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# Preliminary Study : Electronic Module based on Problem Based Learning Model to Improve Students' Concept Understanding

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## ABSTRACT

*Physics learning is inseparable from scientific knowledge, physics problem solving and understanding of physics concepts. To solve physics problems, understanding physics concepts is very important. This research aims to identify problems that arise in physics learning. This research uses design research method with Plomp's development model, which consists of three stages: preliminary research, development or prototyping phase, and assessment phase. In this research, a preliminary study was conducted to students and teachers, analyzing student needs by giving a student needs questionnaire, analyzing teacher needs by giving questionnaires and interviews. Preliminary studies conducted through student and teacher needs questionnaires and interviews show that the use of teaching materials is still limited, with teachers having never developed electronic teaching materials such as e-modules. Existing learning models have also not been applied effectively and there is a lack of student concept understanding. In addition, the interaction between teachers and students in providing problem solving tutorials in physics lessons is still not optimal. Therefore, e-modules are needed as teaching materials that can facilitate students in understanding the material so that it can improve students' understanding of concepts.*



## INTRODUCTION

Fisika Physics is a science that studies objects in nature physically and mathematically. Physics is called a science that is structured, integrated, and has patterns and correlations with the surrounding world because it is a basic science in the development of science and technology (Iftirani et al., 2022). Physics learning includes experiences, known facts, concept, or principal that are discovered through a process of finding by using science process skills (Ananda & Usmeldi, 2023). Physics learning requires scientific knowledge, problem solving and concept understanding (Hudha et al., 2017).

Understanding physics concepts is the basis for understanding statements and solving physics problems. Understanding the concept of physics is the ability to re-explain

the physics material that has been learned and be able to interpret the meaning of the learning in daily life (Shidik, 2020). Teachers have an important role in improving students' understanding of physics concepts. Teachers can use the right learning approaches and resources to help students understand the concepts (Afriani, 2018).

Fluid is a physics material that requires understanding of concepts. Some studies reveal that there is a low understanding of physics concepts in fluid material. Research conducted by (Oktaviani et al., 2017), stated that in static fluid material the level of understanding of students' concepts was still low. In addition, research conducted by (Akhmalia et al., 2018), stated that students have difficulty in learning so that there is less understanding of students' concepts in static fluid material. Then the research conducted by (Anggreani et al., 2023), stated that fluid material provides a lot of explanations about events in daily life so that a correct understanding of fluid concepts is needed.

The application of fluid material that is often found in real world problems requires a learning model that can support the learning process. One model that can be applied is Problem Based Learning (PBL), where students become the center of learning through problem solving (Kimianti & Prasetyo, 2019). PBL is an effective learning model as it gives students the opportunity to investigate multidimensional events in depth. It encourages the development of critical thinking skills, problem solving, as well as social skills, while facilitating the learning of new concepts in the context of problem solving (Sari et al., 2023). The application of the PBL model is supported by the use of the right teaching materials.

Teaching materials are all forms of material used to support success in learning. Teaching materials are tools used to convey information, which can stimulate students' attention, interest and motivation in learning. Thus, teaching materials play an important role in achieving learning goals (Duri et al., 2024). Electronic teaching materials developed by optimizing 21st century technology are expected to make students more active in learning and improve problem-solving skills. E-modules are electronic teaching materials made by utilizing the latest technology and information. Compared to printed modules, e-modules have advantages such as image, animation, audio, video, and quiz features that provide automatic feedback, help students learn independently, and solve problems effectively (Cheva & Zainul, 2019).

## METHODS

The research conducted is Design Research which is relevant to the problems and objectives stated. In this research, the Plomp model is the development model used. Plomp's development model consists of three phases, namely: 1) Preliminary research; 2) Development or prototyping stage, and 3) Assessment stage ( Plomp &; Nieveen, 2013). In this study what was done was the Preliminary research stage. At this stage, a preliminary analysis is carried out or also called a needs analysis which aims to obtain information related to the needs of teachers and students for e-modules.

Studi The preliminary study was conducted in 8 High Schools in West Sumatra Province, namely SMAN 1 Padang, SMAN 1 Lembang Jaya, SMAN 1 Lubuk Alung, SMAN 1 Lembah Gumanti, SMAN 1 Painan, SMAN 1 Tilatang Kamang, SMAN 1 Solok Selatan and SMAN 3 Bukittinggi. Student needs analysis was conducted by giving a questionnaire of student needs analysis in physics learning. Teacher needs analysis was conducted by providing a questionnaire of teacher needs in physics learning and interviews.

Student needs analysis is conducted to determine the characteristics of the e-module to be developed. Student needs analysis is used to pay the attention of the character and needs of students who are the subject of the use of e-modules to be developed. This questionnaire was given to students consisting of 4 indicators, namely student characteristics, implementation of physics learning, use of physics learning materials, and student needs for the use of physics learning materials. The questionnaire given is hoped to help find information about student needs for teaching materials in physics learning.

Teacher needs analysis was conducted to find out what teaching materials have been used by teachers in physics learning. In addition, to find out what learning models have been used in the physics learning process at school. This teacher needs analysis was conducted by giving questionnaires to eight teachers and interviews to teachers at SMAN 1 Padang. The questionnaire given to teachers consisted of 3 indicators, namely the use of physics learning materials, teachers' needs for physics learning materials, and the application of learning models by teachers in the physics learning process.

# RESULTS AND DISCUSSION

## Results

### Results of Student Needs Analysis

The results of research on analyzing student needs in physics learning were conducted on 202 students from 8 high schools in West Sumatra. To develop writing materials such as e-modules, it is necessary to analyze student needs (Hidayati et al., 2023). The needs analysis stage was carried out by filling out a questionnaire consisting of four indicators. This stage aims to find out the problems found in physics learning at school.

The student needs analysis on the student characteristics indicator consists of: 1) Liking physics learning, 2) Difficult to understand physics material, 3) Difficult to do physics problems, 4) It takes a long time to understand physics material, 5) It is more easy to understand physics material if it is presented with audio, 6) It is easier to understand physics material if it is presented with pictures and diagrams, 7) It is more easy to understand physics material if it is presented with video, 8) It is more easy to understand physics material if it is presented with virtual lab, 9) Prefer learning by using books in electronic form accompanied by videos, 10) Prefer learning by using books in electronic form accompanied by pictures/animations.

From the results of the analysis, the data on student characteristics can be seen in Figure 1. The results of the analysis of student needs on the indicators of student characteristics can be seen in Figure 1. there are 77% of students like learning physics, 78% of students find it easier to understand physics material presented with videos, and 74% of students prefer to learn by using teaching materials in electronic form accompanied by videos, images and animations.

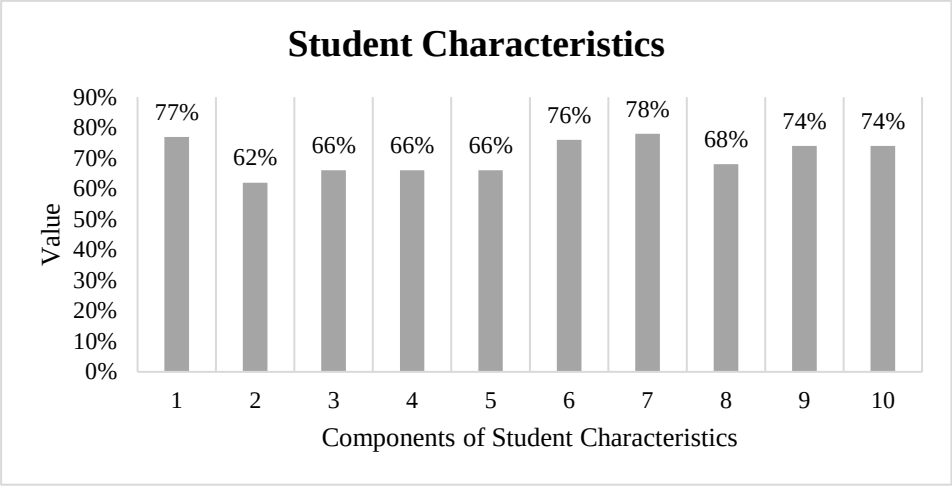


Figure 1: Results of Student Needs Analysis Student Characteristic Indicators

Furthermore, the learning implementation indicators consist of: 1) The role of the teacher is still dominant during physics learning (teacher centered), 2) Given the opportunity by the teacher to find problems, in the form of questions related to those given by the teacher in physics learning, 3) Given the opportunity by the teacher to organize learning tasks related to the selected physics learning problem, 4) Given the opportunity by the teacher to collect relevant information, conduct experiments to explain and solve problems in physics learning, 5) Given the opportunity by the teacher to plan and present appropriate works, such as reports, models, and videos and help various tasks with my friends, 6) Given the opportunity by the teacher to analyze the results of problem solving and present the results of the analysis, 7) Getting Problem Solving Tutorials from teachers during the learning process, 8) Given assignments by teachers in the form of conceptual problems, 9) Given assignments by teachers in the form of calculation problems that require physics equations in solving them.

From the results of the analysis, the data obtained on the implementation of physics learning can be seen in Figure 2.

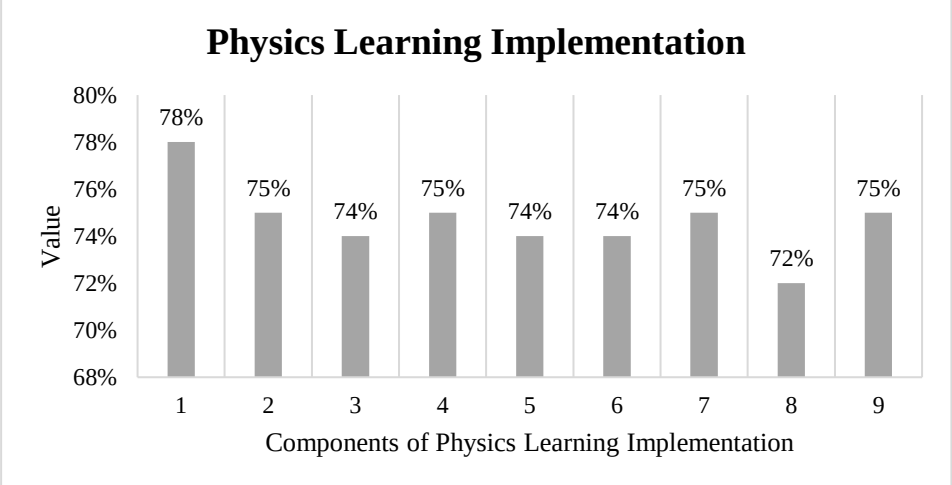


Figure 2: Results of Student Needs Analysis of Physics Learning Implementation Indicators

The results of the analysis of student needs on the indicators of physics learning implementation can be seen in Figure 2. there are 78% of students feel that teachers are still dominant in physics learning, 74-75% of students have implemented the PBL model in accordance with its syntax, and as many as 72% of students are given assignments in the form of conceptual problems.

In addition, the indicators of the use of physics teaching materials in learning consist of: 1) During physics learning, teaching materials used are printed teaching materials, 2) During physics learning using teaching materials such as modules/handouts made by the teacher, 3) Using varied teaching materials during physics learning, 4) Never used digital teaching materials such as e-modules, 5) Think physics teaching materials used by teachers are not sufficient as learning materials.

From the results of the analysis, the data on the use of teaching materials in physics learning can be seen in Figure 3.

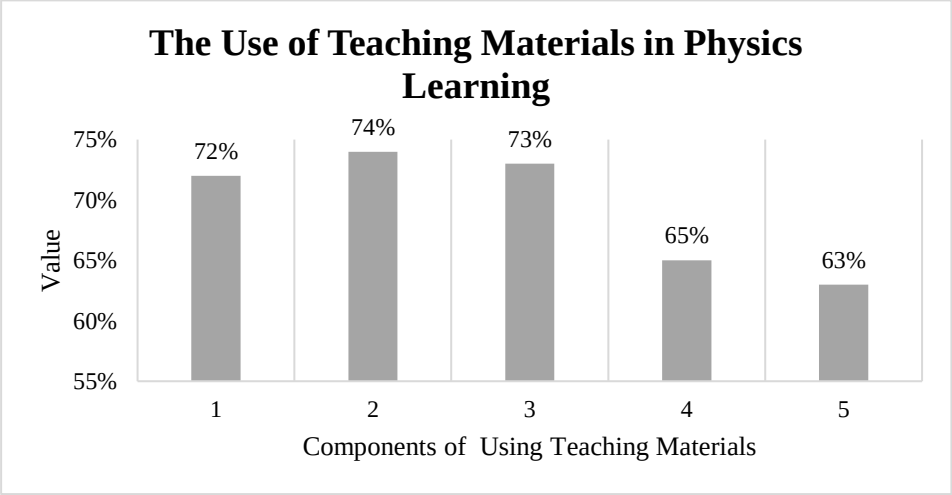


Figure 3. Results of Student Needs Analysis Indicators of the Use of Teaching Materials in Physics Learning

The results of the analysis of student needs on indicators of the use of physics teaching materials in physics learning can be seen in Figure 3. there are 74% of students using physics teaching materials made by teachers, 72% of students in physics learning use printed teaching materials, 65% of students have never used digital teaching materials such as e-modules.

Lastly, indicators of student needs for teaching materials consist of: 1) Physics materials made by the teacher himself make it easier for me to understand physics material, 2) Have used digital materials based on certain learning models during the physics learning process, 3) Need digital teaching materials in the form of e-modules that are able to guide students to find and solve problems related to physics material, 4) Need digital teaching materials in the form of e-modules in physics learning that are used for self-study, 5) Need digital learning materials in the form of e-modules that can be accessed using a smartphone/computer, 6) Physics learning will be more interesting if using digital learning materials in the form of e-modules, 7) Requires digital learning materials in the form of e-modules that provide tutorials for solving problems directly.

From the results of the analysis, data on student needs for teaching materials can be seen in Figure 4.

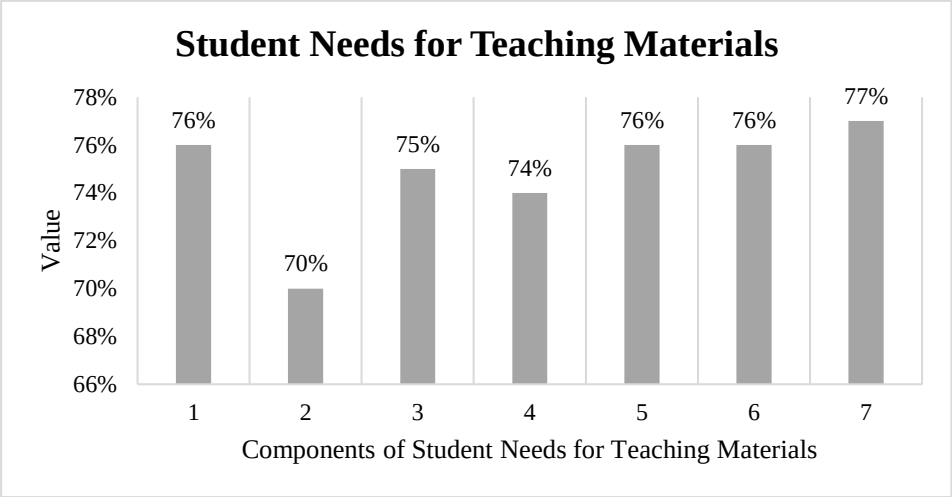


Figure 4. Results of Student Needs Analysis Indicators of Student Needs for Teaching Materials

The results of the analysis of student needs on indicators of student needs for physics teaching materials can be seen in Figure 4. 76% of students feel that physics learning is more interesting if using e-modules that can be accessed via smartphones/computers, 75% of students need e-modules that can lead students to solve problems related to physics material, and 77% of students need digital teaching materials that provide Problem Solving Tutorials directly.

After analyzing the needs of students, among others, students have experienced difficulties in learning physics material, students have never used electronic-based teaching materials in physics learning, during the physics learning process students still use printed teaching materials, students need teaching materials that provide explanations through images, videos and audio, and students need Problem Solving Tutorials to solve physics problems, and need teaching materials that can guide students in conducting problem-based learning.

## Results of Teacher Needs Analysis

The results of the research on analyzing the needs of teachers in physics learning in schools were carried out by administering questionnaires and interviews. The needs analysis stage was carried out by filling out a questionnaire consisting of three indicators. This stage aims to find out the problems found in physics learning at school. In addition, to see the mandatory skills that teachers must have in developing teaching materials (Sundari et al., 2024).

The teacher needs questionnaire, for indicators of the use of physics teaching materials in learning, consists of: 1) Teachers use varied teaching materials during physics learning, 2) Teachers use printed teaching materials in physics learning, 3) Teachers use teaching materials in the form of self-made modules/handouts, 4) Teachers have never used digital teaching materials in the form of e-modules in physics learning, 5) Teachers provide opportunities for students to find other learning resources, 6) Teachers have not used enough teaching materials as a source of student learning.

From the results of the analysis, the data on the use of teaching materials can be seen in Figure 5.

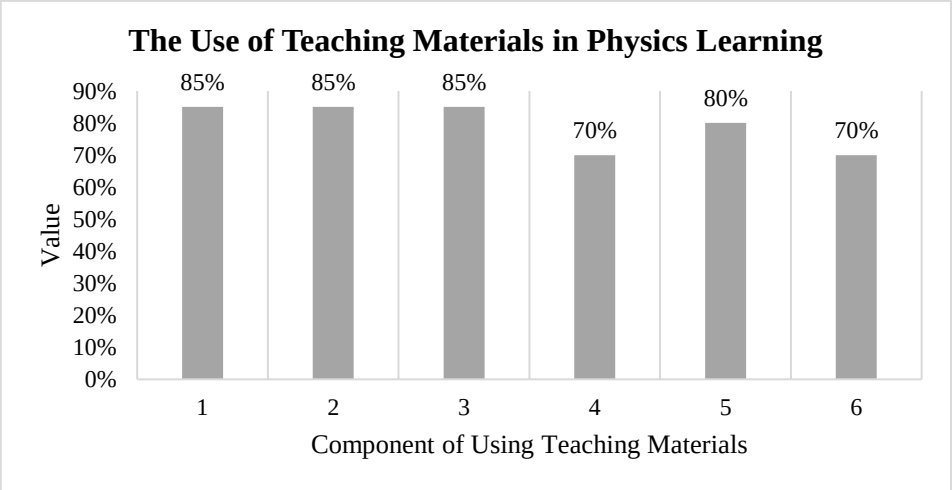


Figure 5: Results of Teacher Needs Analysis Indicators of the Use of Physics Teaching Materials in Learning

The results of the analysis of teacher needs on indicators of the use of physics teaching materials in learning can be seen in Figure 5. there are 85% of teachers using printed teaching materials, varied and self-made. Teachers also give permission to students to find additional teaching materials. However, 70% of teachers have not used enough materials as learning resources and have never used e-modules in physics learning.

In addition, indicators of teacher needs for materials in physics learning consist of: 1) Teachers support the use of digital teaching materials on physics materials to add insight and improve students' understanding of concepts, 2) Teachers have developed digital teaching materials based on certain learning models, 3) Teachers have developed digital teaching materials in the form of e-modules that can be used by students via smartphones/computers, 4) Teachers have developed digital teaching materials in the e-modules based on the PBL model to develop students' understanding of concepts.

From the results of the analysis, the data on teacher needs for teaching materials can be seen in Figure 6.

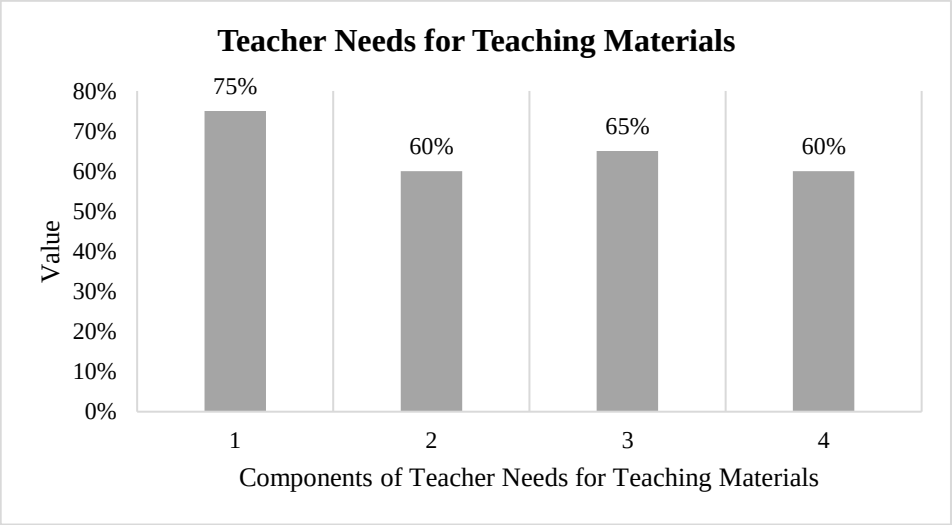


Figure 6: Results of Teacher Needs Analysis Indicators of Teacher Needs for Teaching Materials

The results of the analysis of teacher needs indicators of teacher needs for physics teaching materials can be seen in Figure 6. there are 40% of teachers have never developed digital

teaching materials in the form of e-modules based on a particular learning model, 35% of teachers have never developed teaching materials in the form of e-modules that can be used via smartphones/computers, so as many as 75% of teachers support the development of digital teaching materials on physics material to improve students' concept understanding.

Finally, indicators related to the application of the learning model by teachers consist of: 1) Teachers use the model of learning that can help students in understanding physics material, 2) Teachers already know the PBL (Problem Based Learning) learning model, 3) Teachers provide opportunities for students to find problems, in the forms of questions related to what the teacher gives in physics learning, 4) Teachers provide opportunities for students to organize learning tasks related to selected physics learning problems, 5) Teachers provide opportunities for students to gather appropriate information, carry out experiments to explain and solve problems in physics learning, 6) Teachers provide opportunities for students to plan and prepare appropriate works, such as reports, models, and videos and help various tasks of their friends, 7) The teacher provides opportunities for students to analyze the results of problem solving and present the findings of the analysis, 8) Teachers provide problem solving tutorials to students during the physics learning process, 9) Teachers give assignments to students in the form of conceptual problems, 10) Teachers give assignments to students in the form of count problems which need physics equations in solving them.

The results of the teacher needs analysis related to the implementation of the learning model by teachers can be seen in Figure 7.

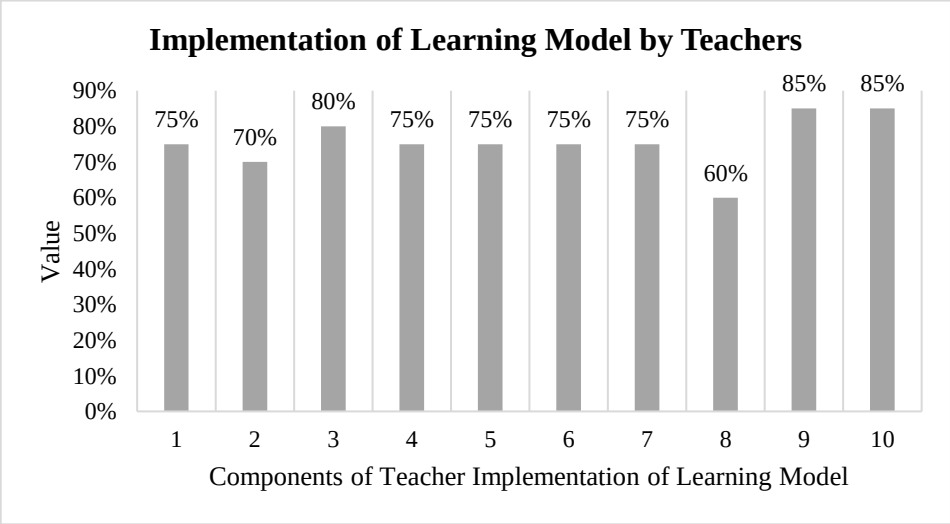


Figure 7: Results of Teacher Needs Analysis Indicator of Implementation of Learning Model by Teachers

The results of the analysis of teacher needs indicators of the implementation of learning models by teachers can be seen in Figure 7. there are 75% of teachers use certain learning models in physics learning, 70% of teachers already know the PBL model and its syntax, and 85% of teachers give assignments to students in the form of conceptual problems and calculation problems that require physics equations in solving them so that 60% of teachers provide Problem Solving Tutorials during physics learning.

Further results, based on the results of observations at SMAN 1 Padang there are low student learning outcomes in fluid material. The low learning outcomes are caused by the lack of students' understanding of the concept of fluid material and its application in everyday life. The results of interviews with teachers show that fluid is a material that is

difficult for students to understand, which is reflected in the low learning outcomes in fluid material as in Table 1.

Table 1. Physics Learning Outcomes on Fluid Material

| Class | Mean PH Score |
|---|---|
| XI F-1 | 75 |
| XI F-2 | 73 |
| XI F-3 | 69 |
| XI F-8 | 65 |

## Discussion

Preliminary research was conducted by analyzing the needs of teaching materials through questionnaires given to teachers and students. The aim is to find out the use of teaching materials and the application of learning models in physics learning. This needs analysis includes distributing questionnaires in schools regarding the importance of developing teaching materials in the form of e-modules. A high quality e-module that follows the development of technology so that it looks more attractive (Opina et al., 2024). The results of the analysis are expected to be a reference for developing e-modules based on the PBL model. Learning with the PBL model can make students learn independently from the problems given (Duri et al., 2024). This study aims to provide an overview of the needs of teachers and students for teaching materials in physics learning.

Based on data from student and teacher needs questionnaires and interviews, information was obtained that the use of teaching materials was still limited, and teachers had never developed electronic teaching materials such as e-modules. The teaching materials used by teachers are still printed teaching materials, these teaching materials tend to be boring for students, electronic-based teaching materials are needed so that they can help students learn (Herman et al., 2023). As many as 74% of students stated that they needed digital teaching materials in the form of e-modules for independent learning. E-modules are one of the independent learning resources that are organized systematically and there are images, videos and animations that can support learning materials that allow users to be more interactive (Falah et al., 2023). While 76% of students want digital teaching materials that can be accessed via smartphone or computer. Students are more enthusiastic when using digital devices such as smartphones or computers, thus supporting the development of electronic learning materials (Paroza & Hidayati, 2023).

From the results of the questionnaire filled out by 8 teachers, 75% supported the development of physics teaching materials to broaden their horizons and improve students' understanding of concepts. The development of teaching materials is one of the tasks and skills that every teacher must have.This is because teaching materials make it easier for teachers to deliver learning materials (Sundari et al., 2024). Therefore, learning physics requires digital teaching materials in the form of e-modules that can be accessed via smartphone or computer to support independent learning.

Furthermore, teachers still have not fully implemented Tutorial Problem Solving in physics learning. As many as 72% of teachers give assignments in the form of conceptual problems. As many as 75% of teachers give assignments in the form of calculation problems

that require physics equations in solving them. As many as 77% of students need digital teaching materials in the form of e-modules that provide Problem Solving Tutorials directly to help solve calculation problems that require physics equations. Students do not understand in answering physics problems because the teacher only provides steps on the blackboard. Teachers can use learning models such as PBL models to help students analyze and solve problems (Kurniawati, 2022). The PBL model is defined as a model that focuses on improving problem solving skills (Hudha et al., 2017). From the results of filling out the teacher questionnaire, 70% of teachers already know the PBL model.The use of the same model makes the learning process tedious (Azmi et al., 2023). The use of the right model can help improve students' concept understanding (Anusba et al., 2023). But in reality, teachers have not implemented the PBL model optimally.

Furthermore, based on the results of observations at SMAN 1 Padang, there are low student learning outcomes in fluid material as shown in Table 1. Fluid material provides a lot of explanations about events in everyday life (Saputra et al., 2019), so that a correct understanding of the concept of fluid is needed (Anggreani et al., 2023). The results of interviews with teachers show that fluid is a material that is difficult for students to understand, which is reflected in the low learning outcomes in fluid material. The low learning outcomes are due to the fact that many students still do not understand the concept of fluid material and the application of fluid in daily life (Maulana et al., 2018). Understanding the concept is important in learning physics, because every material in physics learning has a relationship with each other (Suherly et al., 2023). Therefore, teaching materials are needed that can improve students' concept understanding.

In this research, it is not easy to get results that are perfect due to obstacles and limitations. When conducting research, solutions are necessary to overcome these problems. One of the obstacles in this research is that it takes a long time to collect the results of the student and teacher needs questionnaires. The solution taken by the researcher for this problem is to remind students and teachers to fill out the needs analysis questionnaire so that enough data is needed. With these constraints and limitations, the researcher hopes that this needs analysis can be used as a reference in developing teaching materials such as e-modules that can improve students' concept understanding. And the e-modules developed can be further tested at the validity and practicality stages.

## CONCLUSION

This research is a design research using Plomp's development model. The phases carried out began with preliminary research. The results of the preliminary study obtained from student and teacher needs questionnaires and interviews showed that the used of teaching materials was only limited, teachers had never developed electronic teaching materials such as e-modules, and the learning model applied was not effective. In addition, there is material that is difficult for students to understand and less optimal provision of problem solving tutorials between teachers and students in physics learning. Thus, there is a need for teaching materials in the form of e-modules that can facilitate students in understanding the material that relates to everyday life so that it can improve students' concept understanding.

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