Unveil E-Module Global Warming based on Problem Based Learning to Improve Students' Higher Order Thinking Skills (HOTS)

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The E-module has been developed based on the global warming problem based learning to improve students' Higher Order Thinking Skills (HOTS). The research method refers to the Borg and Gall research model which includes ten steps. Compiled using the 3D Page flip Professional 1.7.7 software and its contents using several software, namely Microsoft Office, CANVA and I Spring Suite 8. The results showed that the feasibility of the material experts obtained an average percentage of all aspects at 84%, media experts 72% and learning experts by 78% included in both categories. The effectiveness test results obtained N Gain of 0.63 which shows that the Global Warming e-module can improve the ability of HOTS students in the medium category. The results of the field test questionnaire filled out by students get a 82% percentage with very good interpretation. Based on the effectiveness test it can be concluded that the e-module is feasible and can improve students' HOTS abilities.

Key words: E-Module, Problem Based Learning, Global Warming, Higher Order Thinking Skills (HOTS)

Introduction
Environmental problems lately become the main thought in the education process as an effort to make the environment sustainable (Kılış, 2016). In anticipating the use of science and technology that is developing very fast, so that the educational process strived for the environment as a reference so that environmental sustainability is guaranteed (Dagiliütü, & Liobikienė, 2015). One of the themes that is very influential today as a cause of environmental change is global warming so that in the teaching curriculum many learning models are needed so that understanding of the environment becomes the object of formal
learning with an optimum outcome (Freije, et al., 2017). The topic of global warming triggered by many variations including the greenhouse effect has begun to receive attention since the 1970s as part of environmental issues. The topic of global warming pops up amid the rapid population growth, the threat of several flora and fauna species, the oil and energy crisis, and the problem of waste. However, this topic had sunk for more than 20 years, then reappeared at the end of the 20th century, along with the occurrence of an energy crisis due to the depleting oil reserves (Shafiullah, et al., 2012).

The implementation of the revised 2013 curriculum provides guidelines for a dynamic learning process, so that a better educational process can be achieved. The 2013 curriculum requires independent and student-centered learning, where the teacher becomes a motivator, the facilitator is no longer the main source of learning for students. Regarding the learning model that supports the implementation of the 2013 curriculum, it was initiated by the Ministry of Education and Culture Regulation No. 65 of 2013 concerning Education Process Standards. One of the preferred learning models in the implementation of the 2013 curriculum is the problem based learning model or problem based learning.

Another variable that is the center of attention on education and teaching is the role of ICT, will determine success in education. The last decade shows the role of ICT is very dominant even one of the characteristics of the 21st century learning model blended learning is a combination of face-to-face methods in the classroom with the use of digital media and online media. In the 21st century learning, technology is mandatory (Spector, et al., 2016). Information technology and communication systems are commonly used in education and learning. The influence of technology and information on the quality of education is very significant, because students will more easily access learning material, faster, more, and vary from various learning sources (Owen, et al. 2017).

The process of understanding the environment becomes important related to human behavior in the form through the process of education and teaching while welcoming the development of science and technology that is developing so fast. Among them, multimedia learning applications can present high-level concepts and skills in learning, which have a link between one element and another and are difficult to teach through books alone. The advantages of interactive multimedia learning applications in explaining a concept can try to explore the concepts and principles contained in a material that it faces (Chiu, & Churchill, 2015), so that it can relatively quickly build the understanding structure of students to explore and analyze try and explore the concepts and principles contained in a material that it faces , so that it is relatively faster to build the understanding structure of students, because integrated components such as sound, text, animation, images, and video function to optimize the role of the senses into the memory system (Cao, & Ali, 2018).

Mastery of concepts that can be obtained from multimedia can help improve higher-order thinking skills. But not necessarily able to apply in everyday life. For this reason, in the learning process, higher-order thinking skills need to be trained and developed. Then we need an educators' creativity in developing multimedia by using a learning model that can facilitate students to develop higher-order thinking skills (Khan, & Masood, 2015). The learning model
that is considered appropriate is Problem Based Learning (Smith, 2014).

Problem Based Learning Model students are required to solve the problems presented by digging up as much information. This experience is very necessary in daily life where the development of one's mindset and work patterns depends on how he learns himself. The teacher presents learning in class with real-world problems, encourages open class discussion, and fosters experiment-oriented experiments, it will foster the ability of Higher Order Thinking Skills.

Based on observations and surveys conducted at physics teachers in senior high schools in Indonesia, it is shown that 80% of students' higher-order thinking skills have not yet been developed by teachers. One of the main causes is the teacher's difficulty in developing learning resources that can train students' higher-order thinking skills. Learning resources in the form of textbooks that are currently used to less train higher-order thinking skills.

One learning resource that can be used to motivate and encourage students is an e-module that integrates sound shows, graphics, images, animations, and films can even display a virtual laboratory so that the information presented is richer compared to conventional books, because the images displayed not only in the form of still images, but already using videos and animations that can involve the user (Roblyer, 2013). Various efforts are still needed to optimize the use of e-modules in the learning process (Serevina, et al., 2018; Sari, et al., 2019).

Learning e-modules generally originate from electronic bookkeeping centers issued by the government, and are not yet interactive so they are only read like ordinary textbooks (Sholeha, et al., 2019). This fact was found in the field from the results of preliminary studies in high schools in Greater Jakarta. The results of a preliminary study show that from a variety of media e-modules are very minimal in their use, it is proven that almost 90% of teachers have never used e-modules in the learning process. When asked about the need for the development of the Problem Based Learning e-module the majority of teachers stated that it was necessary to develop the Problem Based Learning e-module to add insight to students and increase student interest in the subject matter.

The e-module is also a complete and practical learning resource for students. The teachers also hope that the e-module development is in accordance with the material in the applicable curriculum, and the language used is also easier to understand. When asked whether the teacher trained students' high-level skills in learning, all respondents said they had never (Serevina, et al., 2018; Sari, et al., 2019). Based on the results of filling out student questionnaires totaling 136 respondents in Indonesia, it is known that the majority of students (77.7%) use learning resources in the form of texts from certain publishers. Other data obtained is that most of the 75.5% students experienced limitations in the learning process of global warming material.

To overcome this problem, it is necessary to do learning innovations that can be used by students in independent learning. One way is to develop teaching materials that can train higher-order thinking skills with certain software in the form of e-modules (electronic modules). The use of teaching materials in the form of e-modules with multimedia concepts
in electronic format is used instead of books or hardcopy modules without reducing its function as a source of information. With the use of teaching materials in the form of e-modules it is expected to provide renewal in learning (Shafiullah, et al., 2012). Modules are one form of teaching material that is packaged in a whole and systematic way, which includes a set of planned learning experiences and is designed to help students master specific learning goals. Modules contain a minimum of learning objectives, learning material or substance, and evaluation. The module functions as a means that is independent, so students can learn independently according to their respective speeds. While the electronic module is a form of presentation of independent learning materials that are arranged systematically into smaller learning units to achieve certain learning objectives presented in an electronic format in which there are animations, audio, navigation that makes users more interactive with the program.

The electronic module was developed using Flip Book software. Flip Book or Flipping "Flip Book is one type of classic animation made from a stack of paper resembling a thick book, on each page the process is described about something that later the process looks moving or animated." While quoted from a website page http://Flipbook.info stated: "Flip Book is a collection of combined images intended to reverse to give the illusion of movement and make an animated sequence of a simple booklet without a machine." With this software, there is an editing function allows users to add videos, images, audio, hyperlinks and multimedia objects to pages that can be flipped through like an original book. However, the unveil E-Module based on Problem Based Learning about Global Warming to improve students' Higher Order Thinking Skills (HOTS).

**Methodology**

This research uses research and development methods or Research and Development (R&D). While the development model used refers to the Borg and Gall formula which consists of ten steps. The first step is research and information collecting or research and data collection. At this stage the researcher collected data and information to determine the needs in the learning that would take place. The steps taken are conducting literature studies and field surveys. Literature study is conducted to find out information that has a relationship with the research to be conducted, both material and media that will be developed. Field surveys are conducted to find information on the problems faced by educators and students in the physics learning process. In the field survey needs analysis is carried out, namely conducting interviews with physics teachers, curriculum analysis implemented in schools and material analysis (Borg, et al., 1998).

The second step is planning. At this stage the researcher compiles a research plan, starting from determining the objectives and benefits of making e-modules, determining core competencies and basic competencies, formulating objectives to be achieved, as well as design or research steps. The third step is developing the preliminary form of the product or developing the product draft. At this stage the researchers created a product design plan and began designing e-modules with Canva applications, Microsoft Office, Flip Page Professional
1.7.7 and I Spring Suite 8.
The fourth step is preliminary field testing. The next step after developing the initial product is to conduct a validation test by experts, namely material and media experts. Validation is the process of product evaluation by experts in accordance with their fields to determine whether a product is feasible or not.
The fifth step is to play product revision or revision of the trial results. After the due diligence is done, if there are still parts that are not in accordance with the standard, then it needs to be revised according to the validates input. This revision aims to get good media before field trials. The sixth step is playing field testing. After revising the initial product, a validation test was conducted by a high school physics teacher. The seventh step is an operational product revision or improvement of the product of field test results. At this stage the researcher makes improvements or revisions based on input from the results of the validation test conducted by high school physics teachers. The eighth step is operational field testing. At this stage the real class will be tested with 30-37 respondents. In this trial phase, students are asked to make the learning process using the e-module that has been developed, before starting the study conducted pretest and after learning to use the e-module post-test, then at the end of learning gives a questionnaire to find out the input about learning that has been done.
The ninth step is the final product revision. After testing the actual class, it can be seen the response of students as users of the e-module that was developed. This is done to make the final product better and more suitable for use. After making revisions for the third time, then a product that is suitable and suitable for the needs of students, educators, and schools is obtained. The product can be used in the learning process both inside and outside the classroom independently. Students can use it anytime and anywhere. The final product obtained in this development is a problem-based learning based e-module on global warming material for high school students.
The final step is dissemination and implementation. Products that have been developed will then be disseminated, so they can be used by educators and students. The e-module distribution is done through the internet and can be downloaded for free by educators and students who need it.

Results and analysis

The products produced in this research are e-modules based on problem based learning about global warming material. This e-module presents four material sub-chapters, namely the understanding of global warming and the greenhouse effect, due to global warming, efforts to reduce global warming, and alternative energy.
Figure 1. Front and back covers of e-modules

Figure 2. (a) Table of contents (b) content competencies and basic competencies
Figure 3. (a) Overview of e-module contents (b) Display of formative tests using iSpring Suite 8

Figure 4. Display of e-modules in the 3D Page Flip application

E-Module based problem based learning on the developed global warming material has several components that differentiate it from other e-modules such as "Did You Know" which contains interesting general knowledge related to global warming, discussion results, formative tests and summative tests are presented using I Spring Suite 8 so students can immediately write down the results of the discussion and fill in the answers that will be sent to e-mail educators. This E-Module is also equipped with pictures and videos making it easier for students to better understand the material presented (Sholeha, et al., 2019).
The explanation above is the result of problem-based learning based e-module on the developed global warming material. This e-module is used as a learning resource that can be accessed by students anytime and anywhere. E-modules are designed and developed based on the results obtained from the initial observation stage to the design stage (Serevina, et al., 2018; Sari, et al., 2019). To adjust what students need for what has been developed, then validation is done. Validation is done, namely material validation, learning validation and media validation. The validator will provide suggestions, critiques of the developed electronic modules. Validation is carried out until the validator states that the e-module meets the requirements for use.

1. Media Validation

This aspect of the media includes the assessment of media experts, on e-Module oriented problem-based learning. The assessment of media experts consists of 2 aspects which include aspects of the appearance and aspects of use. Data from the assessment of media experts can be seen in Table 1.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Expert Media 1</th>
<th>Expert Media 2</th>
<th>Average Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>View</td>
<td>77</td>
<td>79</td>
<td>78</td>
<td>Good</td>
</tr>
<tr>
<td>Use</td>
<td>32</td>
<td>30</td>
<td>31</td>
<td>Good</td>
</tr>
<tr>
<td>Total Score</td>
<td>109</td>
<td>109</td>
<td>109</td>
<td>Good</td>
</tr>
</tbody>
</table>

The table above explains the results of the assessment of two media experts who rank 108 out of a maximum of 148 and fall into the "Good" category. If converted as a percentage of 76%. The assessment data from the media can be shown in the form of a bar chart below the following Figure 5.

![Figure 5. Validation results of media experts](image-url)
The chart above explains that research on the development of e-modules is included in the category but is not maximized. Obtained a percentage of 76%, according to media experts.

2. Material Aspects
Ecosystem assessment comes from the results of teacher and teacher assessments. The assessment of human resources is assessed based on 5 aspects including instructional, aspects contained therein, stand-alone aspects, adaptive aspects, user friendly aspects. The results of the assessment can be seen in Table 2.

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Expert Material 1</th>
<th>Expert Material 2</th>
<th>Average Score</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-instructional</td>
<td>79</td>
<td>100</td>
<td>89.5</td>
<td>Very Good</td>
</tr>
<tr>
<td>Self-contained</td>
<td>12</td>
<td>16</td>
<td>14</td>
<td>Very Good</td>
</tr>
<tr>
<td>Stand alone</td>
<td>7</td>
<td>6</td>
<td>6.5</td>
<td>Good</td>
</tr>
<tr>
<td>Adaptive</td>
<td>9</td>
<td>10</td>
<td>9.5</td>
<td>Good</td>
</tr>
<tr>
<td>User friendly</td>
<td>9</td>
<td>12</td>
<td>10.5</td>
<td>Very Good</td>
</tr>
<tr>
<td>Total Score</td>
<td>1</td>
<td>126</td>
<td></td>
<td>Very Good</td>
</tr>
</tbody>
</table>

Based on Table 2 of the ratings, the total score is 75 of the maximum score of 96 and falls into the "Good" category. If it is changed in the percentage than 78%, the data of expert material results in the form of bar charts can be seen in this chart.

Figure 6. Experts validation result of learning

The chart above explains that research on e-module development is included in a good category. In fact, a percentage of 78% was obtained according to media experts. So the e-modules developed can be used in the learning process. Based on the above data it can be concluded that the e-modules that have been developed are categorized as having good
eligibility. These results are calculated based on the formula taken from Affective Scale Assessment 4. The specification:

1. E-module with multimedia concept using 3D Flip Book program. In making there are some software needed in the e-module development process, including:
   a. Macromedia Flash, which functions to create animations on e-modules
   b. I am Spring Quiz Maker, which functions to make quizzes on e-modules
   c. Movie Maker, which functions to edit videos, such as cutting videos, adding audio to video, and more.
   d. Photoshop, to make backgrounds and book covers.
   e. Microsoft Publisher, to create modules in PDF format
2. Design layout is made with attractive color consistency.
3. The material in the e-module is global warming and the greenhouse effect, and alternative energy.
4. The material is presented in depth and clearly accompanied by pictures, videos, animations.
5. Learning activities in accordance with the steps of the Problem Based Learning model. Examples of problems that are accompanied by explanations and are present in each learning concept.
6. The e-module is also complete with practice questions and competency tests at the end of each lesson that contains 10 cases that can practice higher-order thinking skills

Conclusion
Based on the results of research and discussion of the global warming e-module oriented to student activities can be concluded as follows. The results of the validation of the material experts obtained an average percentage of the overall aspects of 85%, 72% of media experts, 78% of learning experts and 88% of middle school physics teachers. While the results of student trials are 77.7% of small groups and 82% of large groups of field trials are in the very good category. So that the e-module of global warming and energy is feasible as a learning module. Learning to use e-modules on global warming and energy is quite effective in facilitating middle school students to improve higher order thinking skills. The suggestion that can be given by researchers for subsequent researchers are, It is expected that the development and research on e-modules can be accessed with smartphones, and making e-modules with other learning environment materials.

REFERENCES


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