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Development of Scientific Literacy E-module in Science (Physics) Subject to Improve Students' Science Process Skills

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Abstract: This research is a type of Research and Development (R&D) using the Four-D model. The stages are Define, Design, Develop, and Disseminate. The aim is to develop a science literacy e-module for science (physics) subject and to test its validity, practicality, and effectiveness to improve students' science process skills. Three experts checked the content validity of the e-module, teacher questionnaire, and science process skills test. Ten science (physics) teachers tested the practicality, and the effectiveness e-module was tried on 34 students of Grade 8 at SMP Katolik Belibis Makassar. The results show: 1) the e-module is valid and suitable to use, 2) the teachers' response is very practical, and 3) the effectiveness of the e-module is shown by an N-gain score of 63.40%, which means it is effective to improve students' science process skills. Based on these results, the science literacy e-module for science (physics) is valid, very practical, and effective to support the learning process of science process skills.

Keywords: E-module; Science literacy; Science process skills

Introduction

The rapid advancement of 21st-century technology, including the use of electronic devices for communication, entertainment, and work, has also influenced the education sector. Both teachers and students are required to adapt to these technological developments. Teachers are expected to master digital tools and deliver learning materials in innovative and engaging ways (Annida et al., 2023). In addition, the development of science, technology, and the Industrial Revolution 4.0 demands the integration of new competencies into education, such as higher-order thinking skills and complex communication abilities, which are particularly essential in science learning, especially physics.

Physics is a branch of natural science that explores natural phenomena, concepts, principles, theories, and laws, all of which require precision and critical thinking (Hartono et al., 2021; Okyranida et al., 2021). However, physics is frequently perceived by students as a difficult and less engaging subject due to its abstract concepts and complex calculations (Novelensia et al., 2021). In fact, physics plays a crucial role in enhancing students' science process skills (Darii et al., 2021).

Science process skills are fundamental abilities that students need to develop in order to understand, explore, and construct scientific knowledge through systematic inquiry (Septantiningtyas, 2020; Watin, 2019). These skills include observing, formulating questions, making hypotheses, collecting data, analyzing data, and drawing conclusions. According to Putri (2018), science process skills are a critical component of the learning process as they significantly contribute to students' knowledge development. Moreover, effective learning resources that facilitate understanding, especially in physics, are essential to promote active learning (Supriadi, 2017). Physics learning is closely associated with skill development, and students' success is often measured by their ability to solve problems accurately (Warimun, 2012).

However, the reality in the field shows that students' science process skills remain low.

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Observations at SMP Katolik Belibis Makassar revealed that students' science process skills achieved an average score of only 38%, particularly in performance-based skills. This condition is attributed to several factors, including limited supporting facilities, varying levels of student comprehension, and the use of conventional, non-interactive learning materials.

One promising solution to address this issue is the development of e-modules integrated with science literacy. E-modules are electronic learning resources designed in accordance with the curriculum, enriched with interactive features such as videos, animations, quizzes, and audio to enhance students' motivation, conceptual understanding, and science process skills (Andani et al., 2024; Jumaniar et al., 2024; Kemendikbud, 2017; Muzijah et al., 2020; Purwanto, 2007; Ramadayanty et al., 2021). E-modules offer flexibility by allowing access to learning materials anytime and anywhere through electronic devices such as computers, laptops, or smartphones (Sugianto et al., 2017; Waruwu et al., 2024).

Furthermore, Afdalia et al. (2020) emphasize that providing attractive and user-friendly learning modules is an effective strategy to enhance students' learning experiences. E-modules designed based on science literacy not only present subject matter but also train students' science process skills through simulations, project-based tasks, and interactive formative assessments (Marcelina et al., 2023; Rini et al., 2021; Tarigan et al., 2022). Science literacy encompasses three essential aspects: scientific knowledge (science concepts), scientific competence (science process skills), and scientific context, which collectively enable students to apply scientific concepts in solving real-world problems (Faridah et al., 2022; Latip et al., 2021; OECD, 2019).

The development of e-modules is also in line with the implementation of the Merdeka Curriculum, which emphasizes the integration of science process skills into meaningful project-based learning (Permatasari et al., 2023). Marlena et al. (2019) state that science process skills enable students to acquire information, solve problems, and analyze research results. These skills foster responsibility in learning and reinforce the steps of scientific inquiry, which are developed not only through theoretical concepts but also through practical experience (Rikizaputra et al., 2021). However, the current learning conditions, often conducted online or with limited access to practical activities, hinder the development of science process skills through direct experience (Rufaida et al., 2021).

The development of science literacy-based e-modules must follow a systematic process and undergo expert validation to ensure that the resulting product is appropriate and reliable (Sani et al., 2020). Previous studies have demonstrated that e-modules are valid and practical for learning purposes (Adam et al., 2023). Nonetheless, research focusing specifically on the development of science literacy-based e-modules to enhance junior high school students' science process skills, particularly in physics, remains limited. This gap represents the novelty of the present study.

Therefore, this research is considered essential to develop a science literacy-based e-module accessible via smartphones, designed to improve students' science process skills, with a particular focus on performance-based skills. It is expected that this e-module will support students in engaging in flexible, independent, or group learning, anytime and anywhere. Accordingly, this research is entitled "Development of Science Literacy E-Module in Science (Physics) Subject to Improve Students' Science Process Skills."

Method

The type of research used is research and development (R&D). The procedure for developing the science literacy e-module in physics subjects to improve students' science process skills uses the four-D (4-D) development model. The stages of this model are shown in the following figure 1.

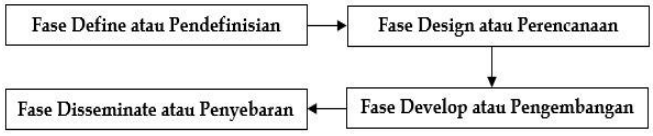

Figure 1. The stages of the 4-D development model (Thiagarajan et al., 1974)

In the defining stage, a preliminary study was conducted through observations of students and the learning process. This preliminary study began by analyzing the problems or needs of students and the school in improving science process skills, especially in physics learning at SMP Katolik Belibis Makassar.

The defining analysis has five stages, namely: 1) The needs analysis relates to problems in physics learning, school conditions, and the completeness of learning media. The purpose of the initial analysis is to identify the main problems faced in physics learning at the school, including curriculum and field problems, so that the development of a teaching e-module is needed. Based on direct observations at the research location, the teaching books used in physics learning have not supported this need, because they still use textbooks that only present material without applying the concept of science process skills. 2) The student analysis aims to examine the characteristics of students, including their background knowledge and learning styles. The students at SMP Katolik Belibis Makassar are in the age

range of 12–15 years. The researcher has identified each student's learning style preferences, whether visual, auditory, or kinesthetic, as the basis for designing learning that suits their needs. The distribution results of students' learning styles can be seen in the following figure 2.

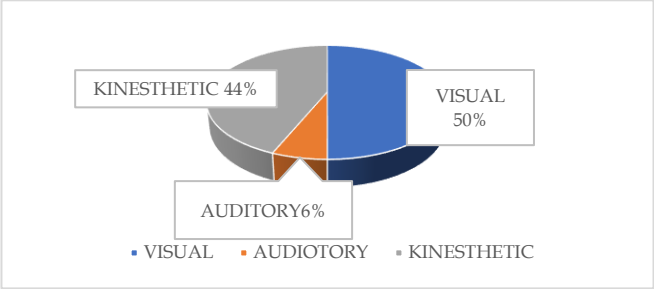

Figure 2. Learning styles of grade VIII students at SMP Katolik Belibis Makassar

Based on the analysis of students' learning styles in Grade VIII at SMP Katolik Belibis Makassar, it was found that students exhibit a variety of learning styles, namely visual, auditory, and kinesthetic. The distribution results show that 50% of students prefer a visual learning style, 44% prefer a kinesthetic learning style, and 6% prefer an auditory learning style. These findings indicate that the majority of students tend to favor learning through visual aids and observation, supported by physical activities or hands-on experiences to strengthen their understanding. Therefore, the development of learning tools, such as e-modules, should be aligned with these learning style characteristics to enhance the effectiveness of the learning process, 3) concept analysis is done by selecting and identifying important concepts in the material to be studied. Based on the material analysis results, the chosen topic for development is "simple machines." This topic was chosen because simple machines are often applied in daily life and can be related to the students' environment, 4) learning objectives are formulated based on the Learning Outcomes and Learning Objective Pathways in the curriculum, as well as the results of identifying relevant material concepts, 5) test analysis is the process of evaluating the questions used to measure learning outcomes and indicators of science process skills. The test is designed to match the learning objectives and to measure how well students understand the concepts and apply science process skills in science learning.

The design stage is carried out to prepare the e-module based on the content framework that has been analyzed from the curriculum material (Trianto, 2011). This stage is the process of planning the structure of the science literacy e-module in the physics subject that will be developed. The main activities at this stage include: 1) selecting the format used in the development, which consists of three components, namely general information, core components, and attachments, 2) the initial design in developing the e-module includes material images obtained by downloading from Google Pictures, videos obtained from the YouTube platform, and question materials taken from physics textbooks and articles on the internet. The cover design, background, and other visual elements are made using the Canva application and combined with the Flipbuilder application.

The development stage consists of two parts: 1) expert/practitioner validation, where the instruments used in this development research are validated and receive suggestions from expert validators, namely lecturers from the Physics Education Study Program, 2) development testing, which includes trial tests conducted by the researcher after revisions based on suggestions from expert validators, followed by limited product testing. The trial test design used is the "One Group Pre-test and Post-test Design." In this design, observations are carried out twice: before the experiment (O_1), called the pre-test, and after the experiment (O_2), called the post-test. The design of this trial test is illustrated as follows (Sugiyono, 2013).

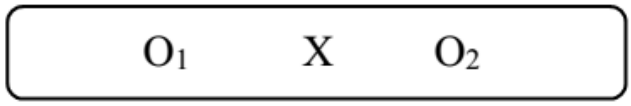

Figure 3. One group pretest-posttest design

Explanation:
O_1 = pre-test (initial test before treatment)
X = giving treatment
O_2 = post-test (final test after treatment)

The dissemination stage is the stage of distributing the developed e-module, which will be distributed on a limited basis to teachers and grade VIII students at SMP Katolik Belibis Makassar. After the report is completed, the e-module will be publicly disseminated through the Physics Education Journal of UNM Postgraduate Program.

Data Analysis

Analysis of Validation Results

The analysis used to determine the level of relevance by several experts is the content validity coefficient (Aiken's V). The Aiken's V formula is used to calculate the content validity coefficient based on the assessment results from each expert for an item (Azwar, 2012).

$$V = \frac{\Sigma s}{n(c-1)} \quad (1)$$

Explanation:
V : index of expert agreement on item validity
s : the difference between the score given by each expert and the lowest score in the rating scale
s : $s = r - l_0$
r : score given by the rater (expert)
L_0 : the lowest score in the rating scale
n : number of experts
c : the highest score in the rating scale

The requirement for the Aiken's V test is that after the calculation, if V ≥ 0.4, then the index of expert agreement is considered valid.

Practicality Analysis

The research distributes a questionnaire to collect responses from teachers and students after the learning process using the science literacy e-module. This is done to improve the score and to measure how easily the science literacy e-module can be used by teachers and students in the learning process and in developing science process skills. The teacher and student response questionnaire is assessed by giving a score of 1 to 4, where the category strongly agree for positive statements gets a score of 4, agree" gets 3, disagree gets 2, and strongly disagree gets 1. This is based on the provisions in Table 1.

Table 1. Coding of Practitioner Response (Sugiyono, 2020)

Category	Score for Positive Statements	Score for Negative Statements
Strongly Agree	4	1
Agree	3	2
Disagree	2	3
Strongly Disagree	1	4

The steps of the analysis are as follows: (a) Calculate the ideal score (maximum score) for each item/statement. (b) Calculate the total score obtained for each item. (c) Calculate the percentage of the total score obtained for each item using the following formula:

$$Practical\ value = \frac{sum\ of\ scores\ obtained}{sum\ of\ highest\ scores} \times 100\% \quad (2)$$

The percentage of practitioner responses for each statement uses the criteria according to Table 2.

Table 2. Criteria for Practitioner Assessment Score (Sahida, 2018)

Percentage (%)	Category
76-100	Very Practical
56-75	Practical
26-55	Less Practical
0-25	Not Practical

Analysis of the Effectiveness

The data analysis of the effectiveness of the science literacy e-module was done by processing and analyzing the students' science process skills data to see the achievement after they used the science literacy e-module. The assessment to improve science process skills was done by analyzing the data from the pretest and posttest results using gain and N-gain. N-gain (normalized gain) is used to measure the improvement of science process skills before and after learning. According to Sundayana (2016), to find N-gain, the following formula is used:

$$< g > = \frac{X_{posttest} - X_{pretest}}{X_{maksimum} - X_{pretest}} \times 100\% \quad (3)$$

Explanation:
g : normalized gain score
$X_{pretest}$: pretest score (initial score)
$X_{postest}$: posttest score (final score)
$X_{maksimum}$: maximum score

The criteria for interpreting the gain index can be seen in the Table.

Table 3. Normalized Gain Score Categories (Sundayana, 2016)

Mark <g>	Category
$0.70 < g \leq 1.00$	High
$0.30 < g \leq 0.70$	Medium
$0.00 < g \leq 0.30$	Low

Then, the effectiveness of using the science literacy e-module is categorized based on the interpretation of the N-gain score. The score is then converted to a percentage (%) as shown in the Table 4.

Table 4. Interpretation of Standard Gain Effectiveness

Interval (%)	Category
$g \leq 55$	Not Effective
$g \geq 56$	Effective

Referring to Table 4, the use of the science literacy e-module in science (physics) lessons is considered effective in improving science process skills if 70% or more of the students have a gain score of ≥ 56% or fall under the effective category (Puspita et al., 2022).

Result and Discussion

Development of Science Literacy E-Module in Science (Physics) Subject to Improve Science Process Skills

This research produced a teaching e-module that was assessed for its feasibility by students, received feedback from teachers, and measured the improvement

of students' science process skills through trials in the development stage. After developing the science literacy e-module, the process of developing the e-module for science (physics) lessons and the trial results on eighth-grade students at SMP Katolik Belibis Makassar are explained. This aims to assess the implementation and effectiveness of the developed science literacy e-module for science (physics) lessons.

The Development Results of the Science Literacy E-Module for Science (Physics) Lessons

The development result of this research is a science literacy e-module for the Physics subject in eighth-grade junior high school with the topic of simple machines. The science literacy e-module and the prepared instruments will be validated by three experts. After the validation process by the experts, the next step is to calculate the assessment scores and make revisions as needed based on the suggestions and feedback from the validators. The following are the validation results from the experts for the science literacy e-module in the Physics subject.

The content validity aspects assessed by three experts include content feasibility, presentation, language, and graphic design. The score of the content validity coefficient test based on the experts' agreement index, which was analyzed using Aiken's V index, is presented in Table 5.

Table 5. Content Validity Test Analysis of the Science Literacy E-Module for Science (Physics) Subject

Feasibility Aspect	Total score of validity items	Validation Index	Category
Content	13.56	0.80	Valid
Presentation	12.33	0.82	Valid
Graphics	8.33	0.83	Valid
Language	8.56	0.86	Valid

Based on the table that has been explained, the language feasibility aspect obtained a validity index (V) with an average score of 0.86, which is considered high. Meanwhile, the content aspect obtained a validity index (V) with an average score of 0.80, which is the lowest. However, all four aspects are in the valid category. Although this research did not measure the validation results of the practitioner sheet questionnaire and the effectiveness instrument by experts, the researcher still validated the practitioner sheet questionnaire and the effectiveness instrument with experts, so it can be concluded that both the practitioner sheet questionnaire and the effectiveness instrument are valid.

The science literacy e-module for the Physics subject is designed in a detailed and practical way, so it can be used as a learning resource for students, especially for the topic of Simple Machines in eighth-grade Physics lessons at junior high school under Phase D of the Merdeka Curriculum. To achieve the learning objectives in the e-module, the Physics material is arranged along with learning activities that include the following steps: observation, formulating questions, making hypotheses, processing data, and drawing conclusions. In addition, the learning activities and practice questions provided in the e-module are also designed to train students' science process skills.

The assessment of the science literacy e-module for the Physics subject on the content feasibility aspect includes the material content, the accuracy of images, and valid references, which were assessed by the validators as being appropriate with the learning objectives and learning achievements. For the presentation feasibility aspect, the presentation technique, activity sheets, and practice questions were considered appropriate by the three experts because they can help, train, and improve students' science process skills. The language feasibility aspect was also considered appropriate by the experts, as the language used follows the general rules of Indonesian spelling, with correct standard language and proper writing of formulas or equations. Meanwhile, for the graphic feasibility aspect, the display of the e-module such as typography and color combination was assessed by the three experts as appropriate because it creates comfort during learning, thus encouraging and increasing students' reading interest.

This is in line with Susanti et al. (2021) who state that an instrument is considered valid if the validity score is high, while the instrument is considered less valid if the validity score is low.

Practitioners' Responses to the Science Literacy E-Module for the Science (Physics) Subject

The responses from practitioners to the science literacy e-module for the Physics subject were obtained through the distribution of an e-module assessment questionnaire. The questionnaire instrument, which had been validated by experts, was completed by seven science teachers from schools under the Science Subject Teacher Forum (MGMP) for junior high schools in Makassar City and three science teachers from SMPN 4 Sungguminasa. Each assessment indicator in the questionnaire consisted of 35 statements assessed using a Likert scale with a score range from 1 to 4, according to the predetermined categories. The results of the analysis of the practitioners' responses to the science literacy e-module for the Physics subject are presented in Table 6.

Based on the data analysis results in point 6, the practitioners' responses showed a very practical assessment of the four aspects in the science literacy e-module for the science (physics) subject. In the content

feasibility aspect, it obtained a high average score of 3.73 with a percentage of 93.25%. Meanwhile, the graphic aspect obtained the lowest average score, which is 3.56 with a percentage of 88.89%.

Table 6. Results of Practitioners' Responses to the Science Literacy E-Module for the Science (Physics) Subject

Feasibility Aspect	Average Score	Percentage (%)	Category
Content	3.73	93.25%	Very Practical
Presentation	3.64	91.00%	Very Practical
Graphics	3.56	88.89%	Very Practical
Language	3.62	90.42%	Very Practical

The practicality of the science literacy e-module for the Physics subject received positive responses from practitioners. It can be concluded that, on average, 10 practitioners gave very good ratings to the development of the science literacy teaching e-module for the Physics subject. These practitioner assessment results are in line with research by Waruwu et al. (2024), which states that similar results were also supported by the practicality test, where the average rating given by teachers reached 4.5, which falls under the "very practical" category. This shows that the science literacy e-module can be applied easily and practically by teachers, thus supporting the learning process in the classroom.

The Effectiveness of the Science Literacy E-Module for the Physics Subject to Improve Science Process Skills

The effectiveness of the science literacy e-module for the Physics subject was assessed based on the improvement of students' science process skills, which were measured through tests given to 34 eighth-grade students at SMP Katolik Belibis Makassar. The science process skills test was divided into two parts, namely a pretest and a posttest. The pretest was given before the use of the teaching e-module, and the posttest was given after the use of the e-module to measure the improvement in science process skills. The descriptive analysis results of the science process skills test are presented in Table 7.

Table 7. Descriptive Score of Students' Science Process Skills

Parameter	Skor Pretest	Skor Posttest
Number of Respondents	34	34
Maximum Ideal Score	100	100
Minimum Ideal Score	0	0
Maximum Empirical Score	65	92
Minimum Empirical Score	3	48
Average Score	31	74

Based on the descriptive analysis of the science process skills test in Table 7, it can be seen that there was an increase in the average score of students' science process skills before and after the implementation of the science literacy e-module for the Physics subject. The students' average pretest score was 31, with the highest score achieved by the 34 students being 65 and the lowest score being 3. The complete analysis results of the science process skills test of the eighth-grade students at SMP Katolik Belibis Makassar before and after using the science literacy e-module for the Physics subject can be seen in Table 8.

Table 8. Percentage of Students' Pretest Scores for Science Process Skills

Feasibility Aspect	Category	Frequency	Percentage
$81 < X \leq 100$	Very Good	0	0%
$61 < X \leq 80$	Good	1	3%
$41 < X \leq 60$	Fair	5	15%
$21 < X \leq 40$	Poor	22	65%
$X \leq 20$	Very Poor	66	18%

The analysis results of the pretest scores for science process skills presented in Table 8 show that 5 students or 15% are in the moderate category, 22 students or 65% are in the low category, and 6 students or 18% are in the very low category.

The science process skills were then measured again for the same group of students after implementing the science literacy e-module for the Physics subject over 5 learning sessions. The analysis results of the science process skills test after using the science literacy e-module for the Physics subject are presented in Table 9.

Table 9. Percentage of Students' Posttest Scores for Science Process Skills

Feasibility Aspect	Category	Frequency	Percentage
$81 < X \leq 100$	Very Good	10	29%
$61 < X \leq 80$	Good	20	59%
$41 < X \leq 60$	Fair	4	12%
$21 < X \leq 40$	Poor	0	0%
$X \leq 20$	Very Poor	0	0%

The analysis results of the posttest scores for science process skills presented in Table 9 show that 10 students or 29% achieved the very good category and 20 students or 59% were in the good category. This indicates that no students obtained scores in the low or very low categories. Meanwhile, no students obtained scores in the poor or very poor categories. The data on students' pretest and posttest scores of science process skills based on the indicators are presented in Table 10 and Table 11.

Table 10 shows the results of students' pretest scores of science process skills, which were analyzed based on five indicators. The total score was obtained by adding up all the scores achieved by 35 students, and the percentage was calculated by dividing the total score by the ideal score, then multiplying by 100%. The results

show that the indicator of formulating questions obtained the highest percentage, followed by making hypotheses, then observing, while the indicators with the lowest percentages were data collection and drawing conclusions. These results indicate that before the implementation of the e-module, most students were already able to formulate questions, make hypotheses, and observe. However, they still had difficulties in data collection and drawing conclusions from the questions.

Table 10. Pretest Scores of Students' Science Process Skills by Indicator

Indicator	Ideal Score	Total Score	Percentage
Observing	1020	323	31.67%
Formulating questions	170	96	56.47%
Hypothesizing	170	76	44.71%
Data Processing	1088	298	27.39%
Drawing conclusions	952	258	27.10%

Table 11. Students' Posttest Scores of Science Process Skills by Indicator

Indicator	Ideal Score	Total Score	Percentage
Observing	1020	751	73.63%
Formulating Questions	170	154	90.59%
Hypothesizing	170	141	82.94%
Data Processing	1088	821	75.46%
Drawing Conclusions	952	642	67.44%

Table 11 shows the results of students' posttest scores of science process skills. The indicator of formulating questions obtained the highest percentage, followed by making hypotheses and data collection. Although the indicators of observing and drawing conclusions had the lowest percentages, both showed significant improvement compared to the pretest results. Therefore, it can be concluded that learning using the developed e-module was able to improve all five indicators of students' science process skills.

In addition, the analysis of the improvement in students' science process skills based on the science process skill indicators used in this research is presented in Table 12.

Table 12. Analysis of Students' Science Process Skills for Each Indicator

Indicator	Average Pretest Score	Average Posttest Score	Percentage of Improvement
Observing	9.50	22.09	41.96%
Formulating Questions	2.82	4.53	34.12%
Hypothesizing	2.24	4.15	38.24%
Data Processing	8.76	24.15	48.07%
Drawing Conclusions	7.59	18.88	40.34%

Based on Table 12 above, it can be concluded that there was an improvement in the science process skills of Grade VIII students at SMP Katolik Belibis Makassar after the implementation of the science literacy e-module in the science (physics) subject. The highest improvement occurred in the Data Processing indicator, reaching 48.07%, while the lowest improvement was in the Formulating Questions indicator, which was 34.12%. A more detailed description of the improvement in students' science process skills for each indicator can be seen in Figure 4.

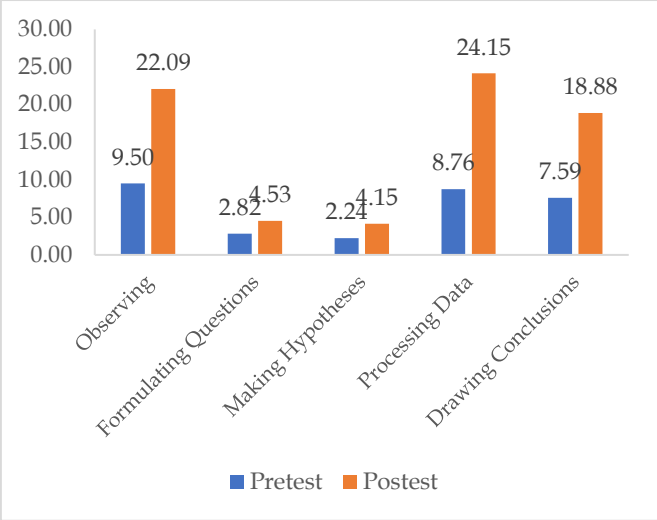

Figure 4. Graph of the percentage of improvement in students' science process skills for each indicator

The indicators of improvement in science process skills measured at the pretest stage of the e-module development assessment showed that, on average, students answered the questions with fairly high scores on the indicators of observation, data collection, and drawing conclusions. This indicates that students were able to observe the statements in the questions, process the data to answer the questions, and justify their answers. However, the indicators of formulating questions and making hypotheses had low scores on the pretest. Students were not yet able to create questions based on their observations and predict hypotheses that would answer the questions they had formulated. This is supported by research from Liandari et al. (2017), which stated that the low ability of students to formulate or test hypotheses can be improved through the application of science process skills approaches using practicum methods. The improvement in science process skills measured at the posttest stage of the e-module development assessment showed that, on average, 10 students or 29% reached the 'very good' category, as shown in Table 9.

Next, the effectiveness of using the science literacy e-module in the science (physics) subject is categorized

based on the interpretation of effectiveness using the gain score, expressed as a percentage (%). The results of the N-gain score analysis can be seen in Table 13 below.

Table 13. Percentage of N-gain Score Effectiveness of Students' Science Process Skills

Interval %	Category	Frequency	Frequency
g ≤ 55	Not effective	6	18%
g ≥ 56	Effective	28	82%
Total		34	100%

Based on Table 13, it can be seen that 6 students or 18% were in the not effective category, while 28 students or 82% were in the effective category, and the N-gain score reached 63,40%, which means that the students' average score increased from the pretest to the posttest. This result is in line with Hake's criteria (Puspita et al., 2022), which states that the N-gain score can be categorized as effective if the average percentage of N-gain reaches 56% or higher. Based on the results of the percentage effectiveness analysis, this is in line with the research by Jumaniar et al. (2024), which states that the use of e-modules can significantly improve students' science process skills.

This means, based on the percentage results, it can be concluded that the developed science literacy e-module for the science (physics) subject is considered effective and suitable for use in the learning process. Several factors that influenced the results of this e-module research on improving students' science process skills include students' lack of focus and incomplete participation during the learning process, a tendency to only memorize formulas without deeply understanding the concepts, and low motivation to learn science (physics).

Thus, it is concluded that the science literacy e-module in the science (physics) subject has proven to be effective, as indicated by the improvement in students' science process skills. Therefore, the use of the science literacy e-module in the science (physics) subject has a positive impact on the learning process of science (physics) for Grade VIII students at SMP Katolik Belibis Makassar.

Conclusion

Based on the results of the research and limited trials, it can be concluded that the science literacy e-module for the science (physics) subject, developed to support students' science process skills, meets the following criteria: (1) The content validity test results show that the e-module meets the valid criteria; (2) Practitioners' responses indicate that the e-module is in the "very practical" category; and (3) The effectiveness test based on students' science process skills shows an N-gain score of 63.40%, which falls into the effective category. These results indicate that the science literacy e-module is valid, practical, and effective in improving students' science process skills, in accordance with the research objectives and problem formulation.

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Conflicts of Interest

The authors declare no conflict of interest

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