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Development of Problem-Based Learning E-Module in Junior High Schools 15 Yogyakarta

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Abstract

Algebra is a concept that is abundant in everyday life, connecting symbols with contextual problems. The challenge of learning algebraic forms is apparent among seventh-grade students at Junior High School 15 Yogyakarta, who have a low mathematical literacy. The initial research findings show variability in the components of mathematical literacy among students, including Communication (23%), Mathematicalization (20%), formulation of Problem-Solving Strategies (11%), Reasoning and Argumentation (12%), Symbolic, Formal, and Technical Language Usage, and Operations (2%), Representation (18%), and use of Mathematical Tools (18%). One of the reasons for the low literacy is the learning model and the material is less suitable. This research aims to develop a PBL-based e-Module to improve students' mathematical literacy in algebraic forms. The research method used is R&D with the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The research instruments include expert validation of materials and media, student responses, and pretests. The developed e-Module received good validation from media experts (average 4.33) and material experts (average 4.63). Student responses were also positive, averaging 82% in the practical category. The conclusion is that this e-Module is suitable for improving students' mathematical literacy.

Keywords: E-Module, Problem-Based Learning, Mathematical Literacy Skills

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INTRODUCTION

In the 21st Century learning era, mathematical literacy skills have become an essential strategic skill for students. Mathematical literacy is not just related to mastering numbers and computing but involves a deep understanding of the real-world context. Mathematical literacy skills include mastery of mathematical concepts, procedures, facts, and functions to describe, explain, and predict everyday phenomena. According to Dede (2009), within the framework of 21st Century learning, media information literacy and information technology are key skills that students must have. This is in line with the views of Hariyanti & Wutsqa (2020) who emphasize that information literacy is an aspect of information literacy, that is increasingly important along with the rapid development of science and technology.

The importance of mathematical literacy is not only in academic contexts but also in everyday life. According to Ojose (2011) and Kholifasari et al. (2020), mathematical literacy allows individuals to apply mathematical concepts in real-world situations accurately and efficiently. The Organization for Economic Cooperation and Development (OECD, 2017) identifies three main domains of mathematical literacy: the content, context, and process. Strong mathematical literacy enables individuals to

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formulate, use, and interpret mathematics in various contexts and assists them in making logical decisions and having a constructive mindset (OECD, 2019c).

Even though mathematical literacy has a crucial role in learning and daily life, there is still a gap between ideality and reality. Data from the OECD (2019d) shows that students' mathematical literacy in Indonesia is still in the low category, with most students at level 2 or below. The results of research by Hasnawati (2016), Babys (2017), dan Fatwa et al. (2019) also confirm the low mathematical literacy abilities of students, which are influenced by factors such as lack of basic mathematical skills, independence in learning, and lack of adequate practice. maximum.

At Junior High School 15 Yogyakarta, for example, class VII students face similar challenges. From the results of the initial research conducted, it appears that students' mathematical literacy abilities are still low. This is reflected in the percentage of students' literacy skills in aspects of communication, mathematical modeling, formulating problem-solving strategies, reasoning, and argumentation, use of symbolic and formal language, as well as the ability to use mathematical tools. Factors such as learning models that do not accommodate students' mathematical literacy abilities, as well as less supportive teaching materials, also contribute to students' low mathematical literacy abilities.

In the growing context of online learning, new challenges emerge. The use of teaching materials in the form of PDF texts, videos, and PowerPoint creates difficulties for students. Most students expressed difficulty in understanding the teaching materials provided, which were not enough to help them discover material concepts independently (Sari et al., 2020). This indicates the need to develop alternative teaching materials that are more interactive and under student needs.

RESEARCH METHOD

This research is development research (*Research and Development/ R&D*) using the ADDIE (*Analyze, Design, Development, Implementation, Evaluation*) design model (Branch, 2010). This model was chosen by researchers to develop effective teaching material products because it facilitates the construction of students' knowledge and skills in guided learning plans that are instructional in nature (Branch, 2010). Apart from that, the ADDIE model is also specifically for solving problems in learning related to gaps due to students' lack of knowledge and skills. Furthermore, according to (Branch, 2010), the ADDIE model is a generative process that applies concepts and theories to a particular context. In this research, the product developed by researchers is a PBL-based e-module to improve students' mathematical literacy skills in algebraic form material with stages applied using the ADDIE model, including analysis (*analyze*), planning/designing (*design*), development (*development*), application/implementation (*implementation*) and evaluation (*evaluation*).

The data sources used in this research consist of two main components. First, validators are divided into two types, namely instrument validators and product validators. Product validators consist of two categories, namely material expert validators and media experts. Second, research subjects are divided into population and sample. The population of this study was all seventh-grade students at Junior High School 15 Yogyakarta, while the sample was 34 students who were involved in testing the e-module developed by the researcher. This assessment of students is used to test the practicability and effectiveness of the product in improving students' mathematical literacy skills.

In this study, data was collected through non-tests and tests. The non-test techniques used are e-module assessment questionnaires by material experts and media experts and student response questionnaires. Test techniques are used to measure the effectiveness of using e-modules. In addition, this research requires instruments to measure the validity and practicality, as well as the effectiveness of a learning module, which is an important element in the evaluation process. To measure validity, the validation sheet is assessed from four aspects of appropriateness, including appropriateness of content, presentation, language, and graphics, as well as suitability to the learning model used.

The validation instrument grid for material experts and media experts was adapted by the Ministry of Depdiknas (2008) guidelines and research needs. The material expert and media expert validation instruments were modified to cover feasibility aspects relevant to the research, such as language, presentation, and graphics. Next, a student response questionnaire is used to measure the practicality of the module, with a focus on practical aspects which include attention, relevance, confidence, and student satisfaction. Student responses to the module are considered good if they meet these criteria. Meanwhile, to measure the effectiveness of the module, mathematical literacy ability test questions are used which refer to indicators of mathematical literacy ability. Thus, this instrument provides a comprehensive picture of the validity, practicality, and effectiveness of a learning module.

The instruments applied in this research include non-test instruments, such as validation questionnaire instruments for material experts, media experts, and student responses, as well as test instruments in the form of questions to measure students' mathematical literacy abilities. To ensure the validity and reliability of research, it is important to pay attention to the validity and reliability of the instruments used. The validity of the instrument must be ensured before using it to collect data (Sugiyono, 2015). Instrument validity testing includes testing construct validity and content validity, which is carried out through expert judgment and comparing the content and construct of the instrument with the material that has been taught (Sugiyono, 2015). The tests applied in this research include a pretest and a posttest, with essay-type questions (Lestari & Yudhanegara, 2015). Apart from that, non-test instruments such as observation sheets and interview sheets were also used after being validated by experts before being used to collect initial data in this research. Thus, the process of testing the validity of instruments, both test and non-test, is an important step in ensuring the credibility and accuracy of research results.

The data analysis technique applied in this research aims to determine the validity, practicality, and effectiveness of the product being developed, namely by using qualitative data analysis. The qualitative data analysis process involves searching and organizing data according to certain categories, as well as making conclusions that can be understood by readers (Sugiyono, 2016). Data analysis refers to the interactive analysis method of Miles dan Huberman (2014), which includes three main stages. The first stage is data reduction, where data from interviews and observations is rearranged by summarizing basic and relevant information for research. Next, in the data presentation stage, the reduced information is presented in various forms such as short descriptions, tables, or graphs, to make it easier to understand data relationship patterns.

Conclusions are drawn regarding whether the e-Module being developed meets the criteria of being valid, practical, and effective. Analysis of this data helps in gaining a comprehensive understanding of the e-Module qualifications by the specified criteria.

Thus, the qualitative data analysis process is an important step in evaluating the quality of learning products. At the stage of making conclusions, there are several criteria as follows.

Validity analysis aims to obtain valid qualifications from the learning media developed by researchers. The first step in validating the E-Modul from experts is tabulating data from validation results from both material and media experts' scores based on each statement in the table. Second, the researchers determine the average score of the data that has been obtained.

Practicality analysis E-Module The modules in this study were assessed based on a usage response questionnaire E-Module given to students. The questionnaire used a Likert scale. The researchers compiled the data obtained from student response questionnaires covering 3 aspects: content, presentation, and language. After the data is collected, the average score is calculated using the following formula.

$$\overline{Y} = \frac{\sum_{i=1}^{n} Y_i}{n}$$

Noted:

$\overline{Y}$: average score of student response questionnaires

Y_i : indicator statement score *i*, Where *i* = 1, 2, 3, ..., *n*

n : number of assessment items

The results of calculating the average student response questionnaire are then matched to the interval class and criteria in calculating the assessment classification.

Assessment Classification. The assessment results are calculated with the aim of obtaining a practical value. To get practical value with classification. E-Module is said to be practical if the average value of the student response questionnaire at least meets the good criteria.

RESULTS AND DISCUSSION

Analysis stage

At this stage, researchers analyze the curriculum and materials, conditions and situations as well as students' characters. The following is the description: Curriculum and Material Analysis. Based on the results of observations and interviews conducted with mathematics teachers at Junior High School 15 Yogyakarta, it was found that Junior High School 15 Yogyakarta had implemented the revised K-13 curriculum as a learning reference material. Table 1 below will explain the contents of the KI and KD of the K-13 curriculum.

Table 1. Basic Competencies of Knowledge and Skills

Basic Cognitive Competency	Basic Skills Competency
3.5 Explain algebraic forms and perform operations on algebraic forms (addition, subtraction, multiplication and division)	4.5 Solve problems related to algebraic forms and operations on algebraic forms.

Next, the researchers asked about the extent to which teachers at Junior High School 15 Yogyakarta provided algebra material to students. The results of the interview were: in the form of algebra material the teacher teaches general material listed in books that students can find. This material includes: understanding how to add,

subtract, multiply, divide and simplify algebraic fractions. And the learning process is carried out with 2 meetings a week and the time allocation is 2 hours and 3 hours for each meeting.

Analysis of conditions and situations. At this stage of analyzing conditions and situations, researchers conducted interviews with mathematics teachers at Junior High School 15 Yogyakarta about the learning process and the use of learning models in the classroom. Based on the results of interviews with teachers, it was found that the learning model is still dominated by conventional learning models, namely learning models that still tend to make teachers as objects in the learning process. Meanwhile, for the learning process, students have not been guided optimally in the process of investigating the contextual problems given, so the information obtained from the contextual problems has not been understood by students, which has resulted in the results of discussions carried out by students not being following the flow or steps in working on the problem correct.

Apart from that, researchers also found that students need teaching materials that they can use or learn independently, effectively and practically. So it can improve students' mathematical literacy skills. Based on this, researchers decided to develop teaching materials in the form of electronic modules or often called PBL-based e-Modules to improve students' mathematical literacy skills. This is sought as a replacement for conventional learning models to facilitate students in the learning process.

Characteristics analysis. At the stage of analyzing student characteristics, researchers conducted interviews with mathematics teachers regarding students' abilities in solving contextual problems and researchers will also give written tests in the form of contextual problems which contain indicators of students' mathematical literacy abilities. This is done to determine the characteristics of students.

Based on the results of interviews conducted with mathematics teachers, it was found that students still find it difficult to solve contextual problems. Apart from that, students also have difficulty in understanding the problems contained in contextual problems, difficulty in creating mathematical models from contextual problems, difficulty in determining steps to solve contextual problems, difficulty in determining the right formula for solving problems, and difficulty in evaluating the results of the work they have done. Meanwhile, the results of the written test in the form of contextual problems which contain indicators of students' mathematical literacy abilities can be seen in Figure 1.

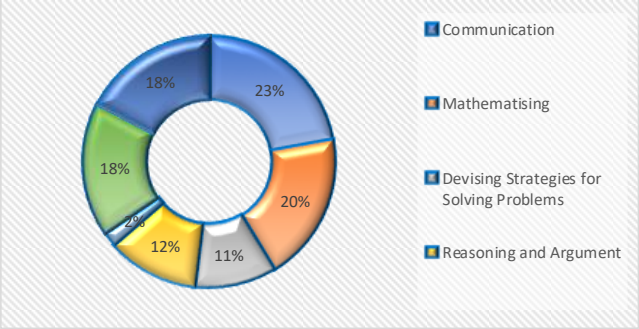

Figure 1. Percentage of Student's Literacy Ability

Based on Figure 1, it can be said that students' mathematical literacy abilities are still relatively low, so it is necessary to improve students' mathematical literacy

abilities. Low mathematical literacy skills can be caused by students not being used to solving problems that contain indicators of mathematical literacy in solving mathematical problems. Apart from that, there is a lack of teaching materials that support independent learning and problem presentation that includes indicators of mathematical literacy. So researchers wish to develop e-modules based on problem-based learning to improve mathematical literacy skills in algebraic material.

A series of activities was carried out by researchers in developing E-Module to improve mathematical literacy skills in algebraic material. The goals of developing e-Module is to improve mathematical literacy skills in algebraic material aims to facilitate students' independent learning by applying the PBL model to improve students' mathematical literacy skills. Apart from that, it aims to create a learning atmosphere by using cellphones or gadgets that contain PBL indicators and mathematical literacy that are valid, practical, and effective.

The development of a PBL-based e-Module to improve mathematical literacy skills in algebraic material is designed based on the stages of Problem-Based Learning (PBL) to achieve mathematical literacy skills. So the e-Module design will contain activities for orienting students to problems, organizing students to learn, guiding individual and group investigations, developing and presenting work results, and analyzing and evaluating the problem-solving process. Apart from that, the e-Module also presents problems that are adapted to mathematical literacy indicators. Meanwhile, the content in the e-Module design consists of a cover, e-Module identity, foreword, table of contents, e-Module syntax, introduction, standard curriculum content, concept map, algebra figures, algebra form material, competency test, bibliography, glossary, self-assessment, and author biography.

In developing e-Module Validation Instruments and Carrying out Validation to produce a valid e-Module, the researcher needs to prepare an e-Module validation sheet instrument by a media expert, an e-Module validation sheet by a material expert, a student response sheet to the e-Module being developed, as well as valid pre-test questions before being tested. use a team of experts.

E-Module Validity Test. The validity of the e-Module was tested using a validation instrument that had been prepared by the researcher. Then whether the results are valid or not is determined based on the results of the validation carried out by experts. Implementation. Implementation was carried out on class VII students at Junior High School 15 Yogyakarta on March 7 and 9 2023. e-Module Practicality Test. The practicality test of the e-Module was carried out using student response sheets, while the results were obtained from filling in the student response sheets for the PBL-based e-Module which contained indicators of mathematical literacy abilities. Evaluation is carried out based on the findings of problems in the learning process, then improvements are made as an action to evaluate these problems.

Design Stage

At this stage, researchers designed a PBL-based e-Module to improve the mathematical literacy skills of class VII Junior High School/MTs students in algebra form material. PBL syntax, the PBL syntax in this e-Module is learning steps by applying the problem-based learning model which includes: orienting students to problems (orientation), organizing students to learn (organization), guiding individual and group investigations (investigation), developing and presenting work results (presentation), as well as analyzing and evaluating the problem-solving process (evaluation). Then, to

make it easier to recognize and understand the PBL steps in this e-Module, symbols in the form of different images are given for each PBL syntax presented.

Mathematical Literacy Ability, Indicators of mathematical literacy skills are prepared in the development of e-Modules to improve mathematical literacy skills in PBL-based algebra material. This includes problem communication skills, mapping real-world problems into mathematical form, restatement of mathematical problems, reasoning and argumentation, problem-solving strategies, use of symbolic, formal, and technical language, and use of mathematical tools. To facilitate recognition and understanding of these indicators, symbols in the form of different images are given for each indicator.

Algebraic Forms Material. The presentation of algebraic material in the PBL-based e-Module design to improve mathematical literacy skills is based on basic competencies (KD) which are then translated into competency achievement indicators (GPA). This is presented in Table 4.

Table 4. Basic Competencies and Indicators of Competency Achievement

Basic Competency	Competency Achievement Indicators	
3.5 Explain algebraic forms and perform operations on algebraic forms (addition, subtraction, multiplication and division)	3.5.1	Recognize the algebraic form of contextual problems.
	3.5.2	Explain the meaning of variables, constants and terms.
4.5 Solve problems related to algebraic forms and operations on algebraic forms	4.5.1	Perform addition, subtraction, multiplication and division operations in algebraic form.
	4.5.2	Solve problems presented in addition, subtraction, multiplication and division operations in algebraic form.

Preparation of product testing instruments, manufacture of instruments *pre-test*, and lesson plan. After drawing up the design e-Module to improve mathematical literacy skills in algebraic material. Next, the researcher prepared validation instruments and lesson plans.

Media Expert Validation Instruments are arranged based on an instrument grid consisting of appropriateness of content, appropriateness of presentation, and appropriateness of graphics. The media expert validation instrument has been validated by the supervisor before use. The validation results show that the instrument is suitable for use as a product validation instrument from a media perspective and input and suggestions from media experts can be seen in Table 5.

Table 5. Media Expert Validator Input and Suggestions

Member	Feedback and Suggestions	Information
Instrument Validator	1. Add and present illustrative pictures that match the contextual problems included in the material. 2. Check the writing.	Worth using with revisions

The material expert instrument has been prepared by taking into account the appropriateness of content, language, appropriateness of presentation, and PBL syntax which is adapted to indicators of mathematical literacy ability. The material expert validation instrument has been validated by the supervisor before use. The validation results show that the instrument is suitable for use as a product validation tool in terms of material. Input and suggestions from material experts can be found in Table 6.

Table 6. Material Expert's Feedback and Suggestions

Member	Feedback and Suggestions	Information
Instrument Validator	Present illustrative images to make it easier for students to understand contextual problems presented in the form of descriptive illustrations.	Worth using with revisions

The student questionnaire instrument has been prepared by considering aspects of attention, connection, confidence and satisfaction, and related to PBL syntax which is adapted to indicators of mathematical literacy abilities. The student questionnaire validation instrument has been validated by the supervisor before use. The validation results confirm that the questionnaire is suitable for collecting data from students. Input and suggestions from questionnaire validation are contained in Table 7.

Table 7. Instruments Validator's Feedback and Suggestion

Member	Feedback and Suggestions	Information
Instrument Validator	Adapt to PBL syntax in student activities	Worth using with revisions

Instrument/question *Pre-test.* The pre-test instrument was prepared by including indicators of mathematical literacy abilities such as problem communication skills, problem mathematization, problem representation, reasoning and argumentation, problem-solving strategies, use of symbolic, formal and technical language, and use of mathematical tools. This instrument has passed a validation process by the supervisor, who stated that it is suitable for use. Input and suggestions from the student questionnaire regarding the instrument are listed in Table 8.

Table 8. Suggestions for Improving Questions *Pre-Test*

Validator	Feedback and Suggestions
Validator	1. The questions are created based on indicators of mathematical literacy abilities. 2. Questions made with shapes *ill-structured*. 3. Questions are created with contextual problems.

Next, improvements to the pre-test questions were made according to input and suggestions from the validator. Improvements to the pre-test questions are presented in Table 9.

Table 9. Question Improvements *Pre-Test*

No	Problem Improvement *Pre-Test*
Before Revision	
1	The price of a bag is 8 times the price of a book. If the price of books is 4 times the price of pens and pencils. Try to find the price of the bag by solving the following problem: a. What do you know about the problem above? b. What problems do you think need to be solved? c. What do you think to solve the problem? d. Give your answer to solve the problem. e. Give your opinion after checking your answer again.
After Revision	
	Mr Yayan wants to make 10 kg of pineapple cake. The ingredients Mr. Yayan has are wheat flour, eggs, powdered sugar, butter and powdered milk. Mr. Yayan has provided 3 kg of wheat flour, 0.5 kg more butter than refined sugar, powdered milk $\frac{11}{3}$ from wheat flour, and twice as much refined sugar as powdered milk. Try to find how much butter and powdered sugar Mr Yayan uses by solving the following problem: a. What do you understand from the problem above? (C) b. Have you tried modeling the problem above? (M) c. Provide a proper explanation regarding the solution. (D) d. Try to write down the steps to solve the problem. (R&A) e. Try writing down what mathematical language (operation symbols and mathematical equations) you used in the solution steps. (U) f. Solve the above problem by using the solution step. (R) g. Try to mention the mathematical tools you used in solving the problem above. (T)
Before Revision	
2	The price of 1 kg of eggs is Rp. 4,000 less than the price of 1 liter of cooking oil. If the price of 1 kg of eggs is twice the price of 1 kg of rice, while the price of 1 liter of Pertamax fuel is IDR. 1,000 more than the price of 1 kg of rice. Try to determine how much 1 liter of cooking oil costs by solving the following problem: a. What do you know about the problem above? b. What problems do you think need to be solved? c. What do you think to solve the problem? d. Give your answer to solve the problem. e. Give your opinion after checking your answer again.
After Revision	
	Toko Tulis Jaya sells various student stationery, namely; sharpener, eraser, 2B pencil, book and pen. The price of the pen is Rp. 3,000 less than the price of the book. The percentage of the price of sharpeners to the overall price of writing equipment at Tulis Jaya stores is 15%, while the percentage of the price of 2B pencils is 30%. If the percentage of the price of the book is the same as the price of the 2B pencil and the percentage of the price of the 2B pencil is three times the percentage of the price of the eraser. Next week, Toko Tulis Jaya will increase the prices of the stationery it sells. Increase the price of erasers and the price of 2B pencils by IDR. 1,000. How much will 2B erasers and pencils cost next week? Try to find it by solving the following problem; a. What do you understand from the problem above? (C) b. Have you tried modeling the problem above? (M) c. Provide a proper explanation regarding the solution. (D) d. Try to write down the steps to solve the problem. (R&A) e. Try writing down what mathematical language (operation symbols and mathematical equations) you used in the solution steps. (U) f. Solve the above problem by using the solution step. (R) g. Try to mention the mathematical tools you used in solving the problem above. (T)

After making improvements to the pre-test questions and being validated by the validator with results that are suitable for use. Next, the researchers tested pre-test questions on class VII students who had received algebra material.

The preparation of the Lesson Plan follows the 2013 Curriculum by covering basic competences, learning objectives, materials, learning models, teaching materials, learning activities, and assessment of learning outcomes. The lesson plan also includes educational units, classes, skill competencies, learning materials, time allocation, and academic year.

Development Stage

The development of a PBL-based e-Module aims to improve mathematical literacy skills in algebraic material. This process begins with a design using Microsoft Word 2021 and saved in PDF format. Then, the PDF file is converted to HTML format using the Flip PDF Corporate Edition application, resulting in an interactive e-Module with additional features resulting in an interactive e-Module with additional features.

To expand the functionality of Flip PDF Corporate Edition on Android devices, the FAPA book extender application provided by Mrs. Dr. Andriyani, M.Si. Researchers also created book configs tailored to the needs of the e-module being developed, so that the publication results from Flip PDF Corporate Edition can be read by the FAPA book extender application.

The e-module that has been developed can be accessed online or offline. Furthermore, the e-module is validated by material experts and media experts before being distributed more widely. Material expert validation involved two validators, namely a lecturer from the mathematics education master's study program at Ahmad Dahlan University and a mathematics teacher from Junior High School 15 Yogyakarta. Meanwhile, media expert validation involves two validators, namely a lecturer from the mathematics education master's study program at Ahmad Dahlan University and a thesis supervisor.

Implementation stage

After the E-Module is declared valid or suitable for use. The next stage is implementation or application. E-Module is implemented on students individually *offline*. The researcher shares the link with students so that students can download and install E-Module independently *online* or *offline*. The implementation E-Module to improve mathematical literacy skills in algebraic material was carried out over 2 meetings. A practicality test of E-Module was carried out on class VII students at Junior High School 15 Yogyakarta, totaling 34 people who had used E-Module to improve mathematical literacy skills in algebraic material. The results of calculating the student response scale were found to be an average of 82% of students stating E-Module to improve mathematical literacy skills in the practical algebra form material

The learning process at Junior High School 15 Yogyakarta class VII uses the PBL model in algebra form. The first step is to provide orientation to contextual problems to students, followed by understanding the problem. The second step involves organizing students into small groups to discuss, understand, and plan steps to solve the problem. The third step is to guide the investigation both individually and in groups. The fourth step involves developing and presenting student work. The final step is to analyze and evaluate the learning outcomes, which are guided by the teacher.

Evaluation Stage

In the evaluation stage, researchers carry out inspections and assessments from the beginning to the end of the research, identify weaknesses in the previous process, and make continuous improvements. The aim is to ensure that the e-Modules produced are better and suitable for use in learning. This evaluation includes an initial measurement of student's critical thinking abilities through an initial test, which is the basis for developing e-Modules with a focus on critical thinking indicators. The research also involves evaluating the design of an E-Worksheet with a PBL model that is oriented towards students' critical thinking abilities, as well as designing instruments based on validator assessments. Evaluation continues in product development based on validation results by material experts and experts.

Based on the research results, it is known that the e-module developed meets the feasibility of the development product, both material and media validity, in the good category. This shows that the e-module has fulfilled the aspects of suitability of content, language, suitability of presentation, and suitability to the PBL model. Meanwhile, in terms of media, the e-module has fulfilled the aspects of suitability for presentation and graphics. This means that the e-module developed by researchers meets the appropriateness of various aspects of material and media as stated in BNSP (2008).

In the material expert assessment, the content of the e-module developed was assessed to be by the basic competencies and achievements of students' critical thinking aspects. The presentation of material in the e-module can also be read clearly using language that is easy for students to understand. Likewise, with the systematic aspect, the e-module is presented in full, so it is easier for students to learn it. The e- Module in this research is equipped with pictures which are considered to be able to help students illustrate the contextual problems presented so that students can do their learning assignments well. The presentation of appropriate and attractive illustrative images also complements the e-module to facilitate the student learning process which is relevant to several research results such as Wibowo's research (2018), Ula & Fadila 2018) and Via (2021).

In terms of practicality, the research results have shown that PBL-based e-modules meet the aspects of attractiveness, ease of use, and contain PBL syntax. Fulfillment of these practical aspects is based on students' positive responses and enthusiasm for using the e-module being developed. The positive interest of students towards the implementation of the e-module developed by researchers in terms of attractiveness is in line with the results of documented research such as research Syahrial et al. (2019), Ulum & Wiyatmo (2018), and Setiabudi et al. (2022).

Students' good response to the implementation of the e-module developed by researchers can be seen in terms of ease of use and in terms of PBL syntax content which is oriented towards literacy skills. The content of the e-module features in this research is new which has an impact on student enthusiasm, especially how interactive this e-module is when used by students. Whether it's a feature for taking pictures of students' work or a feature for giving certain marks to double-check students' answers. This condition is supported by previous research which also shows students' enthusiasm when using interactive e-modules which can activate students during class learning and not feel bored quickly in class.

CONCLUSION

Based on the research results, it can be concluded that the analysis stages in e-Module development include curriculum and material analysis, situation and condition

analysis, and student characteristics analysis. At the design stage, the e-Module was developed based on Problem-Based Learning by the results of the needs analysis, and material expert and media expert instruments were prepared. Overall, the e-Module developed was considered feasible with media expert validation results averaging 4.33 (good category) and material experts averaging 4.63 (good category). Apart from that, this e-Module is also practical, as evidenced by the results of the student response scale with an average achievement of 82%, indicating the practical category.

DECLARATION

Author

All authors contribute to the research process, such as collecting the data, analyzing the data, and writing the manuscript. All authors approved the final manuscript.

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This research did not receive any funding.

Conflict of Interest

Both authors declare that they have no competing interests.

Ethics Declaration

We as authors acknowledge that this work has been written based on ethical research that conforms with the regulations of our institutions and that we have obtained permission from the relevant institutes when collecting data. We support the International Journal on Emerging Mathematics Education (IJEME) in maintaining high standards of personal conduct and practicing honesty in all our professional practices and endeavors.

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