

# Improving the Problem-Solving Skill of Students using Problem-Based Learning-Based E-Modules

Tri Lestari Budi Asih<sup>1</sup>, Baskoro Adi Prayitno<sup>1</sup>, Sri Retno Dwi Ariani<sup>1\*</sup>

<sup>1</sup>Master of Science Education Study Program FKIP Universitas Sebelas Maret, Surakarta, Indonesia

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**Abstract:** This study aims to determine the effectiveness of problem-based learning-based e-modules on pressure materials and their application in daily life to improve students' problem-solving skills. This research is a type of R&D research that uses the design of a Non-equivalent Pretest-Posttest Control Group with a sampling technique, namely purposive random sampling. The instruments used to obtain data include a reading interest test adapted from Khoiriah et al. (2020) and a problem-solving skills essay test based on pressure material indicators whose results are analyzed by the N-Gain Score test. The subjects of this study were two science teachers and 64 students of class VIII of SMPN 2 Colomadu. They were divided into 32 students in the experimental class and 32 in the control class. The research results showed that problem-based learning-based e-modules on pressure materials and their daily application improved students' problem-solving abilities of SMP N 2 Colomadu.

**Keywords:** E-Module; Problem based learning; Problem solving; Reading interest test

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## Introduction

The development of science and technology is growing rapidly in the 21st century, requiring a better quality of human resources and quality education to compete with the times. The Covid-19 pandemic period, which is currently hitting several parts of the world, is used to maximize the application of science and technology, especially in education. The use of technology applied to the world of education has proven to help students understand the material in the learning process. One of the technologies in the world of education that are developing rapidly is teaching materials presented digitally that can be raised and operated with laptops and mobile phones, namely e-modules.

E-module is a teaching material developed from the beginning in the form of print media to now being in digital or electronic form. The difference between e-modules and print modules lies in the presentation. However, the constituent components are still the same (Aryawan et al., 2018); according to Prastyaningrum & Handhika (2017), e-modules with interactive and

communicative characteristics can help students learn the process. E-modules have various important roles in education that can help teachers explain material during the learning process, which is equipped with several features such as images, videos, animations and audio that can help students understand better (Pramana et al., 2020).

According to the Regulation of the Minister of Education and Culture no. 65 of 2013, in the learning process in the classroom, at least they must utilize information and communication technology to improve the efficiency and effectiveness of learning (Kemendikbud, 2013). However, it is undeniable that e-modules have not been implemented optimally due to inadequate resources. This is found at SMPN 2 Colomadu, which until now still uses printed modules as the main teaching material in the learning process. During the observation and interview activities that were carried out, the Science Teacher said that even though he had been available on the internet at school, due to limited time to develop e-modules until now, the learning process still utilizes printed teaching materials

\* Corresponding Author: [sriretno71@staff.uns.ac.id](mailto:sriretno71@staff.uns.ac.id)

such as books and summaries made independently by the teacher. This has an impact on the problem-solving skills possessed by students who are still low. Students are passive during the observation activities carried out during the learning and have not dared to express opinions regarding the material being explained. In addition, students have also not played an active role in the discussion for problem-solving given by the teacher.

Problem-solving skills are one of the components of 4C skills that students must have to be able to compete in the era of globalization (Etistika,2016). When students are faced with a problem, the problem-solving skills possessed by students play an essential role in finding solutions to the problems they face. Kurikulum 2013 also emphasized how critical problem-solving skills are implied in science's necessary competencies, which states, "students are expected to be able to understand the concepts and principles of science and their interrelationships and be applied in solving problems in life" (Kemendikbud, 2016). According to Polya (1957), problem-solving skills have four stages: (1) Defining the problem, (2) Planning the solution of the problem, (3) Execution of the problem, and (4) Evaluation of the problem (Herak, 2010).

Training problem-solving skills can be carried out by applying a solid learning model to create learning conditions that allow students to actively learn and achieve the expected learning objectives (Nurhidayati et al., 2018). One of the learning models that can be used is problem-based learning. This learning model has the characteristics of a scientific construction in which students are provided with problems that are then identified until they get a solution to the problem (Fauzan et al., 2017). This learning model is a simple essay for pressure material which is one of the science materials that is quite difficult for the junior high school level (Ariyanto, 2011).

In addition to applying appropriate learning models, interactive and communicative teaching materials such as e-modules are also needed to improve students' problem-solving skills (Diana et al., 2015). The e-modules developed will later be compiled by applying the stages of problem-based learning in it. So that students can learn independently to solve problems from the e-module, which is accompanied by problem orientation by the material. Based on the above presentation, this study aims to determine the effectiveness of the PBL pressure e-module and its application in daily life to improve the problem-solving skills of junior high school students.

**Method**

This research is included in the type of development research or *Research and Development*

(*R&D*) using the *Four-D* development model (Thiagaraja, 1974), which consists of four stages including (1) Define, (2) Design, (3) Development, (4) Disseminate. This research model has been modified based on the conditions of the research field so that it is only carried out until the stage of development or (Development). This research began to be carried out from November 2021 to April 2022 at SMPN 2 Colomadu.

This study used a type of data retrieval by purposive random sampling. In the research, the subjects were two science teachers and 64 students of class VIII of SMPN 2 Colomadu divided into two classes, namely 32 students in the experimental class and 32 students in the control class. The data collection instruments used are (1) Observation and interview sheets, (2) Initial test sheets for students' problem-solving ability, (3) Validation sheets, e-modules, (4) Questionnaire sheets for students' reading interest, (4) Assessment sheets for students' problem-solving ability.

The e-module development stage begins with analyzing the need to obtain the information needed in the e-module development process at SMPN 2 Colomadu by involving two science teachers and 24 class VIII students. Furthermore, the information obtained is used as a development background to compile the characteristics of problem-based learning e-modules that can improve students' problem-solving abilities. The e-module that has been developed is tested for validity by conducting validation by four expert validators: learning experts, material experts, linguists, and media experts in their fields.

A limited trial was conducted to determine the feasibility of the e-module, involving 2 IPA teachers and 12 grade VIII students of SMPN 2 Colomadu. The determination of this number of students is based on Dick et al. (2006) which involves at least 8 to 20 students for a limited trial. In addition, this limited trial is also helpful for knowing the practicality of the e-module, which was developed using the response questionnaire of the teacher and the student concerned. The criteria for the feasibility of the e-module are presented in Table 1.

**Table 1.** Eligibility Criteria for Problem-Based Learning-Based e-Modules

The score obtained (%)	Category	Information
90-100	Excellent	No revision needed
75-89	Good	Minor revisions
65-74	Enough	Revised to taste
55-64	Less	Many things revised
0-54	Very Lacking	Repeated making of the product

(Tegeh & Jampel, 2017)

The next stage is a large-scale trial involving 64 students of class VIII divided into 32 students of the

experimental class and 32 students of the control class. Designs for significant group tests are presented in Table 2.

**Table 2.** Nonequivalent Pretest-Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	Q1	X	Q1
Control	Q2		Q2

(Herzon et al., 2018)

Information:

Q1 =preliminary observation of the experimental class (pretest)

Q2 =initial observation of the control class (pretest)

X =implementation of development e-module

Q1 =last observation of the experimental class (post-test)

Q2 =last observation of the control class (post-test)

This large-scale test aims to determine the effectiveness of applying the PBL e-module to improve students' problem-solving abilities. The data obtained were then tested to determine their efficacy using the *N-Gain Score* test with the scoring criteria presented in table 3.

**Table 3.** Average *N-gain Score* criterion

Interval	Category
$g > 0.70$	Tall
$0.70 > g > 0.30$	Keep
$g < 0.30$	Low

(Hake, 1999)

## Result and Discussion

The development of *problem-based learning-based* e-modules on pressure materials and their application in

everyday life consists of several stages. The initial step, namely the needs analysis, needs to be carried out to determine the needs or needs of the media field developed (Purwoko et al., 2020). The observations and interviews during the need's analysis showed that the teaching materials used were only print books and short resumes made independently by science teachers. This is to cause less motivation in learning so that student's problem-solving abilities cannot be trained optimally learning. The following problem-solving skills of students Colomadu State Junior High School 2 are presented in Table 4.

**Table 4.** Student Problem-solving Skill Level

Problem Solving Skills Indicators	Value (%)	Category
Defining the problem	83.99	Keep
Plan for problem-solving	75.00	Low
Issue execution	53.03	Very Low
Evaluation of the problem	41.82	Very Low

Based on table 4. It can be concluded that students' problem-solving abilities are still low and must be improved by providing electronic teaching materials that are communicative and in demand by students (Purwoko et al., 2020). The main characteristics of the e-module developed will contain a *problem-based learning* syntax because this learning model has problems that will be investigated and solved so that you can train students' problem-solving skills (Ashari & Salwah, 2017). The matrix of the relationship between problem-based learning-based e-modules to students' problem-solving abilities is presented in Table 5.

**Table 5.** Matrix of the Relationship of Problem-based Learning-Based e-Modules to Students' Problem-Solving Abilities

Problem-Based Learning Syntax	Process Learning	Troubleshooting Capabilities
Problem orientation	Students are presented with problems of everyday life related to the concept	Defining the problem
Student organizing	Students try to give their initial opinion regarding the given problem	Defining the problem
Group investigation	Conducting video observation activities, or activities/experiments and materials that have been provided	Plan for problem-solving
Development and presentation of the results of discussions	Conveying the results of the debate and trying to solve problems supported by data from the discussion results	Issue execution
Analyze and evaluate	Evaluate the solution to a given problem	Evaluation of the problem

After the preparation of the initial stage of the e-module is completed, the next step is to know the validity and practicality of the developed e-module. The following are the results of validation tests involving four expert validators in their fields (Table 6).

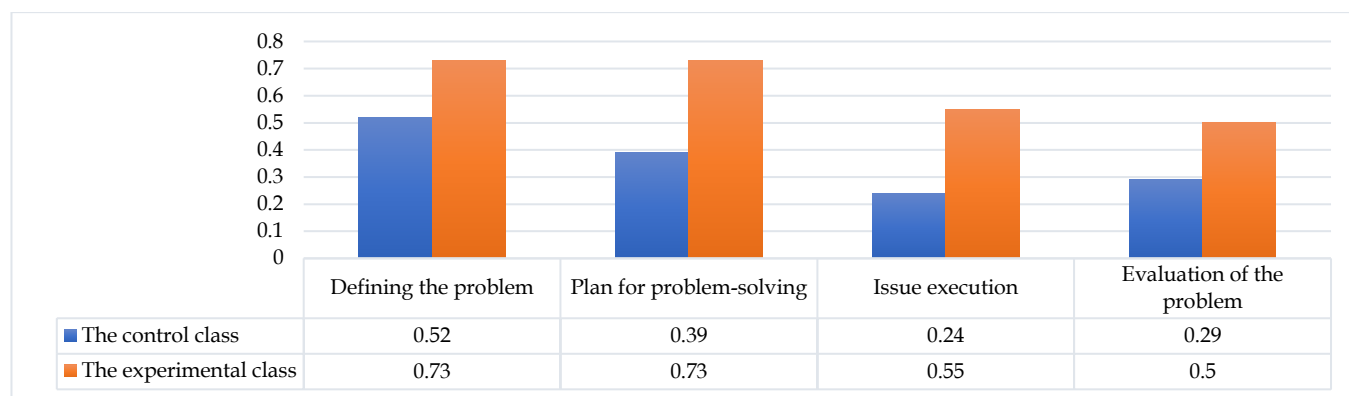
**Table 6.** The Results of the Problem-based Learning-based e-Module Validation Analysis

Validation	Score (%)	Criterion
Learning Experts	94.67	Very Worthy
Linguist	93.33	Very Worthy
Material Expert	86.00	Very Worthy
Media Expert	83.64	Very Worthy

The validation results prove that the problem-based learning-based e-module developed is feasible for limited-scale trials. In this limited-scale trial, results will be obtained for the feasibility and practicality of the developed e-module. The practicality test carried out during the limited scale stage involving the questionnaire results of 2 science teachers got an average score of (90.79%) and 12 students (88.71%), both of which are included in the efficient category, and it can be concluded that the e-module of this development result is valid and valuable so that it can be used for the next stage of testing.

The feasibility of a problem-based learning-based e-module is obtained in the stage of a limited-scale trial to determine the readability of the e-module. The results get an average score of (90.79%). This value indicates that the problem-based learning e-module on pressure material and its application in everyday life are feasible and can be used in the next stage, namely large-scale trials.

This large-scale trial aims to determine the effectiveness of the e-module developed by looking at the results of its analysis using the N-Gain Score. This value is obtained from the effects of pretests and post-tests in experimental classes that apply developed e-modules and control classes that only apply problem-based learning without developed e-modules. Before conducting large-scale trials, both experimental and control classes were carried out, an average difference test of 2 groups consisting of normality tests (experimental class  $0.148 > 0.05$ ; control class  $0.153 > 0.05$ ), homogeneity test (sig.  $0.283 > 0.05$ ) and t-test (sig.  $0.653 > 0.05$ ) where the third result proves that these two groups are normally distributed homogeneously and have no significant or equivalent differences and can be used as subjects for large-scale trials. Here's figure 1. presents the results of the analysis of each indicator of problem-solving skills obtained based on the value of the N-Gain Score.



**Figure 1.** The Results of the n-gain score Test Analysis of the Experimental Class and the Control Class

Based on the picture above, it can be seen that the skills of the experimental class are higher than those of the control class. The application of problem-based learning e-modules in experimental classes has improved students' problem-solving ability compared to print modules in control classes. These results align with research (Permana et al., 2021, Ramadayanty et al., 2021, Trihastuti et al., 2019) on communicative and innovative e-modules and problem-based learning models help students in improving learning outcomes on pressure materials and their application in everyday life.

In addition to the n-gain score test, the effectiveness of the problem-based learning e-module developed can be seen from students' reading interests. The reading habits possessed by these students can help students grow and improve their ability to understand concepts better (Hock et al., 2017). Skills in getting solutions to a problem can also be increased as students' interest in reading increases. Table 7. below show the analysis results of the student reading interest questionnaire adapted from (Khoiriah et al., 2020) and given to 32 experimental and 32 control class students.

**Table 7.** Reading Interest of Students of Experimental Classes and Control Classes

Indicators	Score (%)	Category
While reading a book, I not only read it, but I also marked the key points.	70.69	Tall
To solve a difficult task/homework, I looked for the answer by reading a book in the library	49.31	Keep
I watch my favourite show on television when my assignment/homework has been completed.	83.10	Very High
I reread the notes in the textbook when I was about to test.	73.10	Tall
I reread the previous tests.	77.59	Very High
I read the textbooks I had.	48.97	Keep
Average	67.13	Tall



According to table 8. above, students on average, have a fairly high interest in reading. However, students' interest in reading tends to decline even in the moderate category when students are required to read printed books that they own or provide by the school. So that the development of problem-based learning-based e-modules can be used more effectively to improve students' problem-solving abilities as well as can be used by students as an alternative electronic material that increases students' interest in declining reading of printed textbooks as evidenced by the results of student responses involved on a large scale to the application of problem-based learning e-modules on and the matter of pressure and its application in everyday life shown in Table 8.

**Table 8.** Results of Large-scale Trial Student Response Analysis

Aspects	Percentage (%)	Category
Serving	89.87	Excellent
Contents of the E-module	91.00	Excellent
Language	89.81	Excellent
Average	90.23	Excellent

The analysis of student responses to the developed e-module received a score (90.23%) which belonged to the excellent category. This proves that e-modules that have an interesting presentation can motivate students to form reading habits. Because reading habits can influence positive students' ability and students Based on the results of the n-gain score test, students' interest in reading, as well as student responses to problem-based learning-based e-modules on pressure mats and their application in daily life have proven effective in improving the problem-solving ability of grade VIII junior high school students.

## Conclusion

Based on the trial results of the problem-based learning e-module product on pressure material and its application in everyday life which has been proven to be good in characteristics, validity, practicality and feasibility as teaching material. So, it can be concluded that the development of problem-based learning e-modules on the basis of pressure and its application in everyday life has proven effective in improving the problem-solving abilities of junior high school students.

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problem-based learning-based e-modules to pressure materials and their application in everyday life.

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