Effectiveness of physics electronic modules based on Self Directed Learning Model (SDL) towards the understanding of dynamic fluid concept

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Abstract. This study aims to determine the effectiveness of electronic modules based on the self-directed learning (SDL) model in helping students of Al-Azhar 3 High School Bandar Lampung to understand the concept of dynamic fluid. The research conducted is a poor experiment research, with static group comparison design. Two samples, the experimental class, and the control class were selected in this study with purposive sampling techniques. Hypothesis testing uses Mann Whitney Hypothesis Test and Effect size test with the help of SPSS tools. The hypothesis test results show that the sig value is 0.00. The sig value ≤0.05 and the effect size test result is 1.736895962, where d>0.8, so the effectiveness of the electronic module is high. So the hypothesis is accepted, or the use of electronic physics modules based on the self-directed learning model is effective in helping students of Al-Azhar High School 3 Bandarlampung to understand the concept of dynamic fluid. So this electronic physics module is proven to be able to answer students' needs for learning resources that make it easy for students to understand the concept of dynamic fluids that are following the demands of the times and learning needs in the 2013 curriculum.

1. Introduction

Learning is a process of change from not knowing to knowledge in various fields[1], so, the interaction will be formed from various components of a system. [2] One of these components is a learning resource. Learning resources are tools or goods that are used to support the learning process.[3] The role of learning resources is to make learning more effective and efficient.[4] Therefore, the learning resources used must be interesting, fun, and up-to-date. The development of the age of the 21st century entered the era of industrial revolution 4.0, which resulted in the development of technology and information so rapidly that it became potential in improving the quality of education. [4] To improve the quality of education, innovations must be carried out by educators [5] The innovation must be in accordance with the wishes and current development, in education in Indonesia, these innovations must be adapted to the 2013 curriculum. Ministry Education of Indonesia policy Number 21 A 2013 explained about the learning-oriented approach or student-centered approach. [6] so that innovation in learning resources must be able to help educators and students to carry out learning according to that approach. One learning resource that can support implementing learning is a module. Modules are one of the learning materials that are designed systematically based on a particular curriculum, packaged in the form of the smallest learning unit,
and studied independently in a certain time[7] The advantages of the module are that the module can help students in independent learning, learning becomes interesting because it can be done outside the classroom, helping students expressways of learning according to their interests and abilities, testing skills from learning outcomes with practice questions in the module, and allowing students to develop their ability to interact with the environment and learning resources. [8]

The current module is not just a print module, due to technological advancements, the print module develops into an electronic module. The electronic module is one of the independent learning materials arranged systematically in the smallest learning unit to achieve learning objectives presented in an electronic format in which there are animations, audio, and navigation that make the electronic module more attractive [9]. Electronic module is a manifestation of a multimedia-based module that is able to present information factually, conceptually, effectively and efficiently so that learning is more interesting and able to motivate students because learning material is not only in the form of text but contains images, audio, video, and animation so that Multimedia-based learning is very helpful in learning abstract physics.[10][11][12][13][14]

Physics learning In addition to being supported by appropriate learning resources, it also must be supported by learning models that suit your needs. Because, the use of learning models as patterns or designs in learning is useful for forming curriculum and long-term learning, designing learning materials, and guiding learning in achieving learning goals efficiently.[15] Based on the demands for student-centered learning in the 2013 curriculum, there is one model that is considered capable of assisting independent learning, namely the self-directed learning model. The self-directed learning (SDL) learning model allows students to do independent learning; independent learning is the process by which students involved in identifying what needs to be learned and holding control to find and organize answers[16], the ability to learn independently with learning resources that support is certainly very helpful to teachers and students in learning

However, when observing a school in Lampung, there are problems in the learning process Based on the pre-research results by distributing questionnaires to 40 students at Al-Azhar High School 3 in Bandar Lampung, 85% said they did not like physics, because physics is difficult to understand. The use of printed books has not been able to help students to understand the lesson. The limitations of the introduction of electronic learning resources also lack, so that 95% of students expect an effective and efficient electronic learning resource to help students understand the lesson.

Based on pre-research using interviews with physics teachers, the low interest of students in studying physics caused by physics lessons is considered difficult by students. The implementation of learning strategies cannot run well because learning resources cannot support the learning model. While the demands on the learning curriculum must be centered on students, so that learning resources are still needed to help educators in delivering learning effectively and efficiently, following the demands of 2013 curriculum.

Based on the pre-research through interviews with students, they consider physics difficult to understand, especially in dynamic fluid, because it consists of difficult formulas. Learning by using printed books in school is considered to be not practical and not efficient, so modules are needed because it is more practical and can be taken anywhere. When given the task, students found it difficult because the students didn’t know how to solve it. Students' lack of understanding of concepts and the need for learning resources that can be accessed at any time is the reason.

So, Based on the above problems, it is known that effective, practical, and efficient learning resources are needed that are tailored to the needs of students and teachers to help students understand the concepts of physics in a dynamic fluid material. The learning resources are also adjusted to the times and by the needs of the 2013 curriculum. Therefore, researchers suspect the use of learning resources in the form of electronic modules that have been described above is expected to be a solution to the problems at the school, so the researcher conducts research to find out whether physics-based electronic modules are based effective self-directed learning (SDL) learning model on helping students understand dynamic fluid concepts of Al-Azhar High School 3 Bandar Lampung?
2. Methods

The research method used in this study is poor experimental designs. The design of this study is the static comparison group design

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This research was conducted in class XI Science 2 (experimental class) and class XI Science 4 (control class) Al-Azhar 3 Bandar Lampung. The sample selection uses purposive sampling technique [17]

3. Results And Discussion

The study was conducted in two different classes, namely the experimental class and the control class. The experimental class uses a self-directed learning model that is a learning model that pressures students to do independent learning supported by electronic physics modules and in the control class uses the same learning model supported by physics print books. The electronic physics module used is an electronic module that has been validated by an expert. In the physics module, electronics material is not only presented with text but uses videos, animations as well as interactive quizzes in it. Following is the display of the physics electronics module and physics textbook..
The first known research result is an observation result of the implementation of learning conducted by an observer, a physics subject teacher at the school. The results of the study are presented in the following table:

**Table 1. Recapitulation of the observation sheet of the implementation of learning**

| No. | Meeting to | Amount obtained |  | Maximum number of percentages |
|-----|------------|-----------------|---|-------------------------------|
|     |            | Experimental class | Control class |                             |
| 1   | Meeting 1  | 65              | 65            | 75                           | 86.67%                       |
| 2   | Meeting 2  | 70              | 70            | 75                           | 93.34%                       |
|     | Total      | 135             | 135           | 135                          | 180%                         |
|     | Average    | 67.5            | 67.5          | 67.5                         | 90%                          |
From the above data, the results of observations of the implementation of experiments and controls are the same. that is, at the first meeting based on the results of observations, it is known that the number obtained was 65 out of a maximum of 75 with a percentage of 86.7%. At the second meeting found the results that the total value of 70 with a maximum value of 75 and a percentage of 93.34%. So we get an average yield of 67.5 from the maximum number of 75 with an average percentage of 90%. From the data above, we know that the treatment of classroom actions carried out by researchers is the same. Adjusted to the sequence of learning implementation plans that have been prepared based on the model used and has been validated by experts, here the experimental class uses a self-directed learning model that is a learning model that pressures students to do learning independently supported by electronic physics modules and in the control class using learning design that has been validated with the same model that is a model of self-directed learning with physics learning textbooks learning resources. Furthermore, to know the students' understanding of the concept, do a post-test with the students working on multiple-choice questions with a two-tier test method of 10 questions with four answer choices accompanied by reasons. So we get the average yield learning the experimental class and control class as follows:

Table 2. The average Score

| The average score | Experiment class | Controls class |
|-------------------|------------------|----------------|
|                   | 80,40404         | 54,70588       |

Further analysis results understanding of the concept of participants to obtain the following results:

Table 3. Summary of students' understanding of the concept's profile based on the results of the posttest

| Category                  | Experiment class | Controls class |
|---------------------------|------------------|----------------|
| understanding(M)          | 83.06%           | 57.89%         |
| Not understanding (TM-1)  | 4.79%            | 17.88%         |
| Not understanding (TM-2)  | 1.07%            | 3.03%          |
| Understand some (MS-1)    | 3.15%            | 3.30%          |
| Don't understand (TM-3)   | 8.40%            | 12.13%         |

From the table above we know that the results of the answers to the concept understanding questions are that if the answer is correct and the reason is correct then students understand the concept, as much as 83% of students in the experimental class understand the concept, and in the control class it is known that only 57% of students understand the concept. Explained by the graph above shows the difference in understanding of the concepts in the two classes where the experimental class using electronic modules has a higher percentage than those using printed books. Its happens because when viewed from learning it is known that in the experimental class learning using electronic modules is more interesting and interactive because the explanation of the material using electronic
modules is deeper because the electronic module contains explanatory descriptions along with pictures and is added with learning videos that help students to understand concept better. Because learning videos according to research from Tri Nurul stated that learning using learning videos increases student understanding of concepts and provides positive responses to learning.[18] Next, examples of questions are given in video format, and there is an interactive quiz. Whereas in the control class understanding using printed books there are a lot of complaints from students who state the description in the book uses language that is difficult to understand, the appearance is less interesting to make students bored, and this is what makes students in the control class understand fewer concepts.

At the level of students do not understand (TM-1) seen from students who answer incorrectly with the wrong reasons so that they do not understand the concept, in the experimental class known TM-1 as much as 4.79% do not understand the concept, and in the control class as much as 17.88% of students do not understand the concept. It seems that the control class is more students who do not understand the concept of physics — clarified with a graph the difference can be seen. Why do more control classes answer that do not understand the concept because, as explained above, understanding that using printed books is difficult so that printed books are not effective for independent learning.

At the level of not understanding (TM-2) seen from students who answered questions with incorrect answers and reasons not filled, in the experimental class, it was found that 1.07% and in the control class was 17.88% who did not understand the concept. At this level of concept understanding, it can also be seen that not understanding the concept in the control class is greater than the level of conceptual understanding in the experimental class. Why do control classes answer more that they do not understand the concept because, as explained above, it is difficult to understand using printed books when printed books are not effective for independent learning that helps students to understand the concepts of physics.

At the level of understanding the concept of the part (MS-1) seen from students who answered the questions with the correct answers and wrong reasons, in the experimental class found as much as 3.15% of students understood the concept in part and the control class 3.30% of students understood the concept in part. Seen from the data above in the two classes are balanced at the level of partial understanding of concepts because the level of understanding in part on students is influenced by the provision of second class learning the same observational results, because the level of understanding is different for each student and part of this understanding is because the answer is correct and the reason is wrong because the students also answered randomly or without knowing reason.

At the level of not understanding the concept (TM-3) seen from students who answered the questions with answers that did not answer the test questions, in the experimental class found as much as 8.40% did not answer and the control class as much as 12.13% did not answer the questions. At the level of not understanding, it can be seen that the control class has a greater percentage of not answering questions than the experimental class. Why do control classes answer more that they do not understand concepts because, as explained above, understanding that using printed books is difficult so that printed books are not effective for independent learning in understanding concepts? Based on the results of the average learning and analysis of students' conceptual understanding of the experimental class, the average is greater than the control class.

Based on the above classification, it appears that learning in the experimental class using electronic physics modules the percentage of those who understand the concept is higher than those who do not understand the concept compared to the control class that uses physics learning textbooks. Based on these results, it is known that for the use of electronic modules students can help students to understand the concepts of physics. It is in line with several studies that have been conducted by several researchers who stated that the physics electronics module could help students to understand the concepts of physics.[19][13][14]

From the learning outcomes to test the students' understanding of the concepts. Then to find out the effectiveness of the electronic module is carried out data analysis with data normality test and data homogeneity. From these results, the data will be tested next to the hypothesis data. Following are the results of data analysis:
Table 4. Test Resultsnormality Post-test experimental class and control class

| Criteria of the | Experimental class | Control class |
|-----------------|--------------------|---------------|
| Total           | 33                 | 34            |
| Average         | 80.40404           | 54.7059       |
| Standard Deviation | 10.67135931      | 16.6185        |
| L Table         | 0.154232803        | 0.15195        |
| L Calculate     | 0.242064503        | 0.43894        |
| Variants        | 122.4814815        | 276,173        |

Conclusions Abnormal Abnormal

Table 5. Test results of students’ understanding of the concept of

|                  |                  |
|------------------|------------------|
| F Table          | 1,777406943      |
| F calculate      | 1,307735241      |

Conclusion homogen

Given that the results of the data are not normal and are not homogeneous, namely that the hypothesis test using test MannWhitney that shows that sig of 0.00. The value of sig ≤ 0.05, which means the use of electronic physics modules, is effective in understanding concepts and to know the level of effectiveness of electronic physics modules is carried out atest effect size, and the results obtained are 1.736895962. If the results obtained, d> 0.8, so the effectiveness is high criteria.[20] So that the effectiveness of electronic modules is high criteria. So the use of electronic physics modules is effective in helping students understand the physics concepts, which are solutions to problems in pre-research. Where the difficulty of students in learning and understanding physics concepts, especially the discussion of dynamic fluids can be assisted with electronic physics modules based on a self-directed learning model, supported by the results of hypothesis testing which shows that the use of electronic physics modules based on electronic physics modules is effective in helping students understand the concept of dynamic fluids with high effectiveness criteria. So this electronic physics module is proven to be able to answer students' needs for learning resources that make it easy for students to understand the concept of dynamic fluids that are under the demands of the times and learning needs in the 2013 curriculum.

4. Conclusions And Suggestions

4.1 Conclusions

Based on the results of research on “Effectiveness of Physics Electronic Modules Based on Self Directed Learning Model (SDL) towards The Understanding of Dynamic Fluid Concept” it can be concluded that the use of electronic physics modules based on self-directed learning model is effective in helping students in Al-Azhar 3 high school Bandar Lampung to understand the concept of dynamic fluid. So the use of electronic physics modules is effective in helping students understand the physics concepts, which are solutions to problems in pre-research. Where the difficulty of students in learning and understanding physics concepts, especially the discussion of dynamic fluids can be assisted with
electronic physics modules based on self-directed learning model. Supported by the results of hypothesis testing which shows that the use of electronic physics modules based on electronic physics modules is effective in helping students understand the concept of dynamic fluids with high effectiveness criteria. So this electronic physics module is proven to be able to answer students' needs for learning resources that make it easy for students to understand the concept of dynamic fluids that are following the demands of the times and learning needs in the 2013 curriculum.

4.2 Suggestion
Based on the research, the researchers have several suggestions for future improvements, namely:

a. it is expected for physics teachers to use and develop similar electronic modules on other materials.

b. The need for further research in this study in order to develop better electronic modules that can be adapted to the needs of the times.

c. In this study only reached the conceptual understanding stage which is expected to be improved in the next stage, namely the level of HOTS

d. This research has only been carried out in one school so it is hoped that there will be further research in other schools.

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