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Need Analysis of E-module Based on the Theory of Conceptual Change in Earth and Space Material for Class X of Vocational School in the Sumatra

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Abstract: This research examined the need for developing E-modules based on the Theory of Conceptual Change in physics education, with a focus on the topic of Earth and Space Sciences. Research method is quantitative descriptive The results of the questionnaire analysis involving teachers in 7 provinces, namely South Sumatra, West Sumatra, North Sumatra, Bengkulu, Jambi, Bangka Belitung Islands, Riau and students in 6 provinces, namely South Sumatra, West Sumatra, Bengkulu, Jambi, Bangka Belitung Islands, Riau shows that the average use of E-modules is still limited in schools, namely 42%, while an average of 70% of students stated that they had difficulty understanding physics concepts, especially those related to Earth and Space Sciences. Therefore, 100% of teachers and 88% of students agree that the development of E-modules based on Conceptual Change Theory needs need to do.

Keywords: Conceptual change theory; E-module; Earth and space sciences; Need analysis

Introduction

Learning physics must be supported by adequate resources (Chaeranti et al., 2018; Lesmono et al., 2012; Pilendia, 2020; Husnadi et al., 2024). The digital era requires learning materials that are easily accessible online or offline (Mutiara & Emilia, 2022; Gazi et al., 2019). Thus, the learning resources used tend to be electronic teaching materials (Uçak, 2019; Erdoğan et al., 2023). These learning resources included teaching materials in the form of electronics and textbooks. Teachers must also have the skills to present and create teaching materials (Delita et al., 2022; Hamidi et al., 2024). Teaching materials are not only in the form of modules or printed books, but can also be in other forms (Handoyo & Irawan, 2022; Sugianto et al., 2023; Kurniawan et al., 2023). Lernen mit Bildmedien (Sumiati et al., 2017) groups teaching materials into three main ones, first audio (auditiv), second namely visual (visuell), third namely audio visual (audiovisuell). Therefore, the use of digital teaching materials is a choice of teaching materials that is in line with current developments (Pratama et al., 2023).

The module is important for displaying materials prepared by subject teachers, considering logical preparation guidelines, and distributing them to students (Azairok et al., 2023; Kemenristekdikti, 2019). E-modules are a practical, interactive and flexible independent learning resource so they can be used anytime and anywhere (Perdana et al., 2017; Triwahyuningtyas et al., 2020). E-modules are a solution to this era of disruption in which there is almost no distance or time in the learning process. The use of e-modules is more effective than the printed version (Wijaya & Vidianti, 2020). This is because the e-module is equipped with images, videos, and animations, thereby helping students to understand the learning material (Fadieny & Fauzi, 2019). One of the features of this module is its lessons learned.

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The use of E-modules in physics learning has several benefits, including the development of critical reasoning abilities and science process abilities (Maiyena & Imamora, 2020), facilitating the learning process independently by students (Hakim et al., 2020; Cynthia et al., 2023) increasing interaction between students and learning material (Jamain et al., 2022), making it easier for students to learn independently (Dari & Sudatha, 2022), helping students understand the material better (Laili, 2019), fostering useful thinking skills, and explaining material conceptually to improve students' understanding and memory (Perdana et al., 2018).

The aim of physics subjects is to enable students to master concepts (Subagya & Wilujeng, 2019; Sundari et al., 2024). However, in physics studies, students often experience misinterpretations or misconceptions because there is generally confusion in building concepts based on intuition (Mufit, 2018). E-module is an important parameter in the study of earth and space materials using a conceptual change-theory-based approach. Conceptual change in texts is a learning strategy used to remediate students' misconceptions (Saprudin et al., 2021). Conceptual change theory provides a strong framework for understanding how basic concepts in earth and space science can develop over time, where concepts are a basic part of every student's understanding of physics lessons (Syuhendri, 2022).

A person's ability to master the images of objects leads to their ability to master concepts. Concepts are the basis that every student must understand during physics lessons. The existence of concept interpretation, or what is often called conception, provides the opportunity for each student to have their own perspective and interpretation of a particular concept. A mismatch between a person's understanding of a concept and that agreed upon by scientists is often called misconception (Syuhendri, 2019). It can be concluded from the literature that the use of E-modules in physics learning has significant benefits, such as improving critical thinking and science process skills, facilitating the learning process independently, increasing the interaction between students and learning materials, and helping students understand materials better. Sriyanti et al (2021) stated that using e-modules in learning has a relative influence medium to learning outcomes.

Based on the above description, the researcher considered it necessary to conduct case study research to understand the conditions of the learning environment, which can be in the form of literature and field studies. The purpose of literature studies is to collect information and determine what steps are taken in learning activities, whereas that of field studies is to determine learning conditions in schools (Firdha et al., 2021). This result was consistent with the findings of Fadli et al. This study was conducted by collecting different data, for example, examining the needs of educators and students regarding learning materials or resources that suit their field needs (Saprudin et al., 2021). This study aimed to identify the teaching materials used by educators, obstacles during learning, and the teaching materials needed by students.

Method

The research method was descriptive. Descriptive research was conducted to determine the value of independent variables, either one or more variables, without making comparisons or connecting them with other variables (Sugiyono, 2012). A quantitative approach uses quantitative data, starting from data collection, data interpretation, and appearance of the results (Arikunto, 2013).

Purposive sampling was used to conduct field studies. The participants were vocational school students in South Sumatra, West Sumatra, North Sumatra, Bangka Belitung Islands, Bengkulu, Jambi, and Riau. This was a quantitative, descriptive research method. The number of students who were subjects was 196 students and 15 teachers. The results of the data collected in this research were in the form of a questionnaire analyzing teacher and student needs. Data were analyzed using qualitative and quantitative analyses of the questionnaire results. The questionnaire was written in the form of a Likert Scale with an instrument in the form of a check list.

Result and Discussion

The data were obtained based on an analysis of the teacher needs questionnaire, as listed in Table 1. Data from the questionnaire distributed to the students regarding obstacles and required teaching materials are listed in Table 2. Analysis of teachers' needs for teaching materials using a Google Form questionnaire with the following guidelines.

Table 1. Guideline for E-Module Questionnaire Guidelines for Teachers

Indicator	Number Questionnaire
Suitability of E-modules with the implementation of the independent curriculum	1, 2, 3, 5
The need for an E-module based on conceptual change theory	4, 8, 9, 11
Aspects of content or material requirements for E-modules are based on conceptual change theory	6, 7, 14, 15
Expectations for E-modules are based on conceptual change theory	10, 12, 13

Based on the results of the open questionnaire, the following conclusions were obtained:

Table 2. Results of E Module Needs Questionnaire Analysis for Teachers

Questionnaire Analysis	Percentage (%)
The school has implemented independence	92
Attend training at PMM	69
Suitability of the teaching materials used	54
The teaching method used is discussion	92
The teaching method used is demonstration	62
The teaching method used is Project	54
The teaching method used is experimentation	46
The teaching method used is lecture	54
Students still experience difficulties in understanding physics	69
Teachers have difficulty presenting material so that students can easily understand concepts	69
Use of E-modules in Class	23
Prepare your own teaching materials	31
The teaching materials used do not support understanding of physics concepts	69
Availability of E-modules in schools	10
It is necessary to develop an E-module for earth and space materials	92
It is necessary to develop an E-module for earth and space materials based on TPK	100
Teachers experience difficulties in increasing students' understanding of concepts	77
Students experience misconceptions about Earth and Space material	77

The percentage of results from the E-module needs analysis questionnaire among the teachers is expressed in the figure 1. Based on the results of the questionnaire given to teachers in seven provinces, namely South Sumatra, West Sumatra, North Sumatra, Bangka Belitung Islands, Bengkulu, Jambi, Riau in table 2 and figure 1, it was found that it is necessary to develop E-modules because the use of E-modules is still minimal, namely, only 23 % used in schools, which is also caused by the availability of E-modules in schools, which is still very minimal, namely 10%, where the dominant teaching materials used are student textbooks, around 77% of which are obtained from libraries or purchased by teachers.

Teachers stated that approximately 69% of the teaching materials used still did not help students understand physics concepts, especially earth and space materials. Teachers also saw that students experienced difficulties when experiencing misconceptions in earth and space materials, where 77% of the teachers observed stated that students experienced misconceptions, but further research needs to be conducted on the types of misconceptions experienced by students in earth and space materials. Apart from that, there is still no E-module based on the theory of Conceptual Change to help resolve the problem of misconceptions among students, so the teacher stated that he 100% agreed to develop an E-module based on the theory of conceptual change, especially on Earth and Space material.

After analyzing the need for teaching materials in the form of e-modules for teachers, this was discussed. Next, we will discuss the analysis of the need for teaching materials in the form of E-modules according to the students that were used via a Google Form questionnaire with the following guidelines.

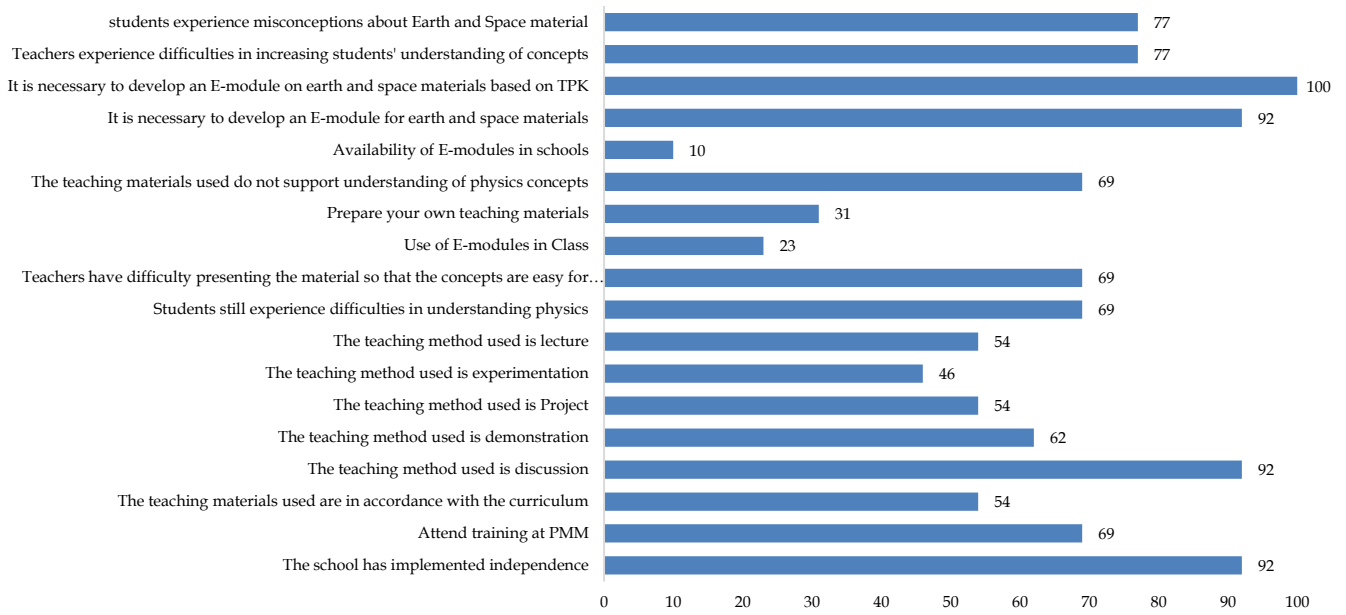

Figure 1. Percentage graph of vocational school teacher questionnaire analysis in 7 Sumatra Provinces

Table 3. Guidelines for Questionnaires Regarding Students' Needs for E-Modules

Indicator	Number Questionnaire
Student responses to the material	1, 4
Availability of E-modules in the field	2, 6
Response to E-module	3, 5, 7, 9
Delivery of material	8

Based on the questionnaire, the results of the questionnaire analysis for all samples from the six provinces are as follows, as shown in Table 4. Based on the results of the questionnaire analysis in Table 4, it is expressed in the diagram as below at South Sumatra. From the results of the analysis of the student needs questionnaire in Table 4 and Figure 2, students predominantly used textbooks for learning with a percentage level of 55%, the use of E-modules was also low (39 %), and many students even stated that they did not know the E-module material. Based on the questionnaire results, 58% of the students stated that they still had difficulty understanding the concepts explained by the teacher. Thus, around 86% of the students stated that they agreed to develop an E-module based on the theory of conceptual change to remediate the misconceptions experienced, especially regarding earth and space material. Students need a variety of teaching resources to help with the learning process, which can be understood independently.

Table 4. Results of Questionnaire Analysis of Students' E-Module Needs

Questionnaire Analysis	Percentage (%)
Students like Physics lessons	57
Students experience difficulties in learning physics, especially earth and space material	72
The teaching materials used are predominantly student books	75
The learning method most often used by teachers is discussion	50
According to students, the teacher still explains the material theoretically by providing formulas and practice questions	80
Many students stated that they had never seen the E-module	66
Teacher level uses E-modules in learning	45
Students agree to develop an E-module on earth and space material based on the theory of conceptual change to support the learning process	84
The majority of students expressed difficulty in understanding concepts in physics learning	75

In line with students in South Sumatra Province, an analysis was carried out on students in Bangka Belitung Province. This can be seen in Figure 3.

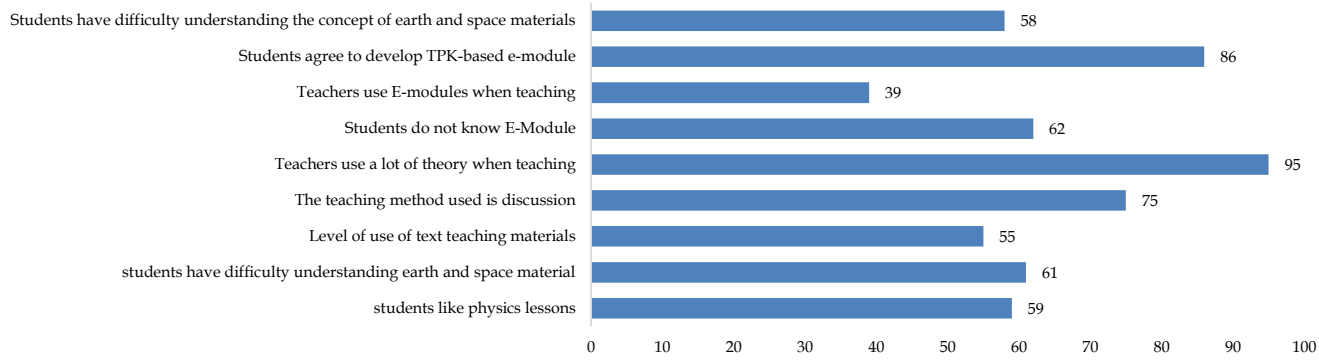

Figure 2. E-module questionnaire analysis diagram for students at South Sumatra

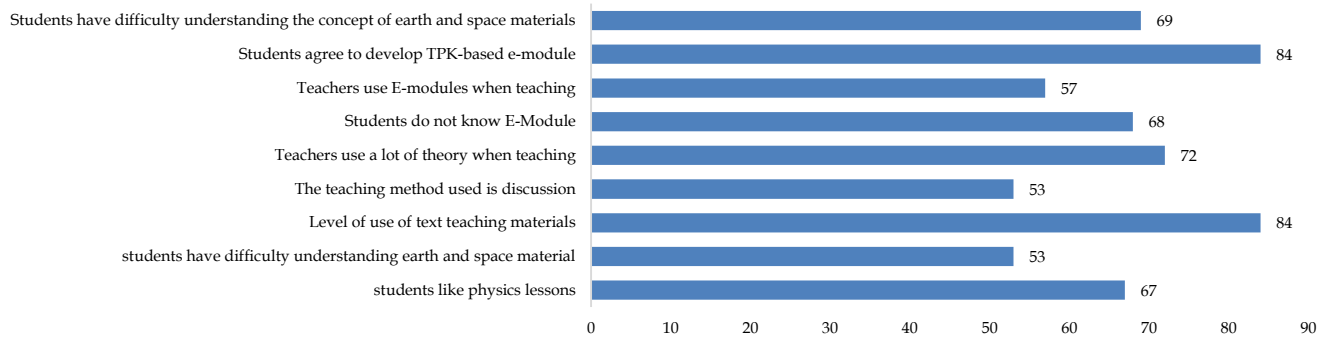

Figure 3. E-module questionnaire analysis diagram for students in Bangka Belitung Province

Based on the results of a questionnaire administered to vocational school students in Bangka Belitung Province, it is known that 67% of students like physics lessons based on the way teachers teach, 53% of whom teach using the discussion method however, teachers are still theoretical when teaching with a percentage of 72%, so as many as 69% of students stated that they still had difficulty understanding the material and concepts, especially in earth and space materials. Therefore, as many as 84% of the students agreed that an E-module based on the Theory of Conceptual Change on Earth and space material should be developed.

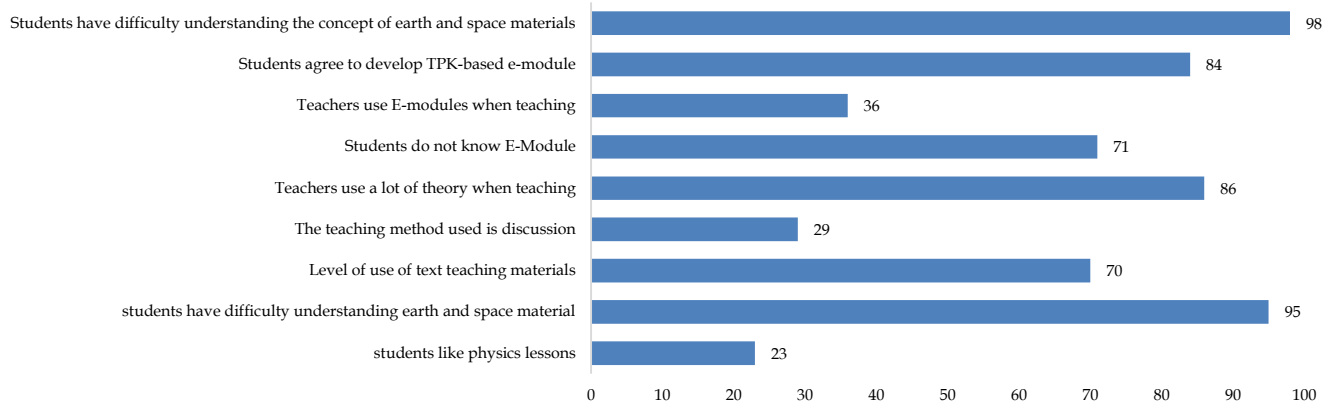

Figure 4. E-module questionnaire analysis diagram for students in Bengkulu Province

The third province that will be discussed is Bengkulu, and the results of the questionnaire administered to vocational school students are presented based on the diagram in Figure 4. Based on Figure 4, only 23% of students like physics lessons, where based on the results of the questionnaire 70% of teachers still use teaching materials in the form of textbooks, the use of e-modules is also still minimal at around 36%, and teachers' teaching is still dominated by the lecture method while the only 29% of discussions were carried out. Approximately 95% of students expressed difficulty in understanding physics concepts and 98% expressed difficulty, especially in earth and space materials. Thus, 84% of the students agreed to develop an E-module based on the Conceptual Change Theory on earth and space material.

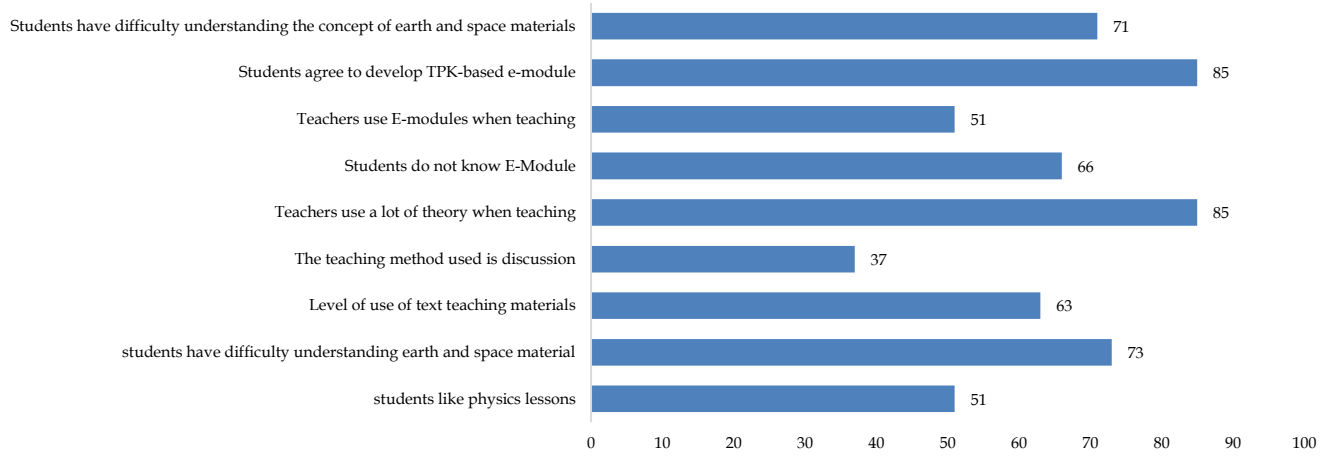

Figure 5. E-module questionnaire analysis diagram for students in Riau Province

Riau Province is the fourth province to be discussed, and the results of the questionnaire are shown in Figure 5. In Riau Province, the number of children who said they liked physics students was approximately 51%, even though the discussion method that teachers usually use is still not the maximum, only 37%, and the books used are still based only on theory, namely around 85%, the use of E-modules is still low (51 %). The students stated that 73% had difficulty understanding physics materials, especially earth and space materials, and around 71% of students still had difficulty understanding the concepts. 85% of the students stated that they agreed to develop E-modules based on the Theory of Conceptual Change to help students better understand concepts and remediate student misconceptions.

The majority of vocational school students in West Sumatra stated that they liked physics lessons, even

though they still had difficulty understanding the physics concepts. Sixty-two percent of the students stated that they had difficulty understanding concepts, especially in earth and space materials, at 62%. Based on Figure 6, we can see that the use of e-modules in the learning process is still 33%, meaning it is still relatively low; therefore, 98% of students agreed to develop E-modules based on the Theory of Conceptual Change in earth and space material.

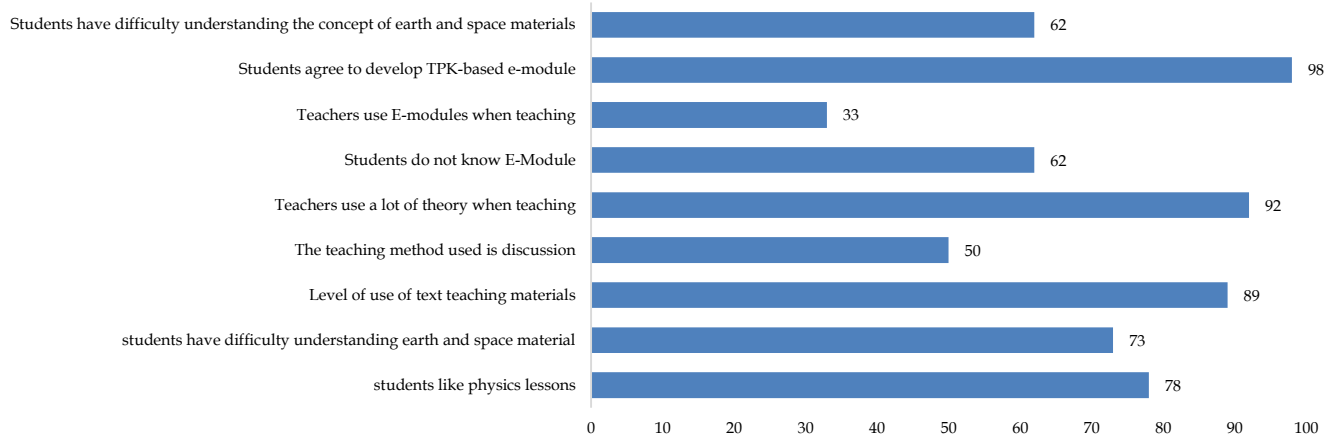

Figure 6. E-module questionnaire analysis diagram for students in West Sumatra Province

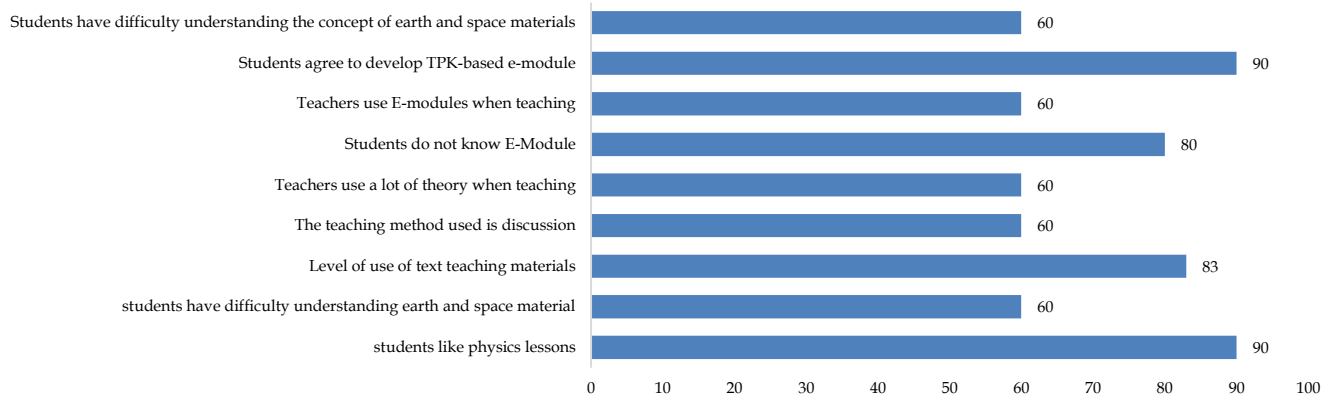

Figure 7. E-module questionnaire analysis diagram for students in Jambi Province

Jambi is the sixth province discussed in this article. Most students in Jambi Province stated that they liked physics lessons; however, like several previous provinces, students experienced difficulties in understanding physics material, especially earth and space material, and as many as 60% of students expressed difficulty in understanding concepts in earth and space material. Based on Figure 7, the level of use of e-modules in Jambi is quite high; 60% of students stated that classroom learning had used e-modules but was still unable to support increasing students' understanding of concepts. Thus, 90% of the students agreed that an e-module based on the Theory of Conceptual Change in Earth and Space materials was developed.

Conclusion

Through observations and questionnaires administered to teachers in seven provinces and students in six provinces, the results showed that the use of E-modules in schools remains minimal. Therefore, it is necessary to develop these E-modules. In addition, students also expressed difficulty in understanding the materials and concepts presented in the textbooks. The teacher also stated that the students had misconceptions about earth and space materials. Both teachers and students agreed to develop teaching materials in the form of E-modules, based on the theory of conceptual change, to help remediate students' misconceptions. The results of a questionnaire analysis involving teachers in seven provinces show that the average use of E-modules is still limited in schools, and there are still many students who say that they have difficulty understanding physics concepts, especially those related to Earth and Space Sciences. Teachers also identified that students' misunderstandings regarding Earth and space topics were still significant. Therefore, teachers and

students agree that it is necessary to develop an E-module based on Conceptual Change Theory.

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Writing original draft preparation, review and editing. All the authors have read and approved the published version of the manuscript.

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The author declares that there is no conflict of interest in publishing this article.

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