

Science E-Book Integrated with Local Potential of Petis Making Based on Problem Based Learning-ESD to Improve Science Literacy Skills of Junior High School Students

Kamila^{1*}, Sabar Nurohman², Ismail Fikri³

¹Science Education, Faculty of Mathematics and Natural Science, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

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Corresponding Author:

Kamila

kamila0152fmipa.2022@student.uny.ac.id

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Abstract: This study aims to determine the effect of science e-books integrated with local potential based on PBL-ESD on students' science literacy skills on the sub-topic of mixture separation methods. This research is an experimental research with One Group Pretest-Posttest research design. The population in this study were VIII grade students of SMP Negeri 8 Yogyakarta and the sample technique used was random sampling, namely VIII-f and VIII-i classes totaling 55 students. The instrument used was a test in the form of multiple choice questions to measure students' science literacy skills. Paired Samples T-Test test results obtained Sig. (2-tailed) of 0.00 < 0.05 which shows there is a change in the improvement of students' science literacy skills between before and after using the e-book. The increase in students' science literacy skills is supported by the N-gain value of 0.24 which is included in the low category and the effect size test results of 0.59 which shows a moderate category. The highest indicator of students' science literacy ability is explaining phenomena scientifically. So it can be concluded that there is an effect of science e-book integrated with local potential based on PBL-ESD on students' science literacy skills on mixture separation material.

Keywords: Local potential; Problem based learning; Science E-book; Science literacy.

Introduction

The challenges of the 21st century require students to become qualified human resources, one of the appropriate efforts is science literacy. This is because science literacy is able to make students solve problems in the surrounding environment by utilizing and producing products that contribute to solving problems (Mustofa et al., 2023). Creating education that continues to develop must be supported by good human resources, one of which is through students' scientific literacy skills (Irsan, 2021). According to Rahman et al. (2022) science literacy is a measuring tool used by teachers to students to be able to develop students in thinking scientifically, as one of the students' efforts in

providing problem solving in everyday contexts. Science literacy is a skill that a person has in applying science concepts in everyday life and his ability to interpret surrounding phenomena based on scientific explanations and scientific evidence (Aditya & Indana, 2022).

Indonesia's performance in the 2022 PISA assessment for mathematics, reading, and science ranked 69th, 70th, and 66th out of 81 participating countries. While these rankings reflect an improvement of 5–6 positions compared to the 2018 results, the average scores in each subject actually declined, with mathematics at 366, reading at 359, and science at 383. This trend highlights the complexity of educational progress, as ranking improvements do not necessarily

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correspond to higher absolute performance within the OECD framework (Schleicher, 2023). This is also supported by research conducted by Intan et al. (2023) which shows that students' science literacy skills in the aspects of knowledge and competence in class VIII junior high school in Gorontalo city are in the low category. This low knowledge and competence aspect shows that students have not been optimal in understanding concepts, facts and theories in a material and students have not been able to apply knowledge in everyday life related to science material. The profile of science literacy skills based on the PISA framework in grade VIII students of public junior high schools in Semarang city in 2022 is in the medium category, meaning that students are sufficient in mastering science literacy, but improvement needs to be done (Saptaningrum et al., 2023).

Science literacy is able to improve the way students think and behave, and form characters who are aware and responsible for themselves, society, the environment, and the challenges of modern times. Students who have scientific literacy can make the right decisions and recognize science and technology as a solution to problems (Syahidi et al., 2023). Context in science learning, science literacy has an important contribution because it is able to prepare students who have quality and can compete in the world internationally. Students' science literacy in science learning can be developed through teachers by creating learning situations by involving students' activeness in learning (Irsan, 2021). In today's education, students are expected not only to understand the concepts, but students are needed to be active in the learning process (Aditya & Indana, 2022). Therefore, fostering scientific literacy is essential for students in all countries (Mulyana & Desnita, 2023). Enhancing science literacy skills is a crucial effort. Research by Kamila et al. (2024) highlights the need for significant measures to strengthen students' scientific literacy. One effective approach is implementing learning strategies that actively engage students and utilize appropriate teaching methods.

The current curriculum is an independent learning curriculum. Based on research conducted by Setiawan et al. (2023) the independent curriculum makes teachers required to innovate and creativity in teaching. Teachers must have innovations in presenting learning materials and media that are applied to students with their broad knowledge. However, based on the results of interviews, teachers have limitations in expressing creative ideas for making learning media and teaching material in an interesting way. Teaching materials that are less creative during the science learning process are also a factor in the low ability of students to understand science concepts and difficulties in applying them (Day et al.,

2023). One of the teaching materials that can be developed by teachers is an e-book.

Efforts can be made to improve students' science literacy through the use of e-books. The 21st century provides great opportunities for the use of e-books to update printed books in the context of education due to the rapid development of information technology, thus providing adaptation of teaching and learning to the growing digital era (Wijaya et al., 2022). E-books are a type of book that is published in digital form. The use of e-books is more flexible and equipped with various features. The role of e-books allows readers to control the pages they want to read, display videos and read context (Gui, 2019). E-books are digital media that combine written text with interactive applications, offering several advantages over traditional printed books. They represent a transformation of conventional books into electronic formats, enhanced with multimedia elements, text, and search functionalities. By integrating the characteristics of printed books with digital features, e-books contribute to the advancement of information media (Alsalmi et al., 2020).

Therefore, using e-books as teaching materials in science learning provides an opportunity to improve students' science literacy. Research conducted by Firdausy & Prasetyo (2020) shows that science literacy can be improved using interactive e-books. Interactive e-books can assist teachers in improving attitudes, motivation, depth of material, and more meaningful learning to students. This is also in line with research conducted by Febrianti (2021) which shows that the digital book media based on Flip Pdf Professional has an impact on the learning process which makes students more active and increases students' science literacy skills as seen from the N-gain results in the high category. The results of research conducted by (Maulana et al., 2023) show that in science learning using e-book media as a whole can effectively improve students' science literacy. E-books can facilitate science literacy if used in certain learning approaches and models, one of which is the ESD approach and PBL model. Consistent with Saktilia & Wulandari (2024) research, the use of interactive flipbook-based e-books following the Problem-Based Learning (PBL) framework has been shown to support teachers in presenting learning materials effectively while also enhancing students' engagement and interest in learning.

Students engaged in Problem-Based Learning (PBL) demonstrate stronger problem-identification skills, a deeper ability to explain scientific phenomena, and more effective data-driven reasoning than those in conventional learning settings. Rooted in a scientific approach, PBL fosters independent learning and critical thinking, equipping students with the cognitive tools

necessary for meaningful knowledge construction (Ramadhan & Mardin, 2023). The principle of PBL is a learning strategy in which it contains certain syntax or principles as characteristics that are applied during learning. The application of PBL in the process students must define the problem, research, and be able to integrate theory into practice to be a solution. PBL builds students to have the ability to ask questions (Arends, 2008). Research on the implementation of the Problem-Based Learning (PBL) model plays a crucial role in enhancing science generic skills in science education, making a significant contribution to 21st-century learning. As an instructional approach, PBL effectively fosters the development of these essential skills. Mastery of science generic skills enables students to analyze and process information efficiently, equipping them to solve problems not only in the classroom but also in real-life situations (Doyan et al., 2024).

The ESD (Education For Sustainable Development) approach is one of the solutions in education with the hope of being able to direct students in realizing a sustainable life (Saffanah & Hamdu, 2022). Learning with ESD that applies science in everyday life related to environmental issues is expected to make the learning process at school more meaningful and direct students to think ahead and have awareness of sustainability values (Alissa et al., 2022). One of them is the sustainability values of petis local potential. Teaching materials must include key elements contained in the Pancasila student profile so that they can support the realization of education for sustainable development (Maghribi & Sidik, 2023). To support this, the integration of local potential in learning needs to be applied in learning. Therefore, integrating Education for Sustainable Development (ESD) is essential for fostering human competencies that contribute to building a sustainable future (Lestari et al., 2021).

Science learning at the junior high school level emphasizes a contextual approach, encouraging students to explore and engage with their surrounding environment. Local potential plays a crucial role as a valuable learning resource, allowing students to connect scientific concepts with real-world applications. One effective way to integrate local potential into science education is by mapping relevant scientific topics to the unique local resources available in a given area. This approach not only enriches the learning experience but also fosters a deeper appreciation for local wisdom and its relevance to scientific inquiry (Yanti et al., 2022). The introduction of local potential needs to be done again to the younger generation, especially students. Local potential is able to act as a values filter in the current era of globalization and modernization, to filter positive values that are appropriate in accordance with

Indonesian cultural values. The process of reorienting local wisdom in formal education can be a forum for socializing good values (Syaputra, 2019). Integrating local culture into science learning can provide insight to students to process local culture into something meaningful in science learning (Rahman et al., 2023). One of the local potentials that can be integrated in learning is the local potential of making petis.

Petis is an important element in the life of Madurese people. Petis cuisine is part of the humanitarian, cultural, and environmental aspects. From a cultural point of view, petis acts as an identity, image, and heritage of the culture that grows among the community (Kusumo & Afandi, 2020). Cultural representation in petis food products can be introduced to the younger generation by making references to teaching materials in schools.

Research on Science E-Book Integrated with Local Potential of Petis Making Based on Problem-Based Learning-ESD to Improve Science Literacy Skills of Junior High School Students presents a novelty in science learning by integrating local potential in digital teaching materials based on Problem-Based Learning (PBL) and Education for Sustainable Development (ESD). This approach has not been widely applied in the development of science e-books, especially in the context of petis production as a local potential that can be an environmental and cultural-based learning resource. By combining the concepts of science literacy, PBL, and ESD, this research offers innovation in learning methods that not only improve students' understanding of science concepts, but also instill awareness of sustainability and the utilization of local resources in everyday life.

The novelty of this research also lies in the utilization of e-books as teaching materials that connect science theory on mixture separation material with real practices through case studies of petis making. This provides a more contextual and applicable learning experience for junior high school students, so that they can understand how science can be applied in everyday life and local industries. Thus, this research not only contributes to the development of digital-based teaching materials, but also to the strengthening of students' science literacy through a problem-based approach that is relevant to their environment.

Method

This study used an experimental method. This method was conducted to determine the effect of one treatment given, namely using e-book teaching materials integrated with the local potential of PBL-ESD-based petis making on students' science literacy skills.

This research design uses an experimental class using One Group Pretest-Posttest. The population in this study was class VIII of SMP Negeri 8 Yogyakarta. Sampling in this study used random sampling, namely classes VIII-f and VIII-i which totaled 55 students.

The design used was a one group pretest posttest design with only the experimental class involved. The research design is presented in Table 1.

Table 1. One Group Pretest Posttest Design adapted from Sugiyono (2019)

Group	Pretest	Treatment	Posttest
Experiment	O1	X1	O2

The data collection instrument in this study was using multiple choice questions totaling 5 questions. Indicators and sub-indicators of science literacy competencies consist of 3 aspects adopted from Schleicher (2019); Snow & Dibner (2016) which can be seen in Table 2.

Table 2. Science literacy indicators and sub-indicators

Indicator	Sub indicator
Explaining phenomena scientifically	Describe a phenomenon scientifically Apply appropriate science knowledge in life
Evaluating and designing scientific questions	Identify questions that can be explored scientifically
Interpreting scientific data and evidence	Convert data from one representation to another Draw conclusions from scientific data and evidence

Assessment of science literacy results, then data analysis is carried out in the form of normality test, homogeneity test, paired samples t-test using SPSS 25, then N-gain test and effect size to determine the effectiveness of teaching materials that have been applied. The N-gain test was conducted to determine the extent of the improvement of students' science literacy skills by calculating the pretest and posttest values using Formula 1 (Kurniawan & Hidayah, 2020).

Table 5. Normality Test Results

Test	Treatments	Shapiro-Wilk		
		Statistic	df	Sig.
Pretest scientific literacy	Modeling class	0.929	24	0.093
	Implementation class	0.940	31	0.081
Posttest scientific literacy	Modeling class	0.922	24	0.064
	Implementation class	0.936	31	0.062

Based on the results of the pretest and posttest normality tests on the modeling class (class with the researcher as the teacher) and the implementation class (class with the teacher as the teacher) contained in Table 4. It is known that the pretest significance of the two

$$g = \frac{S_{posttest} - S_{Pretest}}{S_{max} - S_{Pretest}} \tag{1}$$

Furthermore, the calculation results obtained are interpreted based on the criteria in Table 3.

Table 3. N-Gain Interpretation Categories

Score N-Gain	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

Effect Size is a method utilized to assess the impact of the treatment, specifically the use of science e-books integrated with the local context of PBL-ESD-based petis making, on the science literacy skills of junior high school students. This evaluation employs a single group or one-group analysis using Formula 2.

$$\text{Effect Size} = \frac{x_{post} - x_{pre}}{SD} \tag{2}$$

The results of the effect size calculation are then interpreted based on Table 4.

Table 4. Effect Size Interpretation (Jelita et al., 2022)

Interval Size	Interpretation
0.00-0.20	Weak effect
0.21-0.350	Modest effect
0.50-1.00	Moderate effect
>1.00	Strong effect

Result and Discussion

Given treatment or implementation e-book to student, the normality test was then carried out. Normality test has the aim to test the distribution or distribution of normal data. Normality testing was carried out on the results of the pretest and posttest in class VIII-f and VIII-i students. Normality testing using the help of the SPSS 25 application produced data that can be seen in table 5.

classes is 0.093 and 0.083 > α (0.05) While for the posttest in both classes shows a significance of 0.064 and 0.062 > α (0.05). This shows that the pretest and posttest values come from a normally distributed data distribution, so

that the data test analysis can be carried out using parametric tests.

The next stage is paired samples statistical test to determine whether there is a significant positive effect of

using science e-books integrated with local potential of PBL-ESD-based petis in the learning process on students' science literacy skills. The results of the paired samples t-test can be seen in Table 6.

Table 6. Paired Samples Statistics Test Results

	Test	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest scientific literacy	49.09	55	25.768	3.475
	Posttest scientific literacy	61.45	55	24.602	3.317

Based on the data above, it shows that there are 55 respondents in class VIII i and class VIII-f. In the pretest results, the average value obtained was 49.09 while in the posttest results was 61.45. This shows that before learning, students' science literacy skills vary, with some students having good understanding and some others having less understanding. After the learning was conducted, learners were tested again to see if there was an improvement in students' science literacy skills. The results showed that there was improvement. This indicates that utilizing science e-books integrated with the local potential of petis making based on PBL-ESD can enhance students' science literacy skills on the topic of mixture separation methods. To assess the significance of the improvement in science literacy skills before and after using the e-books, a paired samples t-test was performed, as shown in Table 7.

Table 7. Paired Samples Test Results

Paired Samples Test	Test	t	df	Sig. (2-tailed)
Pair 1	Pretest Science Literacy - Posttest Science Literacy	-4.387	54	0.000

Based on the output in table 6, in the "equal variances assumed" section, it is known that the Sig value. (2-tailed) of 0.00 <0.05, this indicates that there is a significant difference (real) between the average science literacy skills of students before and after learning by using an integrated e-book of local potential of PBL-ESD-based petis. The evidence suggests that employing the ESD-focused Problem-Based Learning (PBL) approach in science education is successful in enhancing scientific literacy. With a significant outcome of 0.000 (p < 0.05), it's evident that there's a notable improvement in students' science literacy skills from the pretest to the posttest. This conclusion aligns with the findings of the study conducted by Rahman et al. (2023) regarding the Profile of Scientific Literacy of Learners through Local Culture-Based Learning using Dadak Merak Reog Ponorogo Dance. The study results indicated an improvement in students' scientific literacy through science education incorporating the local

culture of the Dadak Merak Reog Ponorogo dance, evidenced by a significant (2-tailed) value of 0.001 <0.05.

The improvement in science literacy skills of Class VIII students at SMPN 8 Yogyakarta on mixed separation material is due to the PBL syntax, which involves analysis, synthesizing information, and evaluation. This is crucial for developing science literacy as students encounter real-world problems in the initial syntax, necessitating problem-solving through reading the provided article. This is in accordance with research conducted by Salma et al. (2023) in the student problem orientation phase, the teacher provides sources in the form of videos and articles related to the problems presented. So that through the PBL model there is habituation of students in reading text related to problems that are related to the material.

N-Gain test analysis using formula 1 to calculate the N-gain score of students' science literacy skills. Then the results of students' science literacy skills are categorized based on Table 2. The results of the N-gain score of the students' pretest and posttest as a whole after calculation obtained an N-gain score of 0.24 which is included in the small category because $g < 0.3$. This shows that based on the N-gain analysis, the science e-book integrated with the local potential of PBL-ESD-based petis is still not optimal for improving students' science literacy skills. This means that based on the N-gain results, students' science literacy increases from before to after learning using e-books, but not yet optimal.

Based on the N-gain score, it shows that there is an effect of using e-books on students' science literacy with a small category or no significant effect. The significance of increasing science literacy skills can occur because the e-book applied to students in the PBL step in guiding students towards investigation, students are directed to conduct literature studies without direct investigation or practice in the field. So that students in providing solutions to the problems faced are less than optimal and affect students' problem-solving skills and when working on problems, students lack understanding in analyzing questions. This is in line with Sutrisna (2021) which shows that low science literacy is influenced by students who are less able to understand questions that involve a series of topics that must be analyzed.

Improving students' science literacy skills by using e-books on mixture separation materials. E-books can facilitate students' science literacy skills because the use of e-books is more flexible and equipped with various features. The role of e-books allows readers to control the pages they want to read, display videos and read context (Gui, 2019). E-books make it easy for students to access material using software such as laptops, computers, tablets and smartphones (Acar, 2022). In e-books with the PBL model, it is also very helpful for students in the learning process. In each syntax that affects learning. In the first syntax, students are oriented to problems related to petis and environmental pollution. In the second step, students learn using e-books, while in the third step, they conduct group investigations focused on problem-solving by searching for relevant information and solutions using e-books and literature reviews. The fourth syntax students develop and present the results of the discussion in front of the class and are asked to show the reasons for the chosen problem solving in the case of petis problems and environmental pollution using the mixture separation method. The last syntax is to analyze and evaluate the problem-solving process through reflection among fellow groups and also the teacher. So that the overall learning process makes students more active in the classroom.

This is in accordance with research conducted by Sofyan et al. (2017) which shows that PBL in a learning concept that can help teachers to build learning environment conditions that start from problems so as to provide opportunities for students to get real learning experiences. The PBL learning process will involve students to be active, can work together, student-centered so that students' problem solving skills become more improved. PBL has three characteristics, first, in its application there are a series of activities that must be carried out by students including communicating, searching and processing data to conclude. Second, the learning activities will be directed to solve problems. Third, the approach used is scientific thinking to solve problems. The Problem-Based Learning (PBL) model offers numerous advantages, such as fostering critical and creative thinking, enhancing students' independent problem-solving skills, and boosting their motivation to learn. This approach actively engages students in exploring and grasping concepts, enabling them to cultivate deeper analytical abilities and apply their knowledge effectively in real-life situations (Syahidi et al., 2024).

The N-gain test per indicator was conducted to determine students' science literacy skills in terms of the three science literacy indicators. The N-gain score on indicator 1 is 0.38 with a medium indicator, the second indicator score is 0.33 which is also included in the

medium category, and the third indicator N-gain result is 0.03 including in the small category. Based on the analysis above, it shows that the highest indicator is the first indicator, which is explaining phenomena scientifically. To see the ability of students' science literacy per indicator can be seen in the pie chart presented in Figure 1.

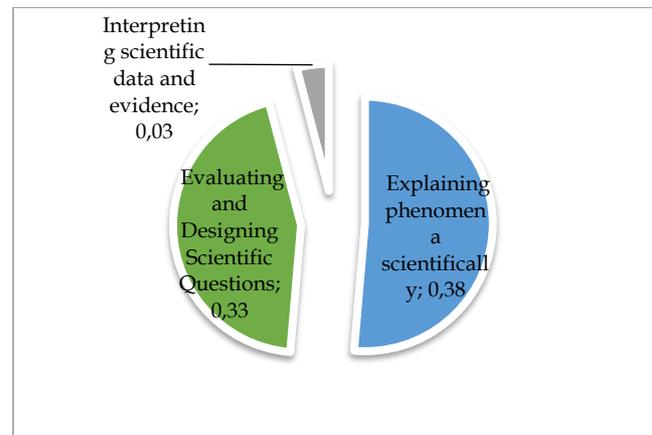


Figure 1. N-Gain Score Results Each Indicator

Based on the bar chart of the results of the N-gain score of the 3 indicators above, it is obtained that the highest indicator is the gem indicator, namely explaining phenomena scientifically with a score of 0.38 in the medium category. The second highest indicator is the indicator of evaluating and designing scientific questions with a score of 0.33 which is included in the medium category. The lowest indicator is the third indicator, namely interpreting data and scientific evidence with an N-gain score of 0.03 which is included in the low category.

The third lowest indicator, evaluating and designing scientific questions, shows that students' lack of ability to interpret data and scientific evidence can be caused by a lack of understanding of the basic concepts of students who do not have a strong grasp of the basic concepts needed to interpret data and scientific evidence correctly. The interpretation of data and scientific evidence is also related to good analytical skills, for example in making comparisons and drawing conclusions, so students have difficulty in interpreting data scientifically. Students have the lowest ability in this competency, this can occur because students do not yet have the ability to draw an appropriate conclusion from data in the form of tables and graphs. This conclusion is backed by earlier studies indicating that students have a poor grasp of fundamental science concepts and struggle with interpreting tables and graphs (Yusmar & Fadilah, 2023). Other research confirms previous research conducted in several schools in Sumenep city also shows that the low scientific

abilities of high school students, the ability to explain phenomena scientifically, evaluate and design scientific investigations, scientific understanding of data and evidence scientifically (Tulaiya & Wasis, 2020).

The highest indicator is the first indicator, explaining the phenomenon scientifically, which shows that students have been able to answer questions related to the local potential of petis on the material of mixture separation methods. This shows that students already have the ability to describe and interpret the phenomenon and anticipate possible changes in the phenomenon. In this indicator, students are good at remembering the content of relevant information in certain situations and using it to interpret and explain interesting phenomena. This is in line with research conducted by Wardi et al. (2023) which shows that the highest average score of students' science literacy skills is the indicator of explaining phenomena scientifically because students are only required to remember and recognize phenomena scientifically, without requiring in-depth analytical skills.

Effect Size analysis of students' science literacy skills before and after the implementation of science e-books integrated with local potential based on PBL-ESD based on the calculation results obtained a score of 0.59. Based on the interpretation contained in table 2, it shows that students' science literacy skills are at the Moderate effect level. This shows that the e-book applied to students is able to improve students' science literacy skills on mixture separation material. Learning based on local potential can explore and utilize regional potential wisely to create a conducive learning environment. Students can actively develop the skills, knowledge, and attitudes needed to contribute to solving problems (Tabun, 2024). Through the Problem Based Learning (PBL) model can be used as a solution to improve students' science literacy because there is a connection, for example in the initial syntax of PBL, namely problem orientation, students can connect problems with students' previous knowledge. Students will find facts by conducting investigations to get conclusions that are used as problem solving (Pakpahan, 2022). This is also in line with research conducted by (Putri et al., 2014) which shows that there is an effect of the local potential-based PBL model on improving the science literacy skills of grade X students with the highest average indicator obtained is using evidence scientifically. This is in line with research conducted by Febianti & Sukmawati (2024) which shows that students' science literacy skills can improve by using a problem-based learning model. This is because the PBL model makes students' problem solving skills more optimal. Based on the results of research conducted related to the development of learning devices using the PBL model, it is effective in

improving students' science literacy, which obtained a very good category that supports students' learning activities well (Wumu et al., 2023).

The integration of the local potential of petis combined with the ESD approach is also a factor in students being able to solve environmental problems associated with the material during the learning process. This is supported by research conducted by Yolida et al. (2023), the research results indicate that integrating environmental awareness with culture, along with fostering a sense of responsibility and problem-solving skills for environmental issues, impacts the Sustainable Development Goals (SDGs), including those related to ESD components. The ESD approach can provide students with an understanding that the utilization of surrounding issues towards sustainable awareness can be used as a solution to increase students' concern for sustainable development around them. This can also improve literacy skills in efforts to solve problems around them (Mulyadiprana et al., 2023).

Conclusion

Based on the results of the research and data analysis above, it can be concluded that there is an effect of implementing e-books integrated with the local potential of PBL-ESD-based petis to improve students' science literacy. Based on the results of the analysis, it can be concluded that the highest indicator of students' science literacy is the first indicator, namely explaining phenomena scientifically. While the lowest indicator is the third indicator, namely the ability of students to interpret data and scientific evidence. This can be seen from the Paired Samples T-test, N-Gain test and effect size. Paired Samples T-Test test results Sig. (2-tailed) of $0.00 < 0.05$ which shows there is a change in the improvement of students' science literacy skills between before and after using science e-books. This increase is also supported by the results of the N-gain score test of 0.24 which is included in the low category and the effect size test results with a score of 0.59 which shows a moderate category. E-books can have a positive effect on junior high school students' science literacy skills on mixture separation materials.

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Conflicts of Interest

This research has no conflict of interest regarding the publication of this paper

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