

DEVELOPMENT OF E-MODULE BASED ON PROBLEM-BASED LEARNING THEME OF SUBSTANCE PRESSURE TO GROW STUDENTS PROBLEM-SOLVING ABILITY IN JUNIOR HIGH SCHOOL

Ida Trianawati*, Vica Dian Aprelia Resti, and Dwi Indah Suryani

Science Education Department, Faculty of Teacher Training and Education, Sultan Ageng Tirtayasa University, Banten, Indonesia

*Email: 2281190038@untirta.ac.id

Received: June 21, 2023. Accepted: July 5, 2023. Published: July 30, 2023

Abstract: The implementation of Natural Sciences learning is not only limited to the ability of students to remember and passively pay attention to the teacher's presentation, but in learning natural sciences, students must participate and play an active role in finding out the concepts that will be and are being studied so that in practice it requires a method for solving problems about nature systematically. To overcome these problems, the thing that can be done is to apply Problem-Based Learning to foster students' problem-solving abilities. The purpose of this study was to describe the level of validity and readability of the E-Module based on Problem-Based Learning with the Theme of Substance Pressure to Grow the Problem-Solving Ability of Grade VIII Middle School Students. This development research uses the Thiagarajan development model, which consists of 3 stages: define, design, and develop. The subjects in this study were 2 expert lecturers, 2 materials and teaching materials experts, 3 expert practitioners, namely natural science teachers, and 30 class VIII students. Data from the study were collected using interview sheets, validation sheets, and readability questionnaire sheets. The results of the validity of the E-Module were obtained with an average percentage of 87.25% with a very valid category. After being revised, a readability test was carried out on students, and the result was 90.65% with a very good category so that the E-Module created contains material and language that is easy to understand, as well as the writing of letters and pictures according to the material.

Keywords: *E-Module, Problem-Based Learning, Problem-Solving Ability*

INTRODUCTION

Natural Science is one of the sciences studied at the junior high school level, which studies various events or events that occur in nature. Natural science is obtained through systematic experimentation, observation, and discussion to get a reliable set of data regarding a symptom or process to provide direct experience in developing students' competence to know more about the natural surroundings in depth [1].

Implementing science learning that is applied in schools is more comprehensive than the ability of students to memorize and passively pay attention to the teacher's presentation but in practice. Students must actively discover the concepts to be learned through observation, experimentation, or experimentation [2].

Students who can solve problems in science learning, these students can understand the issues of the natural surroundings in-depth, can apply the concepts they have learned in various real situations, can analyze in observation, experiment, or experiment activities, and can synthesize an argument to form a unified meaning in concluding the results of observations [3].

Based on the results of interviews in three schools, namely SMPN 1 Kramatwatu, SMPN 3 Kramatwatu, and SMPN 1 Waringinkurung, information was obtained that in implementing science learning in the three schools, students had not maximized their learning activities by finding their

concepts because teachers tended to prefer the lecture method in their learning. The teacher chose the lecture method because of the limited number of teaching materials or textbooks that students can use either at school or home, so the teacher prefers to explain using the lecture method in the hope that students will have notes to be studied again.

The Problem-Based Learning learning model is a learning model that can improve students' problem-solving abilities. To apply the learning model, guides and sources of information, such as teaching materials or lesson packages, are needed to guide activities during the learning process [4].

The substance pressure material is very close to students' daily life; one example is when students walk on muddy ground using wider footwear, using wider footwear will make it easier for them to walk in mud. But the material pressure of this substance is considered as a complex material.

Previously there was research on using E-Modules with the Problem-Based Learning model, which argued that problem-based learning models could make students think critically because students were challenged to solve problems by providing solutions to these problems [5]. The difference between this research and previous research is that this research examines four problem-solving indicators: formulating problems, planning problem-solving, carrying out problem-solving, and re-checking the problem-solving results. Apart from that, another difference is in the learning material,

where in this material, the material chosen is material with the theme of substance pressure.

Based on the background of the problems that have been formulated, the researchers decided to carry out research with the title "Development of E-Module Based on Problem-Based Learning with the Theme of Substance Pressure to Improve the Problem-Solving Ability of Grade VIII Junior High School Students."

RESEARCH METHODS

This study uses Thiagarajan's Research and Development (R&D) research model. However, in this study, the development steps carried out were only up to three stages: define, design, and development.

Define Stage

The defined stage is needed to find out the problems in learning activities and get product information to be developed, which is formulated into five steps:

1. Front end analysis

Based on interviews obtained information that students still need to maximize their learning activities by finding their concepts because teachers tend to prefer the lecture method in their learning process. Another problem is that before starting the learning activity, the teacher sometimes poses a phenomenon or problem that orients students toward the problem. However, students still need clarification in understanding the problem and solving problems from the phenomenon or problem posed by the teacher.

2. Student analysis

Based on the results of the interviews, it was found that students had yet to reach the formal operational cognitive development stage. Namely, students had not been able to think abstractly and had not been able to solve problems by reflecting on their thoughts.

3. Task analysis

The task analysis is adjusted from the results of the student analysis. Namely, students still need to be able to think abstractly, cannot solve problems by reflecting on their thoughts, and cannot yet conclude systematically from what they observe so that essential competencies are chosen that are very close to students' lives. The selected essential competencies are class VII 3.3 basic competencies regarding substances and their characteristics related to class VIII 3.8 necessary competencies regarding substance pressure.

4. Concept analysis

Concept analysis is carried out based on core competencies, essential competencies, and materials to develop E-Module products. Researchers designed the material's content combined with a shared integration model that

combines two disciplines that overlap concepts, skills, and attitudes.

5. Analysis of learning objectives

The researcher formulates the results of the task analysis and concept analysis that have been described previously so that they become learning objectives, namely through problem-based learning E-Module students can distinguish the characteristics of solids, liquids, and gases, analyze the concept of pressure of solids in everyday life, carry out experiments on the pressure of solids, liquids, and gases, presents data on the results of experiments on the pressures of solids, liquids, and gases.

Design Stage

This design stage outlines the product design to be developed, namely choosing media in electronic modules with formats sourced from the Ministry of Education and Culture 2017. The layout consists of a cover, preface, table of contents and list of images, instructions for using the E-Module, signs for using the E-Module, introduction, learning activities, scoring guidelines, answer keys, glossary, bibliography, and author biography.

Development Stage

This stage is carried out when the product has been designed; then the next step is carried out, namely:

1. Expert validation

Expert validation is used to determine the validity level of the E-module product and whether the product made is valid. After obtaining the results of expert validation, then calculated using the following formula [6]:

$$\text{percentage value} = \frac{\text{Total score obtained}}{\text{Maximum total score}} \times 100\%$$

The score obtained will then be entered with the following criteria [7]:

81.25 % - 100 %	: Very Valid
62.50 % - 81.25 %	: Valid
43.75 % - 62.50 %	: Quite Valid
25% - 43.75 %	: Invalid

2. Product revision

The validation results obtained from material experts, teaching materials experts, and practitioner experts will then be used as improvement material in perfecting Problem Based Learning-based E-module development products.

3. Readability Test

The results of the product revision based on the assessment, suggestions, and input of experts will then be tested for readability to determine the readability level of the E-Module product to be developed. After obtaining the

results of the readability test, it is then calculated using the following formula [8]:

$$\text{Readability percentage} = \frac{\text{Total score obtained}}{\text{Maximum total score}} \times 100\%$$

The score obtained will then be entered with the following criteria [9]:

- 80.1% - 100% : Very Good
- 60.1% - 80% : Good
- 40.1% - 60% : Pretty Good
- 20.1% - 40% : Not Good
- 0.0% - 20% : Very Not Good

Subject, location, and time of research

This research was conducted in 3 schools, namely SMP Negeri 1 Kramatwatu, SMP Negeri 3 Kramatwatu, and SMP Negeri 1 Waringinkurung, which was conducted in the 2022/2023 school year from March to April 2023. Who became the subject of this research were 2 subject matter lecturers, 2 teaching material expert lecturers, 3 expert practitioners, and 30 samples of class VIII students. The data collection instruments used were interview sheets for grade VIII SMP Science teachers, validation sheets for material experts, teaching material experts, and practitioners, and questionnaires for students to test the legibility of E-Module products. The research data that has been obtained is then analyzed quantitatively and qualitatively.

RESULTS AND DISCUSSION

Presentation of Validation Data

Problem-Based Learning E-Module Products with Substance Pressure Themes In this study, a validation assessment was carried out on material expert validators, teaching material experts, and practitioner experts with the following details :

Material expert validation results

The material expert validation assessment results obtained a percentage of 79.86% in the valid category. The material expert validation assessment is based on an evaluation divided into six components, namely the material's suitability, the material's completeness, the material's accuracy, the material's technique of presenting the material, the presentation support, and the language.

The material suitability component obtained 87.5% with a very valid category. The validation results show that the material presented in the E-Module is in accordance with KI, KD, indicators, and learning objectives.

The material completeness component gets a percentage of 75% in the valid category. The validation results show that the learning activities presented in the E-Module have orientated students towards problems, organized students to learn, guided students to solve problems according to plan,

developed and presented their work, and analyzed and evaluated the problem-solving process that learners had carried out.

Table 1. Results of Material Expert Validation Assessment

No.	Component	Percentage (%)	Category
1.	material suitability	87.5	Very Valid
2.	material completeness	75	Valid
3.	material accuracy	75	Valid
4.	material presentation techniques	79.16	Valid
5.	presentation support	75	Valid
6.	Language	87.5	Very Valid
Whole		79.86	Valid

The material accuracy component gets a percentage of 75% with a valid category. The validation results show that the material presented is taken from relevant sources. Making teaching materials requires many books or other appropriate authorities as reference materials that can be viewed and expanded again in a more exciting style but still have to show the goals to be achieved [10].

The material presentation technique component obtained 79.16% in the valid category. The results of the validation show that the material presented is conveyed, closely related to everyday life, and the material is presented from the simple to the complex. Teaching materials must be delivered with clear and detailed explanations to give meaning to students so that students remember the material presented [11].

Presentation-supporting components get a percentage of 75% with a valid category. The validation results show that the material presented is equipped with pictures and videos according to the material. Pictures or visual illustrations in teaching materials are vital because they can attract students' attention so that they are more interested and more interested in learning [12].

The language component gets 87.5%, with a very valid category. The validation results show that the writing of words and sentences in the E-Module has been written using good and correct Indonesian language rules, and the language used is also easy to understand. Sentences used in teaching materials must refer to good and correct Indonesian grammar [13].

The results of the validation of teaching material experts

The results of the expert validation assessment of teaching materials obtained a percentage of 93.75% in the Very Valid category. The expert validation assessment of teaching materials is based on an evaluation divided into four components: components of content/material, language, presentation, and graphics.

Table 2. Results of Teaching Materials Expert Validation Assessment

No.	Component	Percentage (%)	Category
1.	content	85	Very Valid
2.	language	95.83	Very Valid
3.	presentation	96.87	Very Valid
4.	graphics	93.75	Very Valid
Whole		93.75	Very Valid

The content/material component gets a percentage of 85% with a very valid category. The validation results show that the material presented in the E-Module follows core competencies, basic competencies, indicators, and learning objectives, and the learning activities offered in the E-Module have also orientated students towards problems, organized students to learn, guided students to solve problems according to plan, develop and present work, analyze and evaluate the problem-solving process that students have done.

The linguistic component gets a percentage of 95.83% with a very valid category. The validation results show that the language used is easy to understand, and the words and sentences used follow Indonesian language rules and the student's level of thinking. The sentence structure in teaching materials must refer to good and correct Indonesian grammar [14].

The presentation component gets a percentage of 96.87%, with a very valid category. The validation results show that the systematic presentation of the material in the E-Module is consistent, the concepts presented are coherent from easy to difficult, from simple to complex, and some pictures and videos are appropriate to the material. Pictures and videos in the E-Modul can increase students' enthusiasm and interest in participating in learning activities [15].

The graphical component gets a percentage of 93.75% with a very valid category. The validation results show that the appearance, font, shape, color, size, and proportion of objects in the E-Module are appropriate, that is, attractive and consistent based on the pattern.

Expert practitioner validation results

The expert practitioner's validation assessment results obtained 89.04% in the very valid category. This expert practitioner validation assessment is based

on an evaluation divided into four components, namely the components of content/material, language, presentation, and graphics.

Table 3. Expert Practitioner Validation Results

No.	Component	Percentage (%)	Category
1.	content	83.33	Very Valid
2.	Language	91.66	Very Valid
3.	Presentation	83.33	Very Valid
4.	Graphics	92.85	Very Valid
Whole		89.04	Very Valid

The content/material component gets 83.33%, with a very valid category. The validation results show that the material presented in the E-Module follows core competencies, basic competencies, indicators, and learning objectives, and the learning activities offered in the E-Module have also orientated students towards problems, organized students to learn, guided students to solve problems according to plan, develop and present work, analyze and evaluate the problem-solving process that students have done.

The linguistic component scored 91.66% in a very valid category. The validation results show that students can understand the language used, and the words and sentences used follow Indonesian language rules and the student's level of thinking. The sentence structure used in teaching materials must refer to good and correct Indonesian grammar [16].

The presentation component gets a value of 83.33%, with a very valid category. The results of the validation show that the E-Module consists of an introduction, content in the form of learning activities, and closing; the concepts presented are sequential from easy to complex. The technique of giving the E-Module must have a consistent category starting from the introduction, content, and closing [17].

The graphic component gets a value of 92.85% in a very valid category. It shows that the appearance, font, shape, color, size, and proportion of objects in the E-Module are appropriate, attractive, and consistent based on the pattern. The use of font size can affect students' reading interests. Therefore, in the E-Module product developed by the researcher, the letters on the cover of the E-Module are larger, dominant, and proportional to attract students' interest in reading [18].

Product revision

Table 4. Revision Results Based on Material Expert Suggestions

Before Revision	After Revision
<p style="text-align: center;">I haven't used my photos yet</p> 	<p style="text-align: center;">Already using photos taken by myself.</p> 
<p style="text-align: center;">All examples still need to be added.</p> 	<p style="text-align: center;">An example question has been added.</p> 
<p style="text-align: center;">Foreign vocabulary needs to be italicized.</p> 	<p style="text-align: center;">Foreign vocabulary has been italicized.</p> 

Table 5. Revision Results Based on Teaching Materials Expert Expert Suggestions

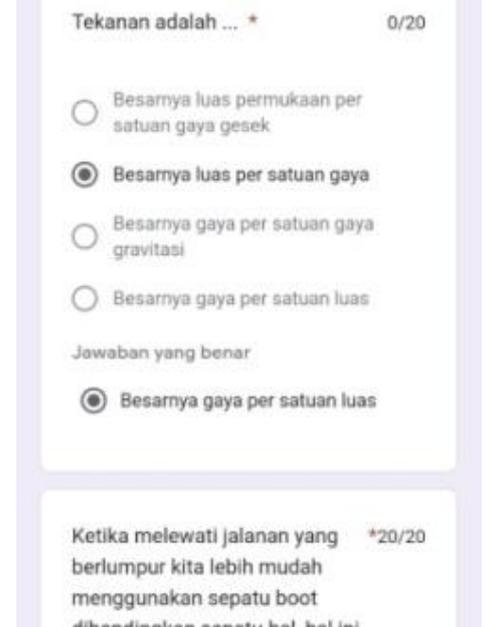
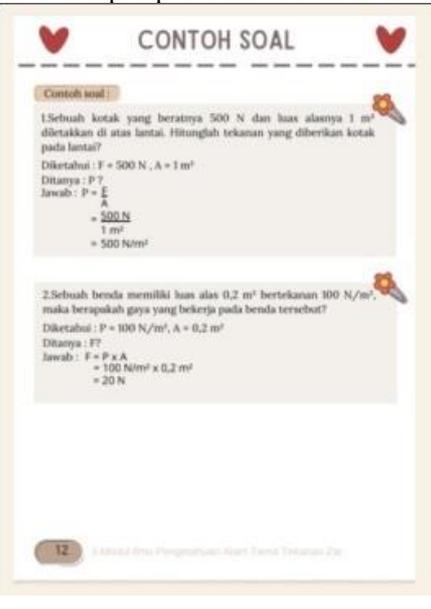
Before Revision	After Revision
<p>The indicators of problem-solving skills and Problem-Based Learning syntax in the E-Module have yet to be explained.</p> 	<p>Indicators of problem-solving skills and Problem-Based Learning syntax contained in the E-Module have been explained.</p> 
<p>There has yet to be an answer key.</p>	<p>There is already an answer key.</p>
	

Table 6. Revision Results Based On Teaching Materials Expert Expert Suggestions

Before Revision	After Revision
<p>Not yet added tools, materials, and work methods</p> 	<p>Tools, materials, and work methods have been added</p> 
<p>All examples still need to be added.</p> 	<p>An example question has been added.</p> 

Readability Test

The readability test results get a value of 90.65% in the very good category. The assessment of the readability test is based on an evaluation that is divided into four components, namely the components of content/material, language, presentation, and graphics.

The content/material component scores 88.47% in the very good category. The validation results show that the material presented in the E-Module is appropriate with core competencies, basic competencies, indicators, and learning objectives, and the learning activities offered in the E-Module have also orientated students toward problems that are

close to everyday life, organizing participants' students to learn, guiding students to solve problems according to what has been planned, developing and presenting work based on problem-solving, analyzing and evaluating the problem-solving process that students have done.

The linguistic component gets 87.91%, which is included in the very good category. The validation results show that the language used in the E-Module can be easily understood, and the words and sentences used follow Indonesian language rules and the student's level of thinking. The sentence structure in teaching materials must refer to good and correct Indonesian grammar [19].

Table 7. Readability Test Results

No.	Component	Percentage (%)	Category
1.	content	88.47	Very Good
2.	language	87.91	Very Good
3.	presentation	95.83	Very Good
4.	graphics	90.41	Very Good
Whole		90.65	Very Good

The presentation component scored 95.83% in the very good category. The results of the validation show that the E-Module consists of an introduction, content in the form of learning activities, and closing; the concepts presented are sequential from easy to complex. The technique of giving the E-Module must have a consistent category starting from the introduction, content, and closing [20].

The graphic component scores 90.41% in the very good category. The validation results show that the appearance, font, shape, color, size, and proportion of objects in the E-Module are appropriate, that is, attractive and consistent based on the pattern.

CONCLUSION

From the results of the research that has been done, it can be concluded that the acquisition of validation results from experts gets an average percentage value of 87.25%, with detailed validation from material experts of 79.86% with a valid category, teaching materials experts of 92.86% with a very valid category, expert practitioners 89.04% with a very valid category. After validation, the E-Module is then tested for legibility, and a percentage score of 90.65% is obtained with a very good category. It indicates that the E-Module product developed contains material and language that is easy to understand, the availability of pictures and videos in each material, and the writing of letters, images, and layouts that have been appropriate.

REFERENCES

[1] Kurikulum, P. (2007). *Panduan Pengembangan Pembelajaran IPA Terpadu. (Draft). Sekolah Menengah Pertama/Madrasah Tsanawiyah (SMP/MTS)*. Puskur. Jakarta.

[2] Sulthon, S. (2016). Pembelajaran IPA yang Efektif dan menyenangkan bagi Siswa MI. *Elementary*, 4(1).

[3] Murdiana, I. N. (2015). Pembelajaran pemecahan masalah dalam pembelajaran matematika. *Aksioma*, 4(1), 1-11.

[4] Sumartini, T. S. (2016). Peningkatan kemampuan pemecahan masalah matematis siswa melalui pembelajaran berbasis masalah. *Mosharafa: Jurnal Pendidikan Matematika*, 5(2), 148-158.

[5] Junaedi, J., & Aripin, I. (2022, October). Model Problem Based Learning (PBL) Berbantuan E-Modul Untuk Meningkatkan Kemampuan

Pemecahan Masalah Siswa. *In Prosiding Seminar Nasional Pendidikan*, Vol. 4, pp. 164-169.

[6] Fatmawati, A. (2016). Pengembangan perangkat pembelajaran konsep pencemaran lingkungan menggunakan model pembelajaran berdasarkan masalah untuk SMA kelas X. *Edu Sains: Jurnal Pendidikan Sains dan Matematika*, 4(2).

[7] Sarip, M., Amintarti, S., & Utami, N. H. (2022). Validitas dan keterbacaan media ajar e-booklet untuk siswa SMA/MA materi keanekaragaman hayati. *JUPEIS: Jurnal Pendidikan dan Ilmu Sosial*, 1(1), 43-59.

[8] Sudijono, A. (2010). *Pengantar statistika pendidikan*. Jakarta : Rajawali Press.

[9] Millah, E. S. (2012). Pengembangan buku ajar materi bioteknologi di kelas XII SMA IPIEMS Surabaya berorientasi sains, teknologi, lingkungan, dan masyarakat (SETS). *Berkala Ilmiah Pendidikan Biologi (BioEdu)*, 1(1).

[10] Magdalena, I., Prabandani, R. O., Rini, E. S., Fitriani, M. A., & Putri, A. A. (2020). Analisis pengembangan bahan ajar. *Nusantara*, 2(2), 180-187.

[11] Magdalena, I., Prabandani, R. O., Rini, E. S., Fitriani, M. A., & Putri, A. A. (2020). Analisis pengembangan bahan ajar. *Nusantara*, 2(2), 180-187.

[12] Makhrus, M., Rokhmat, J., Kosim, K., & Harjono, A. (2022). Development of learning media and online test based smartphone android in physics learning on work and energy topic. *Jurnal Pijar Mipa*, 17(3), 420-423.

[13] Purnanto, A. W., & Mustadi, A. (2016). Analisis kelayakan bahasa dalam buku teks tema 1 kelas I sekolah dasar kurikulum 2013. *Profesi Pendidikan Dasar*, 3(2), 102-111.

[14] Purnanto, A. W., & Mustadi, A. (2016). Analisis kelayakan bahasa dalam buku teks tema 1 kelas I sekolah dasar kurikulum 2013. *Profesi Pendidikan Dasar*, 3(2), 102-111.

[15] Cahyo, B. D., Anggreani, D., Juanti, D. R., Dibah, J. P., Rizky, N., Ulandia, S. B., ... & Lazuardi, L. (2023). Penggunaan Media Pembelajaran Gambar Kreatif untuk Meningkatkan Minat Belajar Siswa SD. *Journal of Rural and Urban Community Empowerment*, 4(2), 78-83.

[16] Irawan, J., & Hakim, A. (2023, April). Development of ethnosience-based natural resources chemistry practicum guideline. *In AIP Conference Proceedings* (Vol. 2619, No. 1). AIP Publishing.

[17] Hikmah, K., & Astuti, R. (2018). Analisis perbandingan kualitas buku teks bahasa Arab Ta'lim Al-Lughoh Al-Arobiyah dan Al-'Ashri: Kajian isi, penyajian dan bahasa. *Halaqa: Islamic Education Journal*, 2(1), 12-29.

- [18] Muhammad, M., Hastuti, K. P., & Setiawan, F. A. Analisis Buku Teks Mata Pelajaran Geografi Kelas XI SMA/Sederajat Pada Materi Dinamika Kependudukan di Indonesia untuk Perencanaan Pembangunan. *JPG (Jurnal Pendidikan Geografi)*, 8(2).
- [19] Hanika, S., & Guspatni, G. (2023). Development of learning media powerpoint-iSpring integrated with prompting questions on stoichiometry topics. *Jurnal Pijar Mipa*, 18(1), 57-64.
- [20] Lestari, M., & Guspatni, G. (2023). Validity of powerpoint-ispring learning media on carbohydrate materials in high school. *Jurnal Pijar Mipa*, 18(2), 170-175.