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The Practicality of Electronic Physics Module Based on Scientific Approach on Fluid Materials

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ABSTRACT
The purpose of this study is to describe the level of practicality of the electronic physics module based on a scientific approach to fluid materials. Research and development using a 4D model consisting of the stages of defining, designing, developing, and disseminating. The practicality test is carried out after the definition and design stages are completed. The research instrument is an observation sheet on the implementation of lesson plans, teacher response questionnaires, student response questionnaires, and the respondents are teachers and students of class XI MIA in one of the SMAN in Padang City. The method used is descriptive statistics to get the average value and percentage. An electronic physics module based on a scientific approach is said to be practical if the practitioner's assessment states that the module can be applied. Based on the teacher's response, the average percentage of 89.28% met the very practical category and the student's response was 78, 45% met the practical category. Overall, the average percentage of the practicality of the electronic physics module based on this scientific approach is 83.86% in the very practical category. This shows that the electronic physics module based on a scientific approach is easy to use and useful for teachers and students.

INTRODUCTION

The development of digital technology has entered the industrial era 4.0. This era makes a fundamental change in the evolution of technology that targets the gaps in all human life. Industry 4.0 is a time of big and rapid changes, broad and deep impacts that can affect business lines around the world, and changes in production, management, and control systems. The aim of Industry 4.0 is to make the production process more efficient [1].

Industrial revolution 4.0 has characteristics that combine human and computer development or what is called the digital era. Digitalization has entered every line of life and has even become part of the needs of today's fast-paced and practical life. Technological developments have a significant impact on the process of exchanging information, including in the field of education. Technology is a medium that can facilitate and help the learning process optimally. Education 4.0 is a response to the needs of the industrial revolution 4.0 where humans and technology are aligned. In the industrial revolution 4.0, technology has changed significantly in improvement, shifting certain activities to human activities [2].

Education 4.0 requires a fundamental transformation in design approaches, teaching and learning delivery, and the provision of smarter learning spaces, services, and learning tools [3]. In the industrial revolution 4.0, learning becomes borderless; students learn anywhere and have unlimited access to new information. Learning involves collaboration with team members and learning in places other than the classroom that interests them [4].

To achieve this, science activities must be relevant to students' lives with a focus on sources of knowledge, strategies, and contexts that students will encounter in real life after graduation [5]. Therefore, a transition is needed where students learn to participate in science activities that demand deeper involvement on their part. This transition is a process that depends on teachers accepting what is expected of them to replace outdated classroom models of science teaching and learning with student-centered models [6].

Physics education in the era of conventional learning is still teacher-centered; a short question and answer session at the end of the lesson with homework assignments; and face a final exam with the same problem pattern in each semester. This learning system then causes almost all students in the field of physics to have the same mindset and characteristics. Educators in the field of science are expected to be able to develop physics learning to be more effective and relevant in accordance with the demands of global needs [7].

Advances in information technology can enable physics learning in a direction that brings students in the same position as physics researchers. The development of information technology tools for physics education should be driven by a combination of educational research, curriculum development, and innovative technology. These tools are integrated into a single open environment designed for a broad educational environment. Openness means: a flexible, adaptable, and versatile system, an open problem-solving environment that requires the definition, organization, exploration, processing, and analysis of data, as free as possible from context or didactic principles, which are considered less as pedagogical tools but more as tools for carrying out physics learning activities [8].

The scientific approach is an approach or work process that meets scientific criteria [9]. The scientific approach is an activity of seeking information and testing ideas by experimentation to arrive at appropriate conclusions. In the learning process in the classroom, this approach is in accordance with the 2013 Curriculum. The learning steps in the scientific approach are observing, asking questions, experimenting, associating, and communicating [10].

Observation activities prioritize direct observation of the object to be studied so that students get facts in the form of objective data which are then analyzed according to the level of student development. It is important to encourage students to use all senses (sight, hearing, touch, smell, and taste when appropriate) to provide maximum information when observing natural phenomena [11].

In the questioning activity, the teacher guides the students to ask questions. In this activity, students create and ask questions in a question and answer activity, answer questions in a question and answer activity, discuss information that has not been understood, and discuss additional information they want to know, or as clarification. This needs to be started as a habit, so that students can ask questions independently. In this activity, there is a reciprocal process between teachers and students. Questioning is the main tool for teachers and students. Teachers can ask questions from students as a means of testing understanding of a topic [12]. When the teacher asks, at the same time he guides or guides his students to study well. When the teacher answers students' questions, at the same time he encourages students to be good listeners and learners.

Then proceed with the process of gathering information (experimenting). Students explore, through various activities such as carrying out activities as an effort to understand the material being studied, discussing with small or large groups related problems related to the material, demonstrating a tool in an activity, imitating the shape/motion exemplified in a textbook, conducting simple experiments then filling out working papers, reading sources other than textbooks to better understand the learning materials, and collecting data from resource persons through questionnaires, interviews, and modifying/adding/developing. Experimenting (trying) requires using all basic and integrated process skills [13].

In reasoning activities, students refer to the ability to group various ideas and associate various events and then enter them into fragments of memory. Students process the information that has been collected, analyze the data in the form of making categories, and associate or connect related phenomena/information in order to find a pattern and conclude. Learning activities carried out in the reasoning process are processing information that has been collected, both limited to the results of information gathering activities as well as results from observing and collecting information and processing information collected from those that add breadth and depth to information processing that is looking for solutions from various sources. sources who have different opinions to the contrary [14]. Reasoning activities can also be described as activities to process information that has been collected, analyze data in the form of making categories, associating or connecting related phenomena/information in order to find a pattern and conclude [15].

Then in communicating activities, students will convey the results of observations and communicate in learning. Students present reports in the form of charts, diagrams, or graphs, compile and present written/oral reports, and present reports covering processes, results, and conclusions in detail. Communicating activities can be done by students through words and graphic representations such as pictographs, histograms, graphs, tables, songs, models, stories, diagrams, graphs, photos, maps, symbols, illustrations, and reports [11].

Learning with a scientific approach is a learning process designed in such a way that students actively construct concepts, laws, or principles through the stages of observing (identifying or finding problems), formulating problems, proposing or formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions. and communicate concepts, laws, or principles discovered [16]. In learning, students are encouraged to find themselves and transform complex information, check new information with what is already in their memory and develop it into information or abilities that are appropriate to the environment, era, place, and time they live. A scientific approach is an approach in learning activities that prioritizes student creativity and findings [17].

This approach prioritizes inductive reasoning compared to deductive reasoning. Inductive reasoning is reasoning that looks at specific phenomena or situations and then draws conclusions as a whole while deductive reasoning looks at general phenomena and then draws specific conclusions [18]. The scientific method refers to the techniques of investigating one or more phenomena or phenomena, acquiring new knowledge, or correcting and integrating previous knowledge. To be called scientific, the method of inquiry must be based on evidence from observable, empirical, and measurable objects with specific principles of reasoning. Therefore, the scientific method generally contains a series of data collection activities through observation or experimentation, processing information or data, analyzing, then formulating, and testing hypotheses [19].

The characteristics of scientific learning are as follows: (1) Learning materials are understood with logical standards according to their level of maturity, but it is possible for students to criticize, know the acquisition procedures and even weaknesses, (2) learning interactions take place openly and objectively. Students have the widest opportunity to express their thoughts, feelings, attitudes, and experiences. However, students still pay attention to scientific attitudes and responsibilities, and (3) Students are encouraged to always think analytically and critically. Accurate in understanding, identifying, solving problems, and applying learning materials. The scientific approach is very focused on students in the learning process. Students' cognitive processes will develop because students are directly involved in learning both inside and outside the classroom [20].

The purpose of learning with a scientific approach is based on the advantages of this approach, including: (1) increasing intellectual abilities, especially higher-order thinking skills, (2) to form students' abilities in solving a problem systematically, (3) creating learning conditions in which students feel that learning is a necessity, (4) obtaining high learning outcomes, (5) to train students in communicating ideas, especially in writing scientific articles, and (6) to develop students' character [21].

The module is one of the learning media that can be used by students as a learning resource in science learning. Basically, the module is a teaching material that is systematically arranged using language that is easily understood by students according to their level of knowledge and age so that students can learn independently with minimal guidance from the teacher. Learning by using modules can make students measure their own level of mastery of the material discussed in each module unit, so that if they have mastered it, students can proceed to the next level. Conversely, if students are not able to, students will be asked to repeat and study it again. A good module is not only interesting but also must be able to foster student's curiosity about the knowledge being studied. If students have a high curiosity about learning materials, then students will be more motivated to learn so that they can improve higher-order thinking skills and student learning outcomes [22].

A module has advantages when compared to textbooks, namely in two-way communication, clear structure, friendly and motivating. The advantages of electronic modules are that they are easily accessible and more relaxed when compared to printed books that have been used in the learning process [23]. The electronic module is easy to use, capable of loading images, text, animations, videos, and assessment of learning outcomes [24]. The use of electronic modules has advantages in terms of interactivity, accessibility and can increase student learning independence [25].

Electronic modules are arranged into materials that will be delivered in the learning process that leads to the goals to be achieved, which have been clearly and specifically formulated. The purpose of learning by using electronic modules is that students can study independently, plan lessons and be able to measure learning outcomes so that learning objectives can be achieved effectively and efficiently. The teaching and learning process through the module functions to: (1) Increase learning motivation (2) Increase teacher creativity (3) Realize the principle of continuous progress indefinitely, (4) Active student learning system [26]. Teaching using electronic modules based on a scientific approach provides opportunities for students to learn according to their own style, because students have different mindsets and techniques in solving a problem based on background knowledge, experience, and personal habits [27].

Previous research conducted by Rikizaputra, Festiyed, et al., [22] showed that the development of scientific-based modules in science learning had met the valid and practical categories. In addition, research conducted by Syahroni, MW, Dewi, NR, et al., [23] shows that digital modules with a scientific approach bring a perfect linear relationship to independence and student learning outcomes by 84% and 89% in the experimental class, and 56% and 78% in the control group. Thus the digital module affects the independence and learning outcomes of students.

Fluid is one of the physics materials that have various forms of implementation in everyday life. Fluids also contain physics concepts that students can experiment with so that they can build their understanding. However, the reality on the ground shows that 63% of high school students in class XI stated that they had difficulty understanding the concept of fluid and 74% stated that they did not like the conventional method of learning physics. Problems in teaching physics can be minimized by choosing an appropriate approach. The scientific method implies student involvement that leads to understanding. In addition, student involvement in learning implies having skills and attitudes that enable them to seek solutions to questions and problems while constructing new knowledge [28].

Therefore, to find out whether or not the electronic physics module based on a scientific approach on fluid materials is necessary, it is necessary to conduct research. There are certain criteria in considering the practicality of the product such as easy to use, easy to interpret, and the right time to use [29]. This study aims to describe the practicality of the electronic physics module based on a scientific approach to fluid materials.

METHOD

This research is a research and development using a 4-D cycle model. This model consists of 4 stages of development, namely Define (defining), Design (Design), Develop (Development), and Disseminate (dissemination). In this article, we will examine the practicality of the products developed. The product developed is an electronic module of Physics based on a scientific approach to fluid materials. The e-learning technology used in this research is Moodle. Moodle is an Open Source Course Management System (CMC), which means a dynamic learning place using an object-oriented model, also known as a Learning Management System (LMS) or Virtual Learning Environment (VLE).

Furthermore, to measure the level of practicality, it can be seen from whether teachers and experts consider that the material is easy and can be used by teachers and students. Learning activities are closely related to the practicality of the material. In line with the results of previous research conducted, that the practicality that is measured is the aspect of ease of use and aspects of the presentation of the material. The ease of use aspect includes ease of understanding the material and the language used. While the presentation aspect focuses on the display [30]. The practicality of learning materials is measured based on the feasibility of learning and the management of learning activities [31].

The practicality test is carried out after the instruments and products have been declared valid. Practical criteria refer to questions about the clarity of the Physics electronic module developed, the timeliness, and the benefits of the Physics electronic module for teachers and students. The practicality of the Physics electronic module is determined by the judgment of an expert or practitioner and the fact that what is developed can be applied. In order for the product to be applied, the practical aspect is related to two things, namely (1) whether the experts and practitioners state that the developed product can be applied, (2) actually in the field the developed product can be applied with practical criteria [32].

The practicality of the Physics electronic module is seen from the results of trials in the learning process at school. The Physics electronic module developed is said to be practical if the assessment of practitioners through teacher and student response questionnaires states that the Physics electronic module can be applied. The type of data for the practicality test is qualitative data. In collecting information about the practicality of the developed Physics electronic module, an observation sheet on the implementation of lesson plans was used, teacher response questionnaires and student response questionnaires. The data from the observation of the implementation of the lesson plans were obtained from the observation sheets of the implementation of the lesson plans obtained from one observer at each meeting in the trial class. The teacher's response questionnaire was given to find out the teacher's response to the physics electronic module that had been developed, while the student response questionnaire was given to all students in the research class concerned to find out student responses about the practicality of the scientific approach-based physics electronic module that had been used.

Analysis of the research data was carried out to describe the level of practicality of the Physics electronic module that had been made. The research data were analyzed using descriptive statistics to get the average value and percentage. The data analysis technique used is descriptive data analysis, namely by describing the practicality of scientific-based physics electronic modules on fluid materials.

The practicality category of the Physics electronics module is based on the final score in the interval as presented in Table 1 below.

Table 1 Product Categories and Practicality Intervals [33]

Intervals	**Category**
0 ≤x< 20	Very impractical
21≤x< 40	Not practical
41≤x< 60	Less practical
61 ≤x<80	Practical
81≤x< 100	Very Practical

RESULTS AND DISCUSSIONS

Practicality is carried out to test the usability of the Physics electronic module by teachers and students by carrying out learning using the revised Physics electronic module based on an assessment by the validator. Practical data was obtained from observations made by observers. Analysis of the data obtained from the observations of the implementation of the lesson plans at the four meetings is presented in Figure 1.

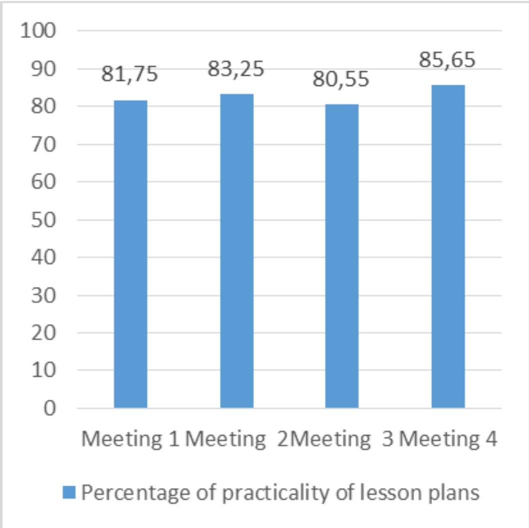

Fig 1. *Results of the Percentage Analysis of the Practicality of the Implementation of the RPP for Each Meeting*

The results of the implementation of the lesson plans for each meeting are in the very practical category, with an average practicality percentage of 82.80% meeting the very practical category. The practicality of the Physics electronic module can also be seen from the teacher's response questionnaire and student responses. Consideration of the practicality of the product such as easy to use, easy to interpret, and the right time to use [29]. Usability means that teachers and students can use the products made, while applicability refers to products that can be used by teachers to convey physics topics in learning conditions.

The teacher's response questionnaire was given to determine the teacher's response to the Physics electronic module that had been developed. The questionnaire was filled out by one of the Physics teachers. The questionnaire that was compiled consisted of a lesson plan practical sheet, an electronic physics module, and an assessment. The results of the teacher response questionnaire data analysis are presented in Figure 2.

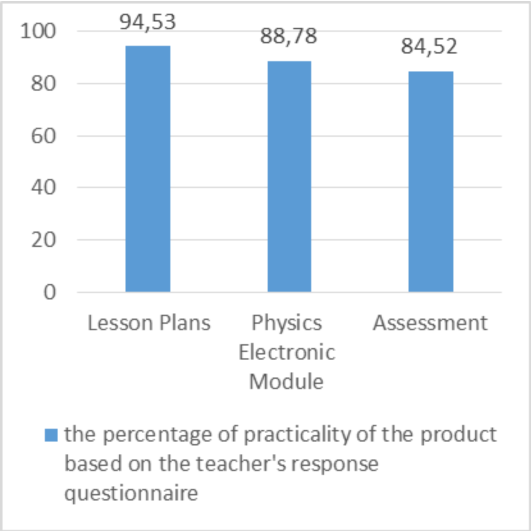

Fig 2. *Results of Practicality Percentage Analysis Based on Teacher Response Questionnaires*

The teacher's assessment of the Physics electronic module is based on a scientific approach to fluid material that has been developed as an average value of 89.28% in the very practical category. The results of the teacher response questionnaire can be seen that the average percentage of teacher responses to the lesson plan is 94.53%; physics electronic module 88.78%; and 84.52% of the assessment instruments used are in the very practical category. This shows that the electronic physics module based on a scientific approach to high school fluid material can support teachers in teaching activities.

One of the advantages of this scientific approach-based Physics electronic module is by applying the steps of a scientific approach that bridges the 2013 Curriculum so that the learning process is no longer teacher-centered but student-centered and it is hoped that the quality of learning will be better. The quality of learning can be improved by changing the pattern of learning activities/steps [34]. Students are led to solving physics problems by finding their own concepts through experiments.

There are five stages in this learning step. Starting with the observing stage to encourage students to explore as shown in Figure 3.

Fig 3. *Exploration at the observing stage*

Students can explore using objects, situations, or conditions that are familiar with students' lives through pictures, videos, or real examples, so that the cognitive load that students often face when encountering things that are not familiar with them can be reduced [35]. It is important to encourage students to use all senses (sight, hearing, touch, smell, and sense of the moment) to provide maximum information when observing natural phenomena [11].

Furthermore, in the questioning stage where the teacher motivates students by asking open-ended questions as presented in Figure 4.

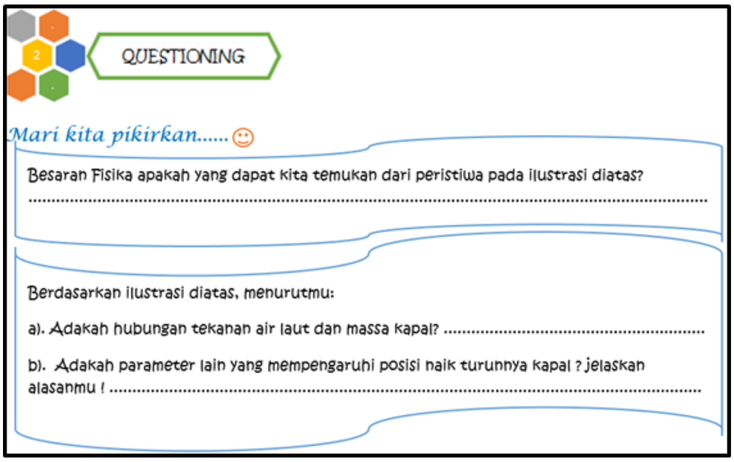

Fig 4. *Open questions at the questioning stage*

Motivation is needed in learning. Motivation becomes a process that explains the intensity, direction, and persistence of an individual to achieve his goals [36]. Then questions are given as an effort to base critical thinking. Questioning becomes the main tool for teachers and students. Teachers can ask questions from students as a means of testing understanding of a topic [12]. When the teacher asks, at the same time he guides or guides his students to study well. When the teacher answers students' questions, at the same time he encourages students to be good listeners and learners. Students can explore their prior knowledge and then develop a learning experience. Teachers can also appreciate students' prior knowledge as a potential that students have. The initial knowledge possessed by students is the result of the exploration of knowledge, ideas, or conceptions obtained from everyday experience [37].

Then in the experimenting stage students carry out the scientific process in the form of experimental activities, literature studies, and discussions as shown in Figure 5.

Fig 5. *Group discussion and experimental activities at the experimenting stage*

At this stage, students have the opportunity to investigate various strategies and ways that they believe in [38]. By discussing students can hone their communication and analysis skills, as well as experimental activities to support the effectiveness of science and learning experiences [39]. This will give students the opportunity to express their ideas. Experimenting (trying) requires using all basic and integrated process skills [13].

Furthermore, at the associating stage students will process the information that has been collected, analyze the data in the form of making categories, and associate or connect related phenomena/information in order to find a pattern and conclude [14]. The associating stage can be seen in Figure 6 below.

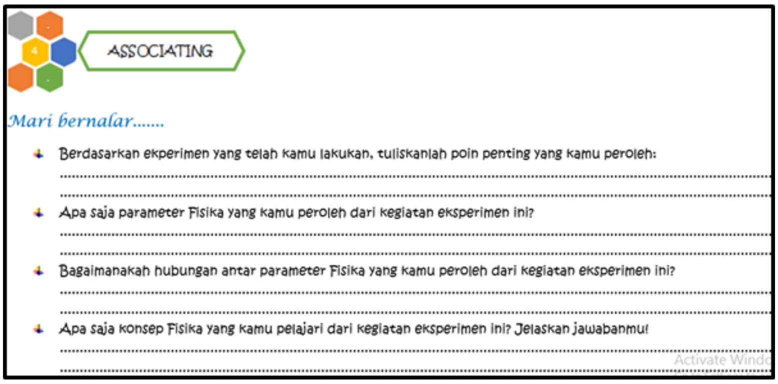

Fig 6. *Associating stage*

Then at the networking/communicating stage, students present reports in the form of charts, diagrams, or graphs, compile and present written/oral reports, and present reports covering processes, results, and conclusions in detail [11]. Communicating activities can be done by students through words and graphic representations such as pictographs, histograms, graphs, tables, songs, models, stories, diagrams, graphs, photos, maps, symbols, illustrations, and reports. The networking stage can be seen in Figure 7 below.

Fig 7. *Networking stage*

In this phase, planting the concept will be the goal in every lesson. If students do not have concepts, then they will have difficulty formulating problems and cannot even solve problems. Concepts help students simplify and summarize information and improve students' memory, communication, and time use efficiency [39]. In addition, good communication between teachers and students will result in better learning quality [40].

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Student response questionnaires were given to all students in the relevant research class to determine the practicality of the Physics electronic module based on a scientific approach to the fluid material that has been used. The results of the student response questionnaire data analysis are presented in Figure 8.

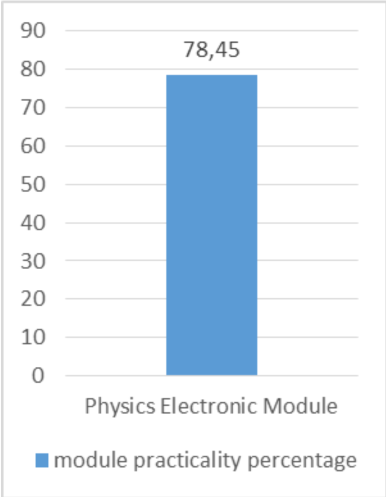

Fig 8. *Results of Practicality Percentage Analysis Based on Student Response Questionnaires*

The results of the analysis of student responses to the Physics electronic module are based on a scientific approach to fluid materials that have been developed with an average value of 78.45% in the practical category. Electronic modules are arranged into materials that will be delivered in the learning process that leads to the goals to be achieved, which have been clearly and specifically formulated. The purpose of learning by using electronic modules is so that students can study independently, plan to learn, and be able to measure learning outcomes so that learning objectives can be achieved effectively and efficiently [26].

A good module is not only interesting but also must be able to foster student's curiosity about the knowledge being studied. If students have a high curiosity about learning materials, then students will be more motivated to learn so that they can improve higher-order thinking skills and student learning outcomes [22]. Teaching using electronic modules based on a scientific approach provides opportunities for students to learn according to their own style, because students have different mindsets and techniques in solving a problem based on background knowledge, experience, and personal habits [27].

The percentage of student responses to the Physics electronic module based on a scientific approach is the highest indicator of the ease of use of instructions in the Physics electronic module based on a scientific approach to Fluid material for students as much as 82.45%, then the indicator of student interest in learning using the electronic module of Physics based on a scientific approach to Fluid material is 80,78%, and the ease with which students solve problems in the material for the electronic physics module based on a scientific approach to fluid material is 77.45%. It is hoped that the learning process can change student behavior, and assume that the behavior change is a result of the interaction between stimulus and response [41].

In general, the percentage of the practicality of the Physics electronic module based on a scientific approach to fluid materials per indicator based on student response questionnaires is presented in Figure 9.

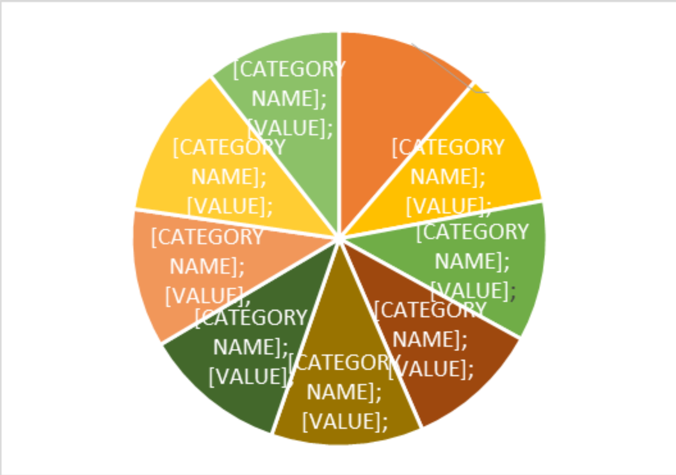

Fig 9. *Results of Percentage Analysis of Practicality of Electronic Physics Modules Based on a Scientific Approach to Fluid Materials per Indicator Based on Student Response Questionnaires*

The practical indicators of the Physics electronic module based on a scientific approach to fluid materials in student response questionnaires are presented in Table 2 below.

Table 2. Practical indicators of the Physics electronic module based on a scientific approach to fluid materials

No	Aspects of assessment
1	Can the questions in the Physics electronic module based on the scientific approach of Fluid matter be done well?
2	The use of Physics electronic modules based on a scientific approach to fluid materials can accelerate the understanding of material facts, concepts, principles, and procedures
3	Learning using an electronic module of Physics based on a scientific approach to fluid materials can make you satisfied with the knowledge of facts, concepts, principles, and material procedures.
4	The questions in the Physics electronic module based on a scientific approach can lead to solving problems based on the concept of Fluids
5	This electronic physics module based on a scientific approach to fluid material is interesting to study.
6	Physics electronic module based on a scientific approach to this fluid material is interesting to read.
7	The use of the Physics electronic module based on a scientific approach to fluid materials can facilitate the understanding of facts, concepts, principles, and material procedures
8	The instructions in the Physics electronic module based on the scientific approach to Fluids are easy to understand.
9	The problems in the Physics electronic module based on a scientific approach to this fluid material are simple and interesting to learn.

Indicator number 4 about the ease of questions in the electronic module of Physics based on a scientific approach can lead students to solve problems based on fluid concepts, as presented in Figure 9 actually gets the lowest score of 71.25%. This shows that the questions in the physics electronic module based on a scientific approach are not enough to find the fluid concept. The reason is that students are not used to doing learning independently, because usually they are always given a direct explanation by the teacher about the material being studied.

In general, from the results of this data analysis, it can be concluded that by using the electronic physics module based on a scientific approach to fluid material, students can be motivated to take lessons. This product helps students to solve Physics problems because students are directly involved

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in constructing their knowledge.

CONCLUSION AND SUGGESTION

The practicality of the Physics electronic module based on a scientific approach to fluid material based on the teacher's response obtained an average percentage of 89.28% meeting the very practical category and 78.45% student responses meeting the practical category. Overall, the average percentage of electronic physics modules based on scientific approaches is 83.86% in the very practical category. The very practical category shows that this module is easy to use, easy to interpret, the time used is right and it is useful for teachers and students.

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