



Analysis of the Need for Developing E-Modules Based on Problem-Based Learning on Heat Transfer Material for Middle School Students

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Abstract

To help students understand the learning process, e-module development for science instruction was crucial. The objectives of this study were to identify the learning resources that students use to comprehend the material in physics, identify the learning resources that need to be developed in physics learning, and describe the examination of needs for developing an e-module based on Problem-Based Learning (PBL) on heat transfer material at the junior high school level. This study (mixed method research) used both quantitative and qualitative methods. The research and development (R&D) technique employing a 4D model (define, design, development, and disseminate) was utilized in this study. However, it should be noted that only the define stage was addressed within the scope of this research. The primary objective was to collect data, for which 38 seventh-grade students from SMP Negeri 6 Palembang participated by responding to an online questionnaire. Analysis was conducted using a descriptive qualitative method. The findings from the questionnaire collection were utilized to develop two e-modules intended to aid in understanding physics learning materials, particularly those related to heat transfer. The implications suggested that resources such as e-modules were necessary for students to comprehend and learn physics concepts, especially those related to heat transfer. Additionally, various learning materials like textbooks, e-books, worksheets, and online media were identified as essential for effective physics education. The significance of creating e-modules rooted in problem-based learning to aid students in grasping physics content, particularly concerning heat transfer, was highlighted. Furthermore, the research underscored the necessity for developing various learning resources such as textbooks, e-books, worksheets, and online media for physics education. These findings could enhance curriculum development and teaching methodologies by providing insights into students' characteristics and requirements when studying heat transfer material.

Keywords: e-modules; needs analysis; problem-based learning

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INTRODUCTION

Law No. 20 of 2003 states that education is a deliberate and planned effort to create an atmosphere for learning and a process for learning so that students actively nurture their potential capacity for religious, spiritual strength, control, personality, intelligence, integrity, and skills needed by themselves, society, nation, and state. Learning is a process of interaction in a classroom—between students, among students and teachers, as well as between students and learning materials. It also states that the educational process is interesting, interactive, inspiring, enjoyable, and challenging, urging students to actively participate while offering ample opportunity for initiative, creativity, and independence in line with students' talents, interests, and physical development. These two principals have made it obvious that education includes a deliberate and planned effort to foster an interactive learning process between teachers and students, as well as resources for learning in an atmosphere of learning that is organized in an exciting, pleasant, challenging, and inspiring way so that students can maximize their potential as resources for oneself, their communities, their nations, and their states (Kurniahtunnisa et al., 2023; Pursitasari et al., 2022).

Developing a balance of spiritual and social attitudes, expertise, as well as skills and being able to utilize them in various situations, both at school and in society is one of the features of the 2013 curriculum based on Permendikbud Number 36 of 2018 (Husna et al., 2020; Nazhifah et al., 2023; Putri et al., 2023). The learning outcomes of the 2013 curriculum resulted in knowledge mastery, the growth of abilities, and the reinforcement of ethical and religious values (Curtin et al., 2019; Gustavsson et al., 2021; Yang et al., 2021). Therefore, these characteristics should be found in the learning that students do.

An ideal learning process cannot be separated from the role of teachers in facilitating students so that the desired learning outcomes and goals are achieved (Mardiana et al., 2019). Teachers are expected to be able to insert social and spiritual values into the learning material delivered. This is the basis for selecting a school or agency teacher. Building facilities, buying high-quality books, and hiring competent teachers are the main variables that have to be taken into consideration while expanding education in order for it to improve the level of its human capital. All three variables serve as the building blocks for promoting linked learning. Students need adequate facilities, such as educational institutions, libraries, and laboratories, to support great education. Moreover, besides completing building facilities, students require teaching materials as essential learning resources. It is crucial that these teaching materials are both sufficient and of high quality to effectively enhance knowledge acquisition.

Teaching materials are a crucial element of education that can facilitate learning for students (Ardiansyah et al., 2016). One of the essential components utilized and required by teachers during instruction is educational resources (Dyah et al., 2021; Maharani, 2017). The purpose of teaching materials is to plan and research the implementation of learning. Teaching materials are all assets arranged methodically and clearly show the competencies students will master and utilize in the learning process (Prastowo, 2012). Teaching aids, which may be printed or not (Istiqomah et al., 2019), also improve the learning process. Non-printed teaching materials, such as books, modules, worksheets, magazines, etc, are tangible or visible. Meanwhile, printed teaching materials are teaching materials that utilize electronic technology, such as e-books, e-modules, e-magazines, etc.

One kind of printed material for learning is a module. Modules encompass educational resources that enable students to study independently, facilitating their ability to acquire knowledge autonomously while actively engaging in the learning process (Deviana, 2018). This is how modules differ from printed teaching materials. As modules possess an organized structure comprising various student learning activities, they inherently restrict the direct instruction students receive (Bakri et al., 2015). Nevertheless, with the advancement of technology, which is progressively becoming more sophisticated each day, many modules are now being created in electronic form, commonly referred to as e-modules.

According to the outcomes of a questionnaire administered through Google Form to 38 seventh-grade students at SMP Negeri 6 Palembang, a significant majority, accounting for 91% of the respondents, expressed that they found physics challenging. This sentiment persisted even though many students found the teacher's explanations of formulas to be challenging to comprehend. The learning resources students use to study science material, especially physics, are still limited to textbooks, worksheets, e-books, and internet media. Up to 100% of students demand the creation of e-modules based on PBL on the transfer of heat material, and up to 74% of students are unaware that modules can be employed as learning resources. Up to 89% of students claim that e-modules based on PBL can aid in understanding the subject matter. Research focuses on studying physics with a particular emphasis on heat transport. Through a needs analysis, this research aims to provide a better understanding of the characteristics and requirements of students in learning heat transfer material, which can assist in developing more effective curricula and

teaching methods.

Physics is an area of instruction that might benefit greatly from using e-modules as teaching resources. Physics is a branch of the natural sciences, a body of knowledge that uncovers all the secrets of the cosmos and laws via studying signs, occurrences, or natural phenomena (Payudi & Ertikanto, 2015). In order to prepare students to understand the knowledge, concepts, and values of physics and develop scientific abilities and science process skills, the teachers must educate them about physics. This is because we often face physics challenges in daily life (Sukiminiandari et al., 2015). A common example of a physical phenomenon encountered in daily life is heat. The study of heat transfer is highly interconnected with everyday experiences because it elucidates an object's capacity to perform work. Humans, for instance, can engage in activities due to the heat derived from their food and beverages. Similarly, objects can accomplish tasks because of heat; for instance, a motor harnesses gasoline-generated heat.

Observations conducted on seventh-grade students at SMP Negeri 6 Palembang revealed that 95% of the students expressed difficulty in comprehending science material, particularly physics. In addition, the learning resources they used to study physics were still limited to books, worksheets, and e-books. 78% of students indicated that their learning resources were still challenging to comprehend and lacked the flexibility to be accessed anytime and anywhere. This was because the teaching materials used by students were still limited to books, worksheets, and e-books, which are difficult to understand. As many as 100% of students want to develop modules besides books, worksheets, and e-books as a learning resource.

Based on the observation results, it

can be concluded that seventh-grade students at SMP Negeri 6 Palembang have not utilized e-modules as learning tools. Providing the necessary infrastructure and facilities to nurture students who excel academically and religiously is crucial in establishing e-modules based on problem-based learning (Larasati et al., 2020). PBL is a student-centered approach that involves active student participation in solving authentic problems. PBL is used in education to improve engagement and drive attainment. In PBL, students work in groups to solve open-ended problems relevant to real-world situations. This approach helps students develop critical thinking and analysis skills, self-directed learning, and the ability to apply course content to real-world examples. PBL also allows students to develop skills related to working in teams, managing projects, oral and written communication, self-awareness and evaluation of group processes, and working independently. PBL in developing e-modules for physics instruction, particularly on heat transfer material, can help students develop critical thinking skills and improve their understanding of the subject matter. Problem-based learning is integrated into the e-module teachings to provide students with guidance and advice applicable to their lives.

Students may profit significantly from electronic modules (e-modules) that use PBL as the teaching method, especially when learning occurs online. The benefit of creating PBL e-modules is that they promote PBL in students, which affects the way they develop their principles and character (Hamzah, 2015; Larasati et al., 2020; Ridwan et al., 2018). Of course, it is hoped that increasingly sophisticated technological advances can help students face the current situation. Furthermore, developing increasingly innovative teaching materials aims to enhance

students' understanding of the subject matter and foster their interest and motivation, particularly in learning physics. This approach also endeavors to promote PBL among students. This research aims to 1) identify learning resources used by students in understanding physics learning material; 2) identify what learning resources need to be developed in physics learning; 3) describe the analysis of needs for developing an e-module based on PBL on heat transfer material at junior high school level. Using e-modules in physics learning, especially heat transfer material, can strengthen students' understanding and improve critical thinking skills. This analysis is needed in PBL-based e-module research to understand students' needs and develop appropriate learning resources. Several studies have shown that developing PBL-based e-modules on heat transfer material can improve junior high school students' critical thinking abilities. Thus, this analysis is important to ensure that the e-module developed is in accordance with students' needs and can improve their understanding and critical thinking skills.

METHOD

This research (mixed method research) used both quantitative and qualitative methods. Mixed Method Research (MMR) is an investigation method used when problems need to be investigated in terms of output and procedure, as well as combining quantitative and qualitative approaches in one study (Masrizal, 2012). Descriptive research, which aims to describe, portray, and depict phenomena that occur in a true, realistic, actual, systematic, factual, and exact manner about the facts, attributes, and connections between the phenomena that are being investigated, is the form of study that is used (Rukajat, 2018).

The indicators and aspects used as benchmarks to obtain this needs analysis

data were: (1) the learning system used by students; (2) students' difficulties in learning physics; (3) learning resources used by students to study "calor" material; (4) student responses to learning resources in the form of modules; (5) students' needs for the development of electronic modules based on PBL as a learning resource.

The research and development (R&D) technique with a 4D model (define, design, development, and disseminate) was used in this study. However, the scope of this study was restricted to the define stage, which involved identifying the needs of students in finding learning resources, particularly for science content. This study utilized a population of seventh-grade junior high school students, with seventh-grade students at SMP 6 Palembang as the research sample to gather the necessary data.

In order to figure out the issues students were having with the teaching materials being used, a questionnaire approach to data obtaining was utilized in this study. A Google Form platform was used to spread needs analysis questionnaires to seventh-grade students at SMP Negeri 6 Palembang.

Additionally, specific data analysis techniques were used to examine the acquired questionnaire data. In this study, descriptive statistical analysis was employed as the method of data analysis. Descriptive statistics used sample or population data to describe or summarize the object being studied. There was no analysis or drawing of generalizations in this descriptive data. In addition to employing the mode, median, mean worth, group variation, and standard deviation, descriptive statistics can be represented with regular tables, frequency distributions, graphs, and descriptions of data groups (Sugiyono, 2012).

This research was conducted by distributing an online needs analysis questionnaire in a Google Form platform to seventh-grade students at SMP Negeri

6 Palembang. However, before the study, students were provided with an overview of the e-module that would be developed. This enabled students to respond to the analysis of e-module development needs. The description given to students was in the form of images of the module parts.

Seventh-grade students at SMP Negeri 6 Palembang were granted access to an online needs analysis survey created using the Google Form platform. However, before the study, students were provided with an overview of the e-module that would be developed. This enabled students to respond to the analysis of e-module development needs. The description given to students was in the form of images of the parts of the module. There were several components in e-modules, including cover e-modul (Figure 1), presentation of a concept map for heat transfer material, PBL approach in heat transfer material, task practice, glossary, student response diagram regarding the learning system, student response diagram regarding physics learning, diagram of learning resources used by students, student response diagram regarding learning resources in the form of modules, requirements diagram for the development of e-modules as learning resources, and diagram of student responses to e-module development.

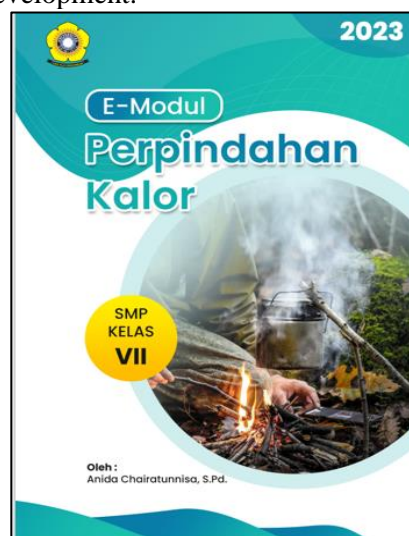


Figure 1 Cover e-module

The title cover contained the e-module title, class designation, and the writing team. The background cover for the module used an image related to the concepts discussed in the module. The concept map presentation of heat transfer materials is shown in Figure 2.

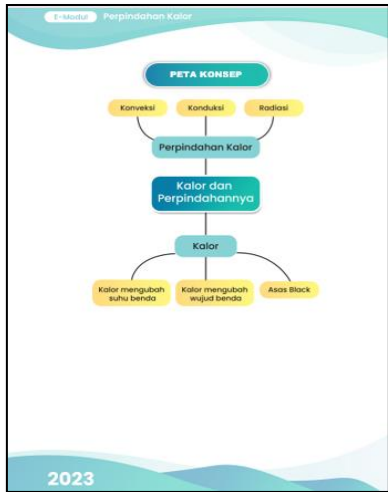


Figure 2. Presentation of a concept map for heat transfer material

This concept map contained the scope of heat transfer material: conduction, convection, and radiation. Concept maps would facilitate students' understanding of the structure and organization of the material being studied. The PBL approach to heat transfer material is shown in Figure 3.

Figure 3 PBL approach in heat transfer material

Figure 3 was a piece of material based on *problem-based learning*. This integration was based on *problem-based learning-based* discussions related to the material presented in the e-module. The task practice is shown in Figure 4.

Figure 4 Task practice

Figure 4 presents an exercise task related to the material explained in the e-module. Assignment exercises were intended to determine the extent of students' understanding after studying the material in the e-module. Practice assignments were also provided, along with answer keys, so that after completing the exercises, students could match their answers and determine whether they were correct or incorrect. This allowed students to gauge their understanding of the material.

Figure 5 Glossary

Figure 5 presents the glossary. The glossary presented a list of words with meanings or explanations related to a particular field. In this case, the presented glossary consisted of a list of words that appeared in the e-module and their meanings, enabling students to comprehend the material more easily.

Learning conducted by seventh-grade students at SMP Negeri 6 Palembang was online-based, utilizing applications such as WhatsApp, Google Classroom, Google Form, and Zoom. However, the implemented online learning system caused students difficulties in the learning process. Students' difficulties regarding the learning system were shown in Figure 6.

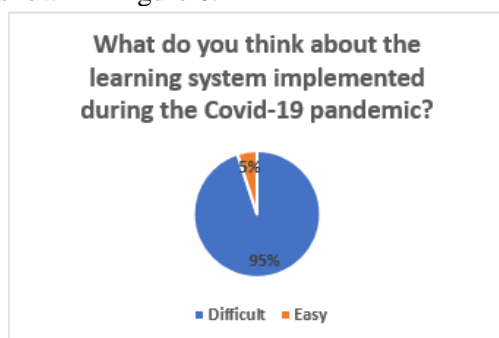


Figure 6 Student response diagram regarding the learning system

Figure 6 shows that 95% of students stated that the current learning system was difficult. The difficulties encountered by students in online learning stemmed from various factors, such as unstable internet connections and challenges in comprehending teachers' explanations online. This aligned with pertinent research (Sidiq et al., 2020), indicating that students face issues during online learning, including difficulties grasping material teachers deliver online and poor internet packages and signals.

The obstacles experienced by students had an impact on the science learning process, especially physics. This could be seen in Figure 7.

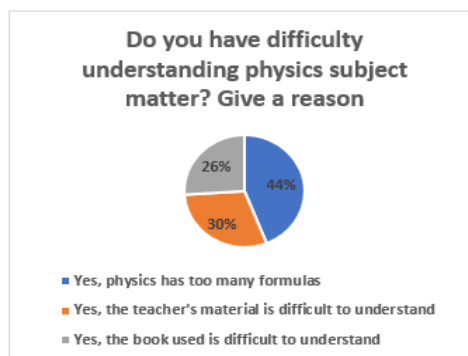


Figure 7 Student response diagram regarding physics learning

Figure 7 showed that 91% of students stated that physics was a difficult subject. Apart from many formulas that needed be understood, the teacher's explanations and the learning resources used were difficult for students to understand. As a result, students' mastery of concepts regarding physics learning material was low. Students who developed conceptual mastery would be able to do things related to procedural knowledge more quickly compared to students who only focused on memorizing and remembering (Nisrina et al., 2017).

To support the ongoing learning process, students utilized various learning resources to comprehend the material being taught, particularly in science, especially physics. The learning resources employed by students to understand science subjects, particularly physics and heat transfer material, can be seen in Figure 8.

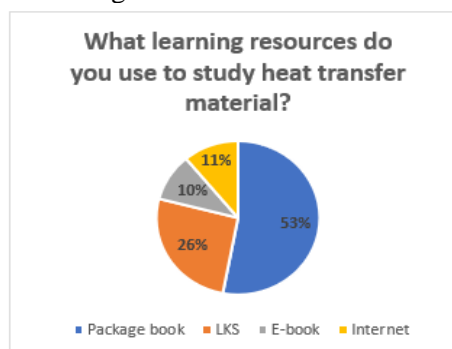


Figure 8 Diagram of learning resources used by students

Figure 8 shows that 53% of students used books, 26% utilized worksheets, 11% accessed the Internet, and 10% relied on e-books as learning resources. Since instructional materials play a crucial part in learning and could aid students in learning smoothly, learning resources and teaching materials should assist students with comprehending learning content (Ardiansyah et al., 2016).

Attractive teaching materials were crucial for the learning process, as they could enhance student interest and motivation in studying. The development of teaching materials by utilizing current technology was urgently needed by students, especially for abstract learning, such as science, especially physics. An example was an electronic module (e-module). However, many students still did not know that modules could be used as learning resources. This was obtained from a survey questionnaire, with student responses shown in Figure 9.

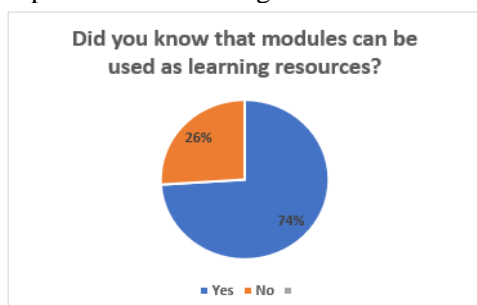


Figure 9 Student response diagram regarding learning resources in the form of modules

Figure 9 showed that 74% of students did not know that modules could be used as learning resources, while the remaining 24% were aware but had not yet implemented them in the learning process. Learning using modules made students active and independent. Learning using modules would increase students' skills in learning independently without depending on the teacher (Prastowo, 2012).

Every student wanted other learning

resources besides books, worksheets, and e-books. Of course, students also wanted complete and interesting learning resources. This desire was evident from the survey questionnaire results, highlighting the need for developing teaching materials, as depicted in Figure 10.

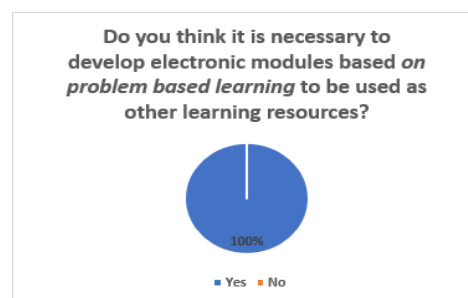


Figure 10 Requirements diagram for the development of e-modules as learning resources

Figure 10 demonstrated that all students, or 100%, indicated a need to create electronic modules (e-modules) as educational tools. Modules are instructional tools that explain difficult subjects in simple terms to allow students to study them independently (Deviana, 2018). Using PBL module helped boost students' faith in God Almighty, from which all knowledge is derived (Sari, 2019).

Developing learning resources like e-modules could help students understand heat transfer material. This was revealed through the results of a survey questionnaire that stated student responses to the development of the e-module, as shown in Figure 11.

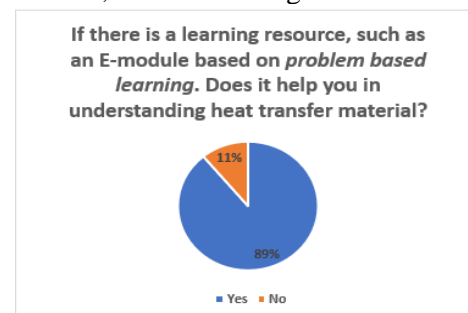


Figure 11 Diagram of student responses to e-module development

Figure 11 showed that 89% of students needed other learning resources, such as e-modules, to understand the material, while another 11% stated they did not need additional learning resources. The use of e-modules as a learning resource was helpful in understanding the material, as the language used was easy to comprehend. The use of illustrations in modules could attract students' attention. In addition, examples of questions and their solutions also helped students understand the material.

The following were some benefits of using modules as teaching aids or other learning resources: (1) they provide immediate feedback; (2) they can be customized to the learning styles of specific students by giving them freedom to choose the pace at which they learn and comprehend the material, as well as the format and content of the lesson; (3) following the evaluation, both teachers and students will know which module components the students completed effectively and which components they have not (Bakri et al., 2015).

The research conducted followed the R&D methodology. This approach aligned with the 4D paradigm, proposed by Thiagarajan et al. in 1974, which included Define, Design, Development, and Disseminate stages. In this research, only the development stage was undertaken. The define stage entailed the

Table 3 Suggestions and input from validators regarding PBL-based e-modules

Validator	Suggestion	Follow-up
I	a. Add material about temperature and expansion	a. Material about temperature and expansion has been added
	b. Adapt the learning video to the material	b. The learning videos in the e-module are adapted to the material presented
II	a. Adjust existing components in the e-module	a. The e-module has been repaired with e-module components
	b. Adjust the PBL learning stages in the e-module	b. PBL learning stages have been added according to the activity steps
III	a. Correct the writing that is still wrong in writing	a. The typing error has been corrected
	b. The images in the e-module are appropriate. However, it's not big enough.	b. Image clarity has been improved

study of needs and challenges to determine the need to create e-modules, the design stage to create learning media in e-modules, and the development stage with expert validation. From August to September 2023, the Physics Education Study Programme of Sriwijaya University developed this e-module. The data from the validation results of the assessment by material experts are presented in Table 1.

Table 1 Validity analysis of the material expert e-module

Aspects	Validator average	%
Content	4.47	89.50
Presentation	4.22	84.44
Language	4.16	83.33
Average	4.28	85.75

The percentage score results that had been obtained were then categorized as the level of validity, while the data from the assessment results by media experts was presented in Table 2.

Table 2 Validity analysis of the media expert e-module

Aspects	Validator average	%
Didactic	5,00	100
Construction	5,00	100
Technical	5,00	90
Average	5,00	97

Suggestions and input from validators were presented in Table 3.

In the expert validation results, the questionnaire material used was 34 questions with an item score range of 1-5. Aspects of assessment by material experts include 1) content/material aspects with seven material indicators, including depth of material, the correctness of material, completeness of the material, breadth of material, presentation of material, evaluation of learning and student activities; 2) presentation aspect with three material indicators, including clarity of sentences, conformity with Indonesian language rules and sentence structure. The assessment scores obtained through the questionnaire were then added up to form an assessment score with a range of 1-5. The percentage score results obtained were then categorized as the level of validity.

Based on Table 1, the average results of the validity analysis of e-modules based on PBL in the content/material aspect were said to be valid by material experts with an average score of 4.28 and an average percentage of 85.75%. By looking at the percentage obtained in the e-module based on problem-based planning, the e-module could be categorized as valid and suitable for use with revisions according to suggestions by material experts. Based on research, it was known that the validity of the PBL-based e-module developed was in the valid and practical category.

According to Laili et al. (2019), the material components, images, and videos presented included facts appropriate to real situations, and the questions presented could measure students' understanding of the material. E-modules would be more interactive if equipped with learning media containing video, audio, and animation to enrich the student experience. The images in the e-module aimed to help students understand the learning material. According Wahab et al.

(2023), the heat transfer material included relevant images and videos, making it suitable for development into e-module teaching material as it facilitated easier comprehension for students to master the material. Learning images and videos should offer precise explanations of the concepts presented in the material, providing easily understandable and visually appealing information. Including video media significantly enhanced students' understanding as they could directly visualize the concepts being taught. According to (Mardiana et al., 2019), e-modules were interactive, facilitating easier navigation and allowing the display and loading of images, audio, video, and animation. Additionally, they were equipped with formative tests/quizzes that provided immediate automatic feedback, enhancing the learning experience. Valid e-module content showed the suitability between the exercises contained in the module and the demands of the material being taught (Fadieny & Fauzi, 2021).

The suitability of the content, presentation, and language were all evaluated in the e-module validity test based on PBL on heat transfer material. Regarding the viability, the e-module's content was based on PBL on heat transfer materials with incredibly reliable findings. This demonstrated that the description of the heat transfer information contained in the PBL e-module was consistent with the Core Competencies (*KI*) and Basic Competencies (*KD*), and the learning objectives were met, indicating that the substance of the material in the e-module comprised facts, concepts, and principles. According to Yuliana et al. (2023), the content of the e-module complied with the criteria aspects that included suitability for learning outcomes and objectives, suitability for the substance of the material, suitability for teaching material needs, and

benefits in increasing insight. This supported the validity of the appropriateness of the content. Additionally, according to Budiastuti et al. (2021), if the learning objectives, learning materials, and Core Competencies, as well as Basic Competencies, were in line with the characteristics and cognitive level of the students, the content aspect was deemed to be good.

In the media expert validation results, the questionnaire used consisted of 40 questions with a score range per item of 1-5. Aspects of media experts' assessment included didactic, constructive, and technical aspects. In the didactic aspect, there were two indicators, including the learning process and ability development. In the constructive aspect, there were three indicators: appropriate use of language and sentences, paying attention to students' abilities, and having benefits, goals, and identity. In the technical aspect, there were six indicators, including correct use of writing, correct use of images, correct color selection, and attractiveness of appearance/layout. The assessment scores obtained through the questionnaire were then added up to form an assessment score with a range of 1-5.

Based on Table 2, e-modules based on PBL in didactic, constructive, and technical aspects were said to be very valid by media experts with an average percentage of 100%. By looking at the percentage obtained in the validation of the e-module media based on PBL, it was declared suitable for use, based on several suggestions given by media experts. This was in accordance with research conducted by (Meldrawati et al., 2023), whose results indicated that the problem-based learning e-module developed was deemed valid and suitable for use.

The didactic aspect of the e-module was based on PBL on heat transfer material with very valid criteria. According to Maryati (2018), this meant that the whole presentation of the e-module was in accordance with the stages in the PBL model, including orienting to problems, orienting students to learn, conducting investigations, developing work results, and analyzing and evaluating problem-solving. In stage 1, the e-module presented problems in the form of images, namely: 1) several individuals can be observed sitting around a campfire; 2) the act of stirring hot coffee with a metal spoon is depicted; 3) a basic experiment demonstrating heat transfer through conduction is illustrated. In stage 2, students were asked to analyze the problem. In stage 3, the material presented helped students obtain the data needed to solve the problems encountered. In stage 4, the discussion results were presented in front of the class as a report. In stage 5, students were asked to assess their understanding by completing the practice questions provided in the e-module. According to Rahmadani (2019), developing modules based on PBL could increase students' understanding because through PBL, students were oriented to surrounding problems. Through the PBL stage, students could ask questions, provide explanations, carry out investigative activities, present results, and draw conclusions.

The e-module's graphic component was based on PBL about heat transfer materials using extremely sound standards. This demonstrated how beautiful the e-module display design was regarding font size, type, arrangement, content, appearance, color, and cover. It was based on problem-based planning on heat transfer material. Students' comfort level using electronic modules might be affected by font size and typeface consistency. If the layout and design of

the e-modules were appealing and included video or animation components, students would be attracted to them, enhancing their motivation, interest, and creativity. The font type used in the e-module was Times New Roman, with a font size of 12 pt for the content and a spacing of 1.0-2.0. Employing appropriate fonts was crucial as it ensured that the message or material conveyed in the e-module was clear to students.

The PBL-based e-module yielded a product intended for student utilization. Validation of the e-module, based on PBL, was conducted by both material experts and media experts to assess the validity of Prototype II following improvements made from Prototype I. Material experts evaluated the e-module based on PBL in terms of material, language, and presentation, resulting in an average validity percentage of 85.75%, categorized as valid. Meanwhile, media experts assessed the e-module's didactic, constructive, and technical aspects, resulting in an average validity percentage of 97%, categorized as very valid. This research aligned with previous studies, particularly one on interactive multimedia based on PBL in physics subjects using R&D methods, which also achieved a very valid media validation score of 89%.

Table 3 shows changes made to the e-module based on PBL about the created heat transfer medium. The results of the updated problem-based learning-based E-module were presented following a practicality test on teachers and students to gauge the viability of the generated PBL-based e-module. Results from data analysis in the validity test of the PBL-based E-module on heat transfer materials had extremely good criteria.

CONCLUSION

A conclusion was reached based on the findings from distributing online

questionnaires: the existing learning system appeared to pose challenges, and students encountered multiple obstacles. These learning barriers affected the science learning journey, particularly in physics. A staggering 91% of students expressed the view that physics was challenging. Despite receiving explanations of formulas from teachers, many still needed help to comprehend. The learning resources used by students to study science material, especially physics, were still limited to textbooks, worksheets, e-books, and internet media. Up to 100% of students demanded the creation of e-modules based on PBL on the transfer of heat material, and up to 74% of students were unaware that modules could be employed as learning resources. Up to 89% of students claimed that e-modules based on PBL could aid in understanding the subject matter. Research focused on studying physics with a particular emphasis on heat transport. Through a needs analysis, this research aimed to provide a better understanding of the characteristics and requirements of students in learning heat transfer material, which could assist in developing more effective curricula and teaching methods. It underscored the importance of developing e-modules based on problem-based learning to help students comprehend physics material, especially heat transfer concepts. Additionally, the research highlighted the necessity of developing learning resources such as textbooks, e-books, worksheets, and internet media to support the study of physics.

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