, if we take a look at more detail it is still less quality such as the scientific literacy aspect (Dhitareka et al., 2022; Fayanto et al., 2023). On the other side, there's also a problem when the teachers should be trained the students in scientific literacy, but they are also still not literate enough (Klemenčič et al., 2023; Sumanik et al., 2021; Wahab et al., 2023). This thing causes students to still have difficulties developing their abilities.

Scientific literacy consists of the words literatus which means literate and scientia which means knowing. The term scientific literacy was first introduced in the 1950s by Paul DeHart Hurd who stated that scientific literacy is an understanding of natural science and its social applications (Wasis et al., 2020). According to the Programme for International Student Assessment (PISA), scientific literacy is defined as "the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity" (OECD, 2016). Thus, scientific literacy is defined as a person's knowledge and understanding of scientific concepts and processes that are needed for decision-making, socio-cultural life, and economic growth. PISA describes three competencies in students' scientific literacy skills along with their indicators as follows: Explaining phenomena scientifically, Evaluating and designing scientific investigations, and Interpreting scientific data and evidence (OECD, 2019). PISA defines the cognitive level of scientific literacy assessment into three different levels. The levels set for this assessment are: low, medium, and high. When compared with the revised Bloom's taxonomy, the low level is equivalent to C1; the medium level is equivalent to C2 and C3; and the high level is equivalent to C4, C5, and C6 (Toharudin et al., 2011; Wasis et al., 2020).

Programme for International Students Assessment (PISA) reported from their latest survey, that Indonesian students' scientific literacy level average is still in low level condition (OECD, 2019, 2022). More than 50% of students that become a sample, they're still in the low-level category of scientific literacy with level 2 or lower. The Indonesian students' scientific literacy if compared to the other Southeast Asian neighboring countries such as Malaysia, Thailand, Brunei, and Vietnam, our level of student scientific literacy still below them (OECD, 2022). In the latest survey Indonenesia had 383 scores, meanwhile the other neighboring countring that mentioned above has score above 400. Our student's scientific literacy skills still need more attention to be improved and developed.

Based on recent research about students' scientific literacy level, the average category that students achieved is still very low. From 127 samples in two schools, only 32 students reached above the minimum category level which means only 25%. The students that reach this were at enough and good category, and still, no one can reach very good (Sunandar et al., 2022). In the other research from Amala, most students can understand deeply scientific literacy in explaining phenomena indicators. It seems from her research findings that from three indicators that are used in scientific literacy tests, 60% of students can answer correctly. It's easier for them to answer the question in this indicator because they explain the phenomena that are presented in a simple knowledge of science. Meanwhile, in two other indicators, the students still have difficulties to answer this type of question. These things happen because students mostly only memorize theories that are mentioned while learning in the classroom. They never try to apply scientific knowledge in their daily life to evaluate or design an investigation, also to interpret data and evidence scientifically (Amala et al., 2023).

It is intended that people who comprehend science's fundamental significance will be scientifically literate and use this information to make decisions that are thoughtful, original, rational, practical, and methodical (Fatmawati & Khotimah, 2023). In the order to progressing the development of our students' scientific literacy to reach this level, various efforts and more attention must be made, such as developing scientific literacy based learning device or maybe using a new learning method that focused to facilitated the students to develop their scientific literacy skills (Wahab et al., 2021). According to Lestari et al. (2021), Luzyawati et al. (2023), and Setiaji et al. (2023) in their research stated that using a new learning method in classroom are effective to improve the students' scientific literacy. Meanwhile, the other research also stated that using a developed learning device that focused to improve students' scientific literacy also effective in a various learning material in science learning (Andriani et al., 2021; Aprilia et al., 2023; Putra et al., 2023; Utari et al., 2024; Widodo et al., 2020).

Referring to several research results, the researcher felt the need to conduct research focusing on training students' scientific literacy skills. The researcher believes that this research is necessary, especially considering that there is still barely any study on this topic in the local area where the researcher is located. The novelty of this research is that the researcher tried to use the 7E learning cycle model to develop a scientific literacy-based learning device to train students' scientific literacy skills in junior high school.

The purpose of this research was to determine the effectiveness of scientific literacy based learning device to improve students scientific literacy. The learning device that had been developed includes learning

syllabus, lesson plan, students learning modul, and scientific literacy assessment. The reason for the researcher developing the scientific literacy based learning device is to produce an innovative learning that able to train students scientific literacy in schools.

Method

Sample and Procedures

This research is a continuation of the research on developing learning devices based on scientific literacy. The syllabus, lesson plans, learning modules, and assessment tools were developed earlier using the PISA scientific literacy indicators. Five validators who are experts in the field of scientific literacy were involved in this research. Three lecturers are experts in scientific literacy, and two actual school science teachers have tested the validity of the developed products. The research flowchart can be seen in the following figure:

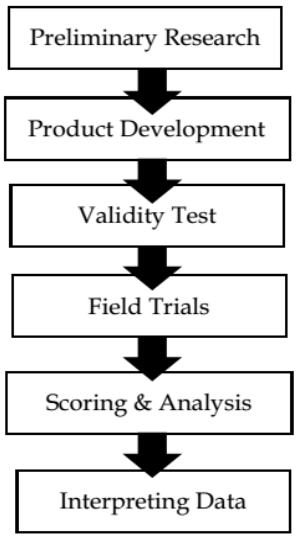

Figure 1. Research flowchart

This study used the scientific literacy based learning device to train student's scientific literacy on junior high school students. The trials were carried out on students through scientific literacy test with one group pre-test post-test design with two replications at Junior High School 2 and Junior High School 5 Banjarmasin. The trials were carried out with a sample of 66 students, 35 students from junior high school 2 Banjarmasin, and 31 students from junior high school 5 Banjarmasin. The research design is shown by the following figure:

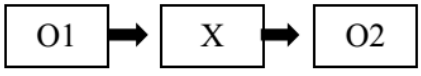

Figure 2. Field trial design

Notes:

O1 : Pre-test, to determine the ability of students before being giving the treatment

X : Treatment, learning process using the scientific literacy based learning device

O2 : Post-test, to determine the ability of students after being giving the treatment

In this study, two classes were used as experimental class with two replications. The design of this study was carried out so that research was more accurate in comparing before being given treatment with after being given treatment (Sugiyono, 2013).

Data Analysis

Analysis of Students' Level of Scientific Literacy Skills

This study uses scientific literacy questions to measure students' scientific literacy skills. The questions used are made based on PISA scientific literacy indicators, namely: 1) explaining phenomena scientifically, 2) evaluating and designing scientific investigations, and 3) interpreting data and evidence scientifically. The questions used are 20, which consist of 4 different discussion topics adapted to the context of PISA scientific literacy and the science curriculum at school. The questions used have also been adjusted to the scope mentioned by PISA, namely personal, local/national, and global (OECD, 2019).

Analysis of scientific literacy tests is used to determine scores and levels of students' scientific literacy skills, which are measured by 1) giving value or score to each question with a different level. The value score is adapted from PISA, then 2) Determine the achievement score for each level using the scoring formula as follows:

$$Score = \sum \frac{Bi \; x \; bi}{St} \; x \; 100\% \quad (1)$$

Description:

Bi = the number of items answered correctly

bi = the value of each item (adapted from PISA)

St = theoretical score (Pravitasari et al., 2015; Wahab et al., 2023).

By converting the scores contained in PISA with the research results obtained, the range of scores and levels of scientific literacy skills can be seen in table 1. Following the calculation of the score to categorize students' scientific literacy levels, the next step involves evaluating each student's answer sheet. Subsequently, the scientific literacy skills students attain are determined based on Table 1, which outlines various abilities corresponding to each level. For a more comprehensive analysis, the author will refer to PISA's descriptions of the skills associated with each level to

identify the constraints of students' capabilities (Wahab et al., 2023).

Table 1. Students' Scientific Literacy Level Criteria

Score Range	Scientific Literacy Level	Criteria
93.0 – 100.0	6	Very Good
73.0 – 92.0	5	Good
55.0 – 72.0	4	Enough
40.0 – 54.0	3	Deficient
14.0 – 39.0	2	Low
7.0 – 13.0	1a	Very Low
1.0 – 6.0	1b	Very Low

After that, to determine the increase in students' scientific literacy by calculating the n-gain using the increased score in students' overall scientific literacy. The amount of increase or gain is analyzed using the following formula, then the result of this calculation interpreted with the following Table 2.

$$(g) = \frac{\text{Spost} - \text{Spre}}{\text{Sm ideal} - \text{Spre}} \quad (2)$$

Description:
g = increase in scientific literacy skills
Spre = pretest score
Spos = post-test score
Sm ideal = maximum score

Table 2. N-Gain Criteria

n-gain score	n-gain criteria
$\langle g \rangle \geq 0.7$	High
$0.3 \leq \langle g \rangle < 0.7$	Medium
$\langle g \rangle < 0.3$	Low

This study uses analysis with an independent 2-sample T statistical test to determine the level of effectiveness of the device that has been developed and used during the trial. Several prerequisite tests must be carried out first, namely the normality test & homogeneity test. If both tests have been met as prerequisite tests, then the next analysis can be continued to the independent 2-sample T statistical test. The normality test aims to assess the distribution of data whether the data is normally distributed or not. While the homogeneity test aims to show that the data samples used have the same variance (Gio, 2013).

The data normality test in this study used the Kolmogorov-Smirnov test with the condition Asymp > 0.05, then the data can be said normally distributed. Meanwhile, the homogeneity test is carried out with using Levene Test, with condition if significance value that obtained is > 0.05 then the data can be said homogen. After that, if the data obtained is normally distributed and homogeneous, then a hypothesis test can be carried out with parametric statistics of the independent 2-sample T-test. Hypothesis testing using n-gain data is carried out to determine whether there is a significant average difference in improving students' science literacy skills from the trial data (Gio et al., 2019). The hypotheses used are:

H0 = there is no significant difference, the average increase in science literacy skills of class SMPN 2 and SMPN 5 students.

H1 = there is a significant difference, the average increase in science literacy skills of class SMPN 2 and SMPN 5 students.

The significance level used is α = 0.05. Hypothesis H0 is accepted if the p-value obtained is > 0.05. Meanwhile, if the p-value obtained is <0.05, then H0 is rejected. Analysis using statistical tests is an inferential test that aims to determine the extent of the similarity between the results obtained for the two trial classes. This test aims to determine whether there is a significant increase in the value of scientific literacy obtained by students in the trial classes SMPN 2 and SMPN 5 Banjarmasin and whether the increase in scientific literacy in classes SMPN 2 and SMPN 5 Banjarmasin is significantly different. So that it can measure how effective the learning device that have been developed when used.

Result and Discussion

The effectiveness of the developed learning device product is measured by calculating and analyzing the results obtained by students when answering the developed science literacy test questions. In this trial, a pre-test assessment was carried out before the first meeting of the learning process, and a post-test was carried out after the learning process at the fourth meeting ended. The assessment aims to determine the science literacy skills of students both before and after participating in learning with the developed device.

The values obtained are then calculated to determine the n-gain of each student. Where the n-gain value is then used in statistical analysis using SPSS, the comparison of pre-test and post-test values and n-gain of each trial class can be seen in figures 3 and 4.

Based on the average results for the SMPN 2 Banjarmasin trial class, the average score was 35.71. While for the SMPN 5 Banjarmasin trial class, the average score was 30.81. As with the pre-test scores, the same conditions were found in the post-test scores. Based on the known average results for the SMPN 2 Banjarmasin trial class, the average score was 82. While for the SMPN 5 Banjarmasin trial class, the average score was 80.32. This can be seen in Figure 5.

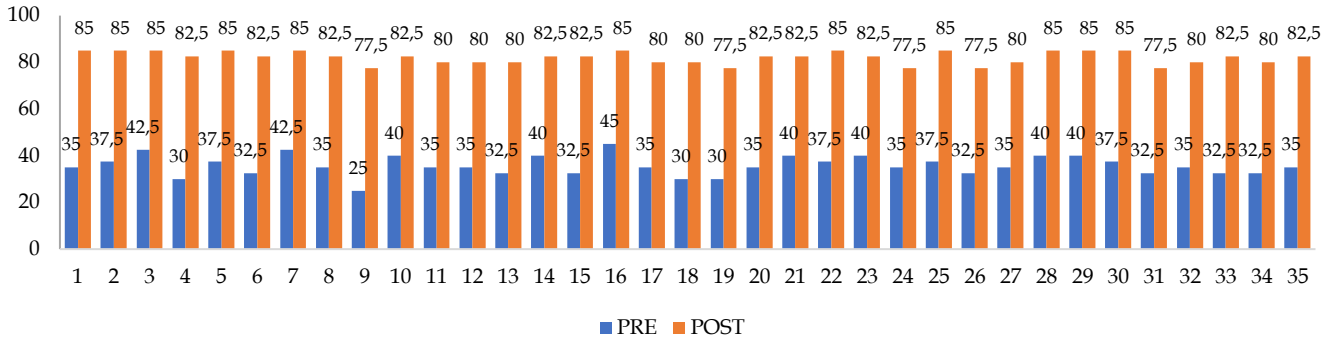

Figure 3. SMPN 2 trial class scores

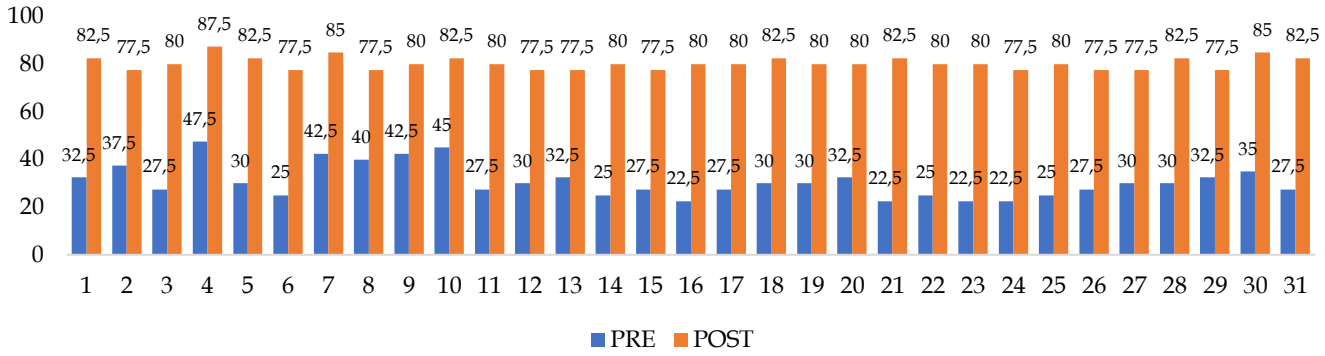

Figure 4. SMPN 5 trial class scores

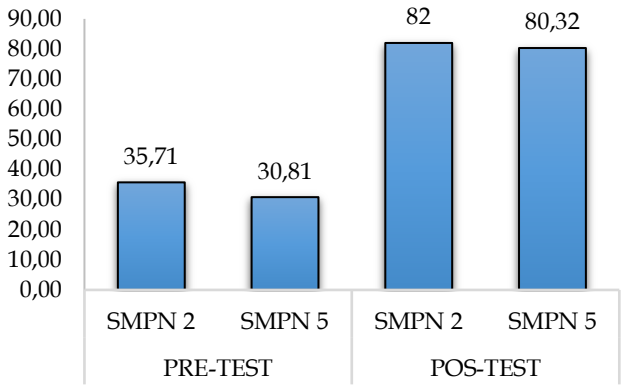

Figure 5. Average scores on two trial class

After obtaining the pre-test and post-test scores, the next step is to group the scientific literacy levels achieved by students based on their pre-test and post-test scores according to the range of scientific literacy level scores that have been determined in advance in Table 1. Based on the grouping results, it is known that the scientific literacy levels of students before treatment are still limited to levels 2 and 3 only. Meanwhile, after following the learning process using the developed devices, students' scientific literacy skills increased and were at level 5. This can be seen in Figures 6 and 7

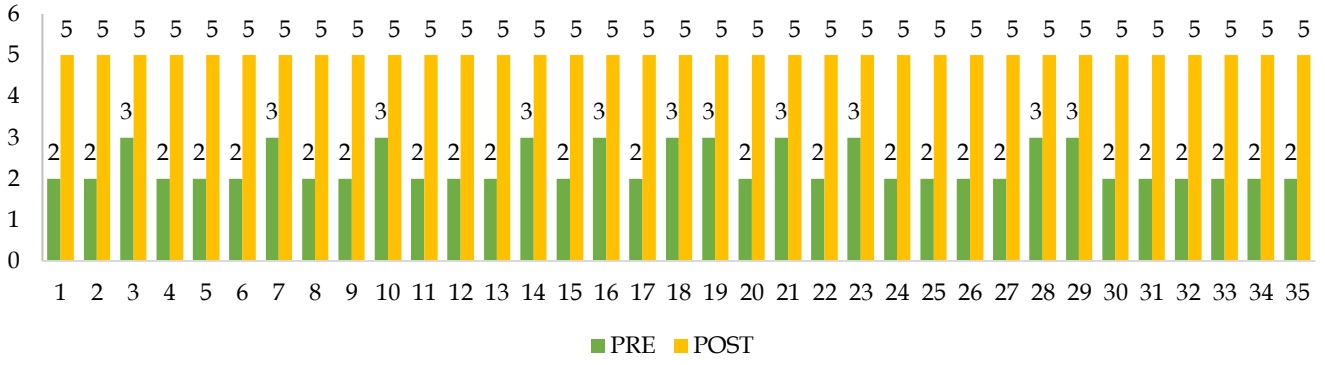

Figure 6. SMPN 2 trial class student's scientific literacy

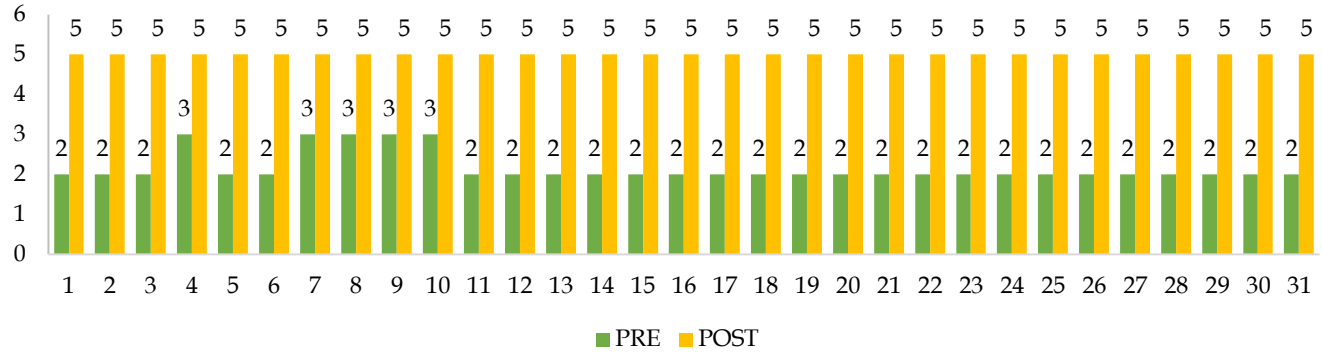

Figure 7. SMPN 5 trial class students scientific literacy

Referring to the PISA framework, the ability of level 2 students can be able to utilize everyday content knowledge and basic procedural knowledge to identify and explain scientifically, and identify questions being discussed in simple concept design (OECD, 2022). For example, in the literacy test instrument used, for example, when students are asked to provide a scientific explanation related to how mining activities can cause environmental pollution. For the example of the solar system material, students are asked to explain why all planets can orbit the sun and never leave their orbital lines.

While, level 3 students can utilize fairly complex content knowledge to identify or construct explanations of familiar phenomena in less familiar or more complicated situations, they can build explanations with relevant cues or support (OECD, 2022). For example, in the literacy test instrument used, the students are asked to provide an explanation related to the phenomenon of meteors entering the earth's atmosphere which is sometimes still called by laypeople a shooting star event. Another example is where the students are asked to explain the treatment that needs to be taken by the local government regarding the former mining area, to combat environmental damage.

According to PISA, students at level 5 can use abstract scientific ideas or concepts to explain unknown and more complex phenomena, events, and processes that involve many causal relationships (OECD, 2022). For example, in the literacy test instrument used, for example, when students are asked to interpret data related to the increase in fuel car sales that can cause global warming against data on temperature increases that have occurred regionally in the last 20 years. Another example is when students are asked to interpret data related to the use of transportation in daily activities and the ongoing impacts it causes on environmental pollution and global warming.

This result are in line with several previous research that focusing on improving students scientific literacy. According to Saputro (2022), using a new learning method can be significantly improve students scientific literacy. The development of learning tools using a learning model an combining it with scientific literacy indicator from PISA, can facilitated students to develop their scientific literacy (Saputro et al., 2022). Meanwhile, Utari (2024) in her research finds that using an enriched learning materials can effectively improved students scientific literacy, especially if the materials that developed involving the daily life phenomena as a source of learning (Utari et al., 2024). This research findings also in line with Hindun (2024) who stated that The more the learning device can facilitate students to practice their scientific literacy, the more effective its use will be during the learning process (Hindun et al., 2024).

The pre-test and post-test scores were then used to determine the n-gain score of each student using n-gain calculation formula (Hake, 1999). After the n-gain score was obtained, the n-gain score was grouped according to their respective categories. The grouping results were then made into a graph to compare the n-gain scores in the 2 trial classes. The grouping of the n-gain score categories can be observed through the following figure:

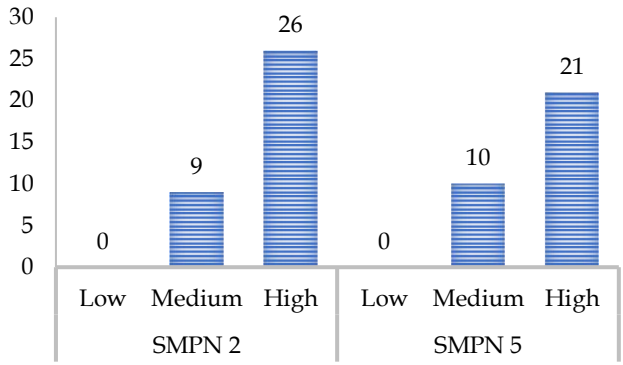

Figure 8. N-gain categories

Based on the n-gain data obtained for the SMPN 2 trial class, out of 35 students who participated in the learning process, 9 students were classified as a medium n-gain, the other 26 participants were classified as

having a high n-gain, while the average n-gain value at the SMPN 2 trial class was 0.72 or categorized in high n-gain category. Meanwhile, for the SMPN 5 trial class, from 31 students who participated in the learning process, 10 students classified as a medium n-gain, and 21 other students classified as a high n-gain, while the average n-gain value of the SMPN 5 trial class was 0.71, also categorized as a high n-gain category. Through these findings, it can be said that the learning process using the developed learning tools was effective in improving students' scientific literacy skills.

The n-gain value that has been obtained is then used to conduct statistical tests using the SPSS application. Several stages of statistical tests will be carried out to analyze the n-gain data to determine the level of effectiveness of the device being tested, namely the data normality test using Kolmogorov-Smirnov test, the results of the statistical test can be seen in the following figure:

One-Sample Kolmogorov-Smirnov Test

		GAIN_SMP2	GAIN_SMP5
N		35	31
Normal Parameters[a,b]	Mean	.7203	.7135
	Std. Deviation	.03129	.03808
Most Extreme Differences	Absolute	.136	.119
	Positive	.115	.069
	Negative	-.136	-.119
Test Statistic		.136	.119
Asymp. Sig. (2-tailed)		.099[c]	.200[c,d]

Figure 9. SPSS output on normality test

Based on the results of the pre-requisite tests above, it can be seen that the data is categorized as normally distributed. It can be observed based on the results of the Kolmogorov-Smirnov test where the sig. (2-tailed) values were obtained at 0.099 and 0.200. The basis for decision-making used is that if a significance of value > 0.05 is obtained, then the distribution of the data can be said to be normal (Gio, 2013; Gio et al., 2019). Then, after the normality test, the prerequisite test which must be done is the homogeneity test. This test will be carried out using the Levene test by using SPSS also like the normality test. It can be seen in the following figure:

Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
NILAI_GAIN	Based on Mean	1.040	1	64	.312
	Based on Median	.673	1	64	.415
	Based on Median and with adjusted df	.673	1	61.454	.415
	Based on trimmed mean	.975	1	64	.327

Figure 10. SPSS output on homogeneity test

The Levene test's purpose is to determine whether the distribution of the data used is homogeneously distributed or not. The basis for decision-making is also the same as the previous test, where if a significance of value > 0.05 is obtained, then the data can be said to be homogeneous (Gio, 2013; Gio et al., 2019). The results of the Levene test can be observed in Figure 14 where the sig. value obtained has a significance value of > 0.05 so that the data used can be categorized as homogeneously distributed. Then the last one, after passing the prerequisite test, the data were obtained will be tested with T-Test 2 independent sample. The result of T-Test 2 independent sample can be seen in the following figure:

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
NILAI_GAIN	Equal variances assumed	1.040	.312	.789	64	.433	.00674
	Equal variances not assumed			.779	58.236	.439	.00674

Figure 11. SPSS output on t-test 2 independent sample

Based on the results of the statistical test of 2 independent samples above, a sig. significance value (2-tailed) obtained was 0.433, where based on decision making that used if the significance value is > 0.05 then H0 is accepted (Gio, 2013; Gio et al., 2019). Based on the results of the T-test of 2 independent samples, there is no significant difference in the average value of the n-gain of scientific literacy in the two trial classes. It can be concluded that the learning device products are proven effective in improving students' scientific literacy based on the results of trials from 2 different classes.

Conclusion

According to the result data and findings, the scientific literacy based learning device can be declared effective based on the increasing scientific literacy ability of students is seen through the average n-gain value obtained, namely 0.72 for the SMPN 2 trial class which is in the high category, and the average n-gain value is 0.71 in the SMPN 5 trial class with high category, and then based on the results of the statistical test T-test 2 independent samples, it was concluded that there was no significant difference in the average n-gain value of scientific literacy for students in class SMPN 2 and SMPN 5. The learning device products that have been developed have been proven to be effective in

improving students' scientific literacy in junior high school.

Acknowledgments
The author would like to thank those who have supported this research until it can be finished. First and especially for my parents who always supported the author under any conditions. Special thanks also to my thesis supervisor and my thesis co-supervisor without their guidance and support, I would not be able to complete this research. Also, never forget that. Last but not least the teachers from SMPN 2 and SMPN 5 Banjarmasin allowed me to do the research observation on their class.

Author Contributions
Conceptualization: M.N.N.D.W., W., & Y.; Methodology: M.N.N.D.W., W., & Y.; Validation: M.N.N.D.W.; Formal Analysis: W., Y.; Writing-Original Draft Preparation: M.N.N.D.W., W., & Y.; Writing-Review and Editing: M.N.N.D.W., W., & Y.; All authors have read and agreed to the published version of the manuscript.

Funding
No external funding.

Conflicts of Interest
No conflict interest.

References

Almeida, B., Santos, M., & Justi, R. (2023). Aspects and Abilities of Science Literacy in the Context of Nature of Science Teaching. *Science & Education*, *32*(3), 567–587. https://doi.org/10.1007/s11191-022-00324-4

Amala, I. A., Sutarto, S., Putra, P. D. A., & Indrawati, I. (2023). Analysis of Scientific Literacy Ability Junior High School Students in Science Learning on Environmental Pollution. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1001–1005. https://doi.org/10.29303/jppipa.v9i3.1816

Andriani, S. A., Masykuri, M., & Sukarmin, S. (2021). Development of Electronic Modules (E-Modules) Based on Guided Inquiry on Temperature and Heat Materials to Improve Students' Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 281–287. https://doi.org/10.29303/jppipa.v7iSpecialIssue.1234

Aprilia, C., Anggereini, E., Nazarudin, N., & Ahda, Y. (2023). Development of Web-Based Learning Media (Glideapps) to Improve Digital Literacy and Science Literacy About Materials Human Digestive Systems. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1112–1117. https://doi.org/10.29303/jppipa.v9i3.2618

Astuti, W. P., Ramli, M., & Suranto, S. (2022). Validity and Practicality of Sangiran Site-Based Virtual Laboratory Learning Media on Evolutionary Materials to Empower Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *8*(3), 1378–1384. https://doi.org/10.29303/jppipa.v8i3.1672

Bahtiar, B., Ibrahim, I., & Maimun, M. (2022). Analysis of Students' Scientific Literacy Skill in terms of Gender Using Science Teaching Materials Discovery Model Assisted by PhET Simulation. *Jurnal Pendidikan IPA Indonesia*, *11*(3), 371–386. https://doi.org/10.15294/jpii.v11i3.37279

Dhitareka, P. H., Hidayat, A., & Siahaan, P. (2022). Comparison of Nature of Science Profile in Indonesia, Malaysia, and Singapore Secondary Science Textbooks: Case of Electricity Lesson. *Jurnal Penelitian Pendidikan IPA*, *8*(5), 2299–2306. https://doi.org/10.29303/jppipa.v8i5.1878

Fatmawati, B., & Khotimah, H. (2023). Assessing the Scientific Literacy of Prospective Biology Teachers. *Jurnal Penelitian Pendidikan IPA*, *9*(5), 2701–2706. https://doi.org/10.29303/jppipa.v9i5.3526

Fayanto, S., Sulthoni, S., Wedi, A., Takda, A., & Fadilah, M. (2023). Exploration of Integrated Science-Physics Textbooks Based on Science Literacy Indicators: A Case Study in Kendari City Indonesia. *Anatolian Journal of Education*, *8*(1), 159–172. https://doi.org/10.29333/aje.2023.8111a

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

Gio, P. U. (2013). *Aplikasi Statistika dalam SPSS*. USU Press.

Gio, P. U., Syahputra, R., Lubis, I. T., Kurniawan, R., Zuhanda, M. K., Akasah, W., Shara, Y., & Sari, M. N. (2019). *Buku Mengolah Data Menggunakan Software SPSS*. Uwais Inspirasi Indonesia.

Hake, R. R. (1999). *Analyzing change/gain scores*. Dept of Physics Indiana University.

Hindun, I., Nurwidodo, N., Wahyuni, S., & Fauziah, N. (2024). Effectiveness of project-based learning in improving science literacy and collaborative skills of Muhammadiyah middle school students. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *10*(1), 58–69. https://doi.org/10.22219/jpbi.v10i1.31628

Jamaluddin, J., Jufri, A. W., Ramdani, A., & Azizah, A. (2019). Profil Literasi Sains dan Keterampilan Beprikir Kritis Pendidik IPA SMP. *Jurnal Penelitian Pendidikan IPA*, *5*(1). https://doi.org/10.29303/jppipa.v5i1.185

Klemenčič, E., Ploj Virtič, M., & Majer Kovačič, J. (2023). The Role of Teacher Education in the Science Literacy Development. *Athens Journal of Education*,

10(4), 647–668. https://doi.org/10.30958/aje.10-4-5

Lestari, H., Rahmawati, I., Siskandar, R., & Dafenta, H. (2021). Implementation of Blended Learning with A STEM Approach to Improve Student Scientific Literacy Skills During The Covid-19 Pandemic. *Jurnal Penelitian Pendidikan IPA*, *7*(2), 224–231. https://doi.org/10.29303/jppipa.v7i2.654

Luzyawati, L., Hamidah, I., Faudzan, A., & Wiyati, E. (2023). Lesson Study to Improve Students' Scientific Literacy Abilities on Respiratory System Material. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6626–6633. https://doi.org/10.29303/jppipa.v9i8.3806

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

Moiyo, Y., Buhungo, T. J., & Abdjul, T. (2024). Analisis Keefektifan Perangkat Pembelajaran Model Problem Based Learning (PBL) Berbantuan Video Pembelajaran Materi Fluida Statis. *Jurnal Jendela Pendidikan*, *4*(02), 125–132. https://doi.org/10.57008/jjp.v4i02.714

OECD. (2016). *PISA 2015 results in focus: What 15year-olds know and what they can do with what they know*. Columbia University.

OECD. (2019). *PISA 2018 results in focus: What 15year-olds know and what they can do with what they know*. Columbia University.

OECD. (2022). *PISA 2021 results in focus: What 15year-olds know and what they can do with what they know*. Columbia University.

Pravitasari, O. T., Widodo, W., & Purnomo, T. (2015). Pengembangan Media Pembelajaran Blog Berorientasi Literasi Sains Pada Sub Materi Perpindahan Kalor. *PENSA: E-Jurnal Pendidikan Sains*, *3*(3). Retrieved from https://media.neliti.com/media/publications/251441-none-25a3963a.doc

Putra, I. M. T. P., Sudiatmika, A. A. I. A. R., & Suardana, I. N. (2023). Effectiveness of E-LKPD IPA through Socioscientific Inquiry Based Learning (SSIBL) Model to Improve Students' Scientific Literacy Skills. *Jurnal Penelitian Pendidikan IPA*, *9*(8), 6337–6344. https://doi.org/10.29303/jppipa.v9i8.3957

Saputro, V. C. E., Wasis, & Prastowo, T. (2022). The Effectiveness of STEM-Based Guided Inquiry Learning to Train Science Literacy of Physics. *Studies in Learning and Teaching*, *3*(3), 141–148. https://doi.org/10.46627/silet.v3i3.179

Saraswati, Y., Indana, S., & Sudibyo, E. (2021). Science Literacy Profile of Junior High School Students Based on Knowledge, Competence, Cognitive, and Context Aspects. *IJORER : International Journal of Recent Educational Research*, *2*(3), 329–341. https://doi.org/10.46245/ijorer.v2i3.118

Setiaji, B., Santoso, P. H., Aziz, K. N., Retnawati, H., & Khairudin, M. (2023). Using Multilevel Modelling to Evaluate Science Literacy and Technology Course of the Indonesian Non-Science Students. *Jurnal Pendidikan IPA Indonesia*, *12*(1), 96–111. https://doi.org/10.15294/jpii.v12i1.41457

Sugiyono. (2013). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

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

Sunandar, A., Srihanaty, S., & Rahayu, H. M. (2022). Scientific Literacy Skills Of State High School Students In Singkawang City. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 767–772. https://doi.org/10.29303/jppipa.v8i2.1350

Tegeh, I. M., Astawan, I. G., Sudiana, I. K., & Kristiantari, M. G. R. (2021). Murder Learning Model Assisted by Metacognitive Scaffolding to Improve Students' Scientific Literacy and Numeracy Skills through Science Studies in Elementary Schools. *Jurnal Pendidikan IPA Indonesia*, *10*(4), 618–626. https://doi.org/10.15294/jpii.v10i4.32926

Toharudin, U., Hendrawati, S., & Rustaman, A. (2011). *Membangun literasi sains peserta didik*. Bandung: Humaniora.

Ustun, U., Cansiz, M., Ozdemir, E., & Cansiz, N. (2022). Student and school-level factors to predict science literacy for two top-performing countries in PISA 2015: Finland and Singapore. *International Journal of Science Education*, *44*(4), 579–603. https://doi.org/10.1080/09500693.2022.2037167

Utari, P. H., Subagia, I. W., & Sudiatmika, A. A. I. A. R. (2024). Development of Junior High School Science E-Module Integrated with Socio-Cultural of Balinese Society to Improvw Students Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *10*(3), 1093–1104. https://doi.org/10.29303/jppipa.v10i3.7151

Wahab, M. N. N. D., Istyadji, M., & Putri, R. F. (2021). Pengembangan modul pembelajaran IPA SMP berbasis literasi sains pada materi sistem tata surya. *Jurnal Ilmiah Pendidikan Fisika*, *5*(3), 278. https://doi.org/10.20527/jipf.v5i3.3675

Wahab, M. N. N. D., Wasis, W., & Yuliani, Y. (2023). Profile of Junior High School Students' Scientific Literacy. *IJORER : International Journal of Recent Educational Research*, *4*(2), 176–187. https://doi.org/10.46245/ijorer.v4i2.292

Wasis, Rahayu, S. Y., Sunarti, T., & Indana, S. (2020). *HOTS dan Literasi Sains: Konsep, pembelajaran, dan penilaiannya*. Kun Fayakun.

Widodo, W., Sudibyo, E., Suryanti, S., Sari, D. A. P., Inzanah, I., & Setiawan, B. (2020). The Effectiveness of Gadget-Based Interactive Multimedia in Improving Generation Z's Scientific Literacy. *Jurnal Pendidikan IPA Indonesia*, *9*(2), 248–256. https://doi.org/10.15294/jpii.v9i2.23208

Yani, Y. P., Hardeli, H., Oktavia, B., & Kurniawati, D. (2020). Development of an Integrated E-Module of Scientific Literacy and Video Demonstration Using a Problem-Based Learning Model for High School Students on Acids and Bases. *Jurnal Penelitian Pendidikan IPA*, *8*(2), 452–462. https://doi.org/10.29303/jppipa.v8i2.1306