

# E-Modules on Problem Based Learning to Improve Students' Higher Order Thinking Skills (HOTS)

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A problem-based learning E-module has been developed on global warming to improve students' Higher Order Thinking Skills (HOTS). The research method used the 3D Page flip Professional 1.7.7 software and its contents was formulated through the use of several software programs, namely Microsoft Office, CANVA, and I Spring Suite 8. The results showed that the material experts obtained an average percentage of 84%, media experts an average of 72%, and learning experts an average of 78%, including both categories. The effectiveness of test results obtained an N Gain of 0.63, which shows that the Global Warming e-module can improve the HOTS of students to a medium extent. The results of the field test questionnaire filled out by students achieved a result of 82% percentage, with very good interpretation. Based on the effectiveness of these tests, it can be concluded that the e-module is feasible and can improve students' HOTS.

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

## Introduction

Environmental problems have lately become the main consideration in the education process, as efforts to make the environment sustainable continue (Kılıkış, 2016) (Dagiliūtė, & Liobikienė, 2015). One of the themes that is very influential today as a cause of environmental change is global warming, so in the teaching curriculum, many learning models are needed to ensure that an understanding of the environment becomes a key object



of formal learning (Freije, et al., 2017). Global warming is caused by many factors, including the greenhouse effect, which has received attention since the 1970s as an environmental issue. The topic of global warming has resurfaced repeatedly in response to rapid population growth, the threat of the extinction of several flora and fauna species, the oil and energy crisis, and the problem of waste. However, this topic had remained submerged for more than 20 years before it reappeared at the end of the 20th century, when it accompanied 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. The learning model that supports the implementation of the 2013 curriculum 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 centre of attention for education and teaching is the role of ICT, which will determine success in education. The last decade shows the role of ICT is very dominant. One of the characteristics of the 21st century learning model is a combination of face-to-face methods and digital and online media. In 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 frequently, and from various sources (Owen, et al. 2017).

The process of understanding the environment is crucially related to human behaviour, and it is best done through education and teaching that welcomes the development of science and technology. Among them, multimedia learning applications can present high-level concepts that link one element to another and are difficult to teach through books alone. The advantages of interactive multimedia learning applications is that they can explain a concept and allow a student to explore its principles (Chiu, & Churchill, 2015). This quickly builds the understanding of students because integrated components such as sound, text, animation, images, and video optimize the role of the senses in the memory system (Cao, & Ali, 2018).

Concepts mastered through multimedia can help improve higher-order thinking skills, but these do not necessarily apply to everyday life. For this reason, in the learning process, higher-order thinking skills need to be trained and developed. We need an educators' creativity to develop multimedia that can improve students' higher-order thinking skills (Khan, & Masood, 2015). The learning model that is considered most appropriate is that of Problem- Based Learning (Smith, 2014). Problem-Based Learning Models require students to

solve problems by digging up as much information as possible. This skill is necessary in daily life, where the development of one's mindset and work patterns depends on one's ability to learn. If a teacher presents real-world problems, encourages open class discussion, and rewards experimentation, then they will foster Higher Order Thinking Skills.

Based on observations and surveys conducted on physics teachers in senior high schools in Indonesia, 80% of students' higher-order thinking skills have not yet been developed by teachers. One of the main causes of this is that teachers find it difficult to develop learning resources that can train students' higher-order thinking skills. Learning resources such as textbooks are much less frequently used to 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, and can even render a virtual laboratory that presents information through a much richer medium than conventional books. The images displayed are not still, but instead use 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 centres issued by the government and are not yet interactive so they can only be read like ordinary textbooks (Sholeha, et al., 2019). This was found from the results of preliminary studies in high schools in Greater Jakarta. These results show that compared to a variety of other media, e-modules are used only minimally, and almost 90% of teachers have never used e-modules in the learning process. When asked about the need for the development of Problem-Based Learning E-Modules, the majority of teachers stated that they were necessary for providing insight to students and increasing student interest in classroom 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 of the relevant curriculum, and the language used is also easier to understand. When asked whether they had trained students' high-level skills in learning, all respondents said they had never done so (Serevina, et al., 2018; Sari, et al., 2019). Based on the results of the student questionnaires, which totalled 136 respondents in Indonesia, the majority of students (77.7%) use published texts as their learning resources. Furthermore, most (75.5%) students experienced limitations in the learning process on global warming.

To overcome this problem, learning innovations that promote independent learning are necessary. One way this may be achieved is through the development of teaching software that trains higher-order thinking skills, such as e-modules (electronic modules). E-modules present multimedia concepts in an electronic format without detracting from their function as a source of information. The use of e-modules 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 and that includes a set of planned learning experiences designed to help students master specific learning goals. Modules comprise a minimum of learning objectives, learning material or substance, and evaluation. Modules function such that students can learn independently and at their own speed. Electronic modules present their independent learning materials systematically in smaller learning units, each of which achieves a certain learning objective. They also contain animations, audio, and navigational interfaces that encourage user interaction.

The electronic module was developed using Flip Book software. "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." A quote from the website <http://Flipbook.info> states that: "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." Within this software, there is an editing function that allows users to add videos, images, audio, hyperlinks, and multimedia objects to pages that can be flipped through like an original book. The Problem of this research is to unveil an E-Module based on Problem Based Learning about Global Warming to improve students' Higher Order Thinking Skills (HOTS)

## **Methodology**

The methodology of research is research and development (R&D). The development model used a formula that 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 of the learning that would take place. The steps taken include conducting literature studies and field surveys. A literature study is conducted to find information that has a relationship with the research to be conducted. 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 by conducting interviews with physics teachers, analysing the curriculum implemented in schools, and analysing the material (Ary, et al., 2018).

The second step is planning. At this stage, the researcher compiles a research plan, which is formulated by determining the objectives and benefits of making e-modules, determining core competencies and basic competencies, and determining 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 or not a product is feasible.

The fifth step is revision of the trial results. After due diligence is done, if there are still parts that are not in accordance with the standard, then the plan needs to be revised. This revision aims to improve the 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 based on the 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 of 30-37 respondents will be tested. In this trial phase, students are asked to engage with the learning process using the e-module that has been developed. A pre-test was conducted before starting the study and post-test was conducted at the study's conclusion. Participants were then given a questionnaire about the learning that had taken place.

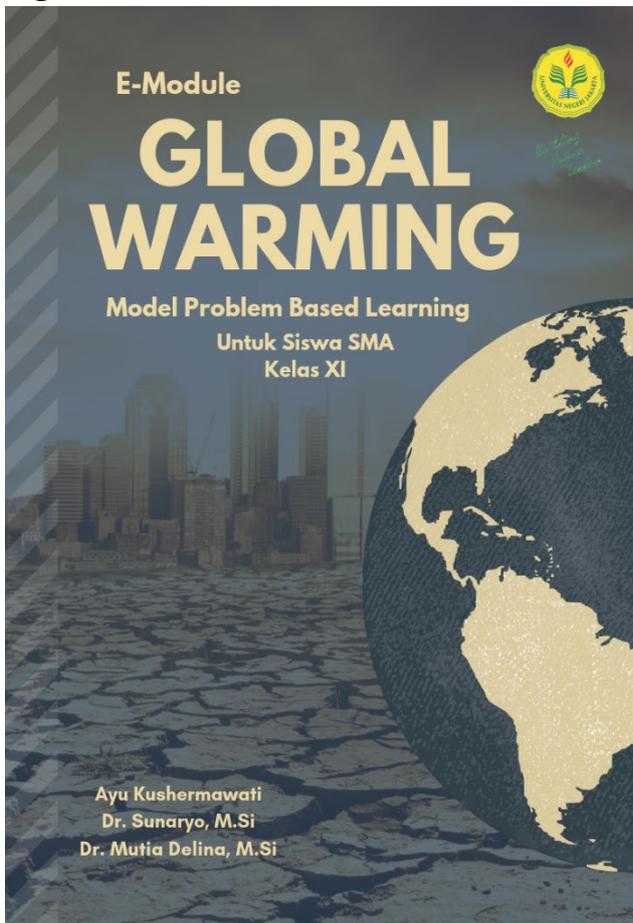
The ninth step is the final product revision. After testing the class, the responses of students who used the e-module were collected. This was done to make the final product better and more suitable for use. After making revisions for the third time, the product is refined such that is suitable for students, educators, and schools. The resulting product can be used in the learning process both inside and outside the classroom. 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 that they can be used by educators and students. The e-module distribution is done through the internet, and the module can be downloaded for free by educators and students who need it.

## **Results and Analysis**

The product of this research is a problem-based learning e-module about global warming. The 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

(a)

# DAFTAR ISI



E-Module Global Warming

- ii Kata Pengantar
- iii Daftar Isi
- iv Tinjauan Pustaka
- vii Kompetensi Inti
- viii Kompetensi Dasar
- x Peta Konsep
- 2 Pengertian Pemanasan Global dan Efek Rumah Kaca
- 16 Akibat Pemanasan Global
- 25 Usaha Mengurangi Pemanasan Global
- 33 Energi Alternatif
- 43 Rangkuman
- 44 Glosarium
- 46 Daftar Pustaka

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(b)



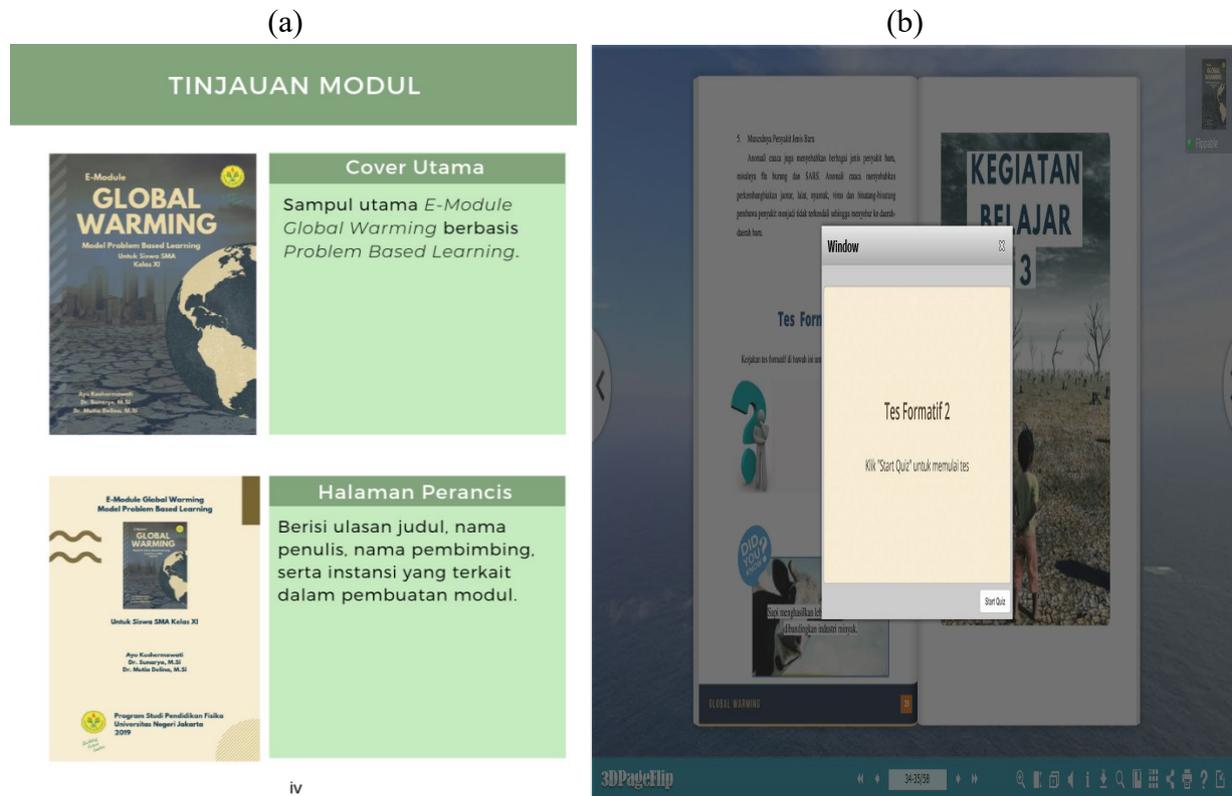
## KOMPETENSI INTI & KOMPETENSI DASAR

**Kompetensi Inti**

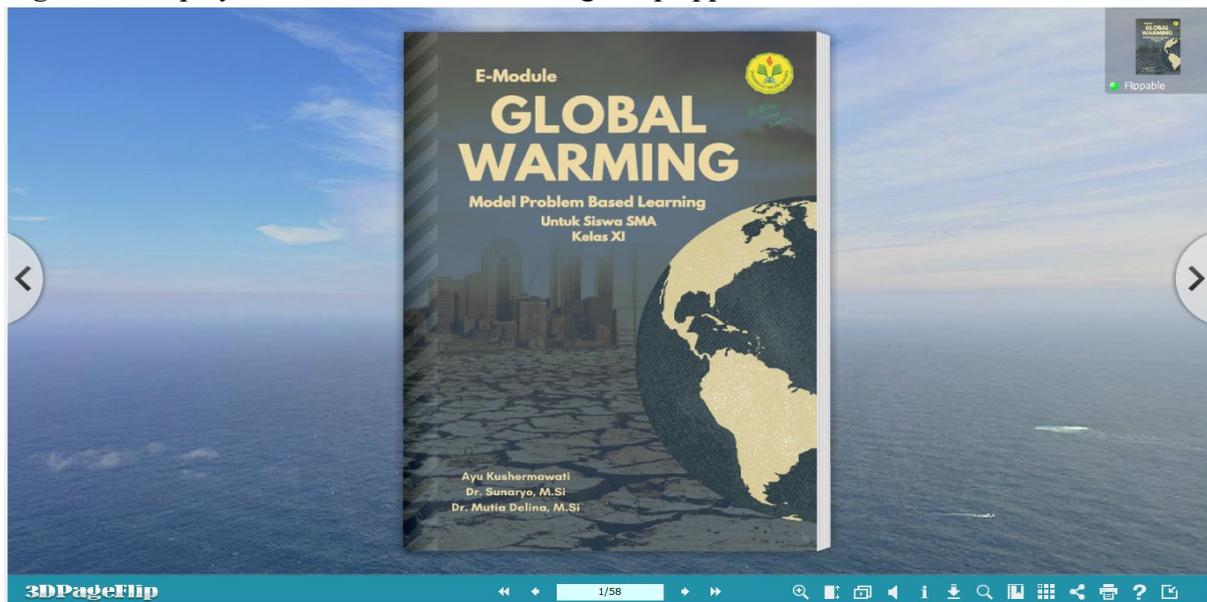
1. Menghayati dan mengamalkan ajaran agama yang dianutnya.
2. Menunjukkan perilaku jujur, disiplin, tanggung jawab, peduli (gotong royong, kerja sama, toleran, damai), santun, responsif dan pro-aktif dan menunjukkan sikap sebagai bagian dari solusi atas berbagai permasalahan dalam berinteraksi secara efektif dengan lingkungan sosial dan alam serta dalam menempatkan diri sebagai cerminan bangsa dalam pergaulan dunia.
3. Memahami, menerapkan, dan menganalisis pengetahuan faktual, konseptual, prosedural, dan metakognitif berdasarkan rasa ingin tahunya tentang ilmu pengetahuan, teknologi, seni, budaya, dan humaniora dengan wawasan kemanusiaan, kebangsaan, kenegaraan, dan peradaban terkait penyebab fenomena dan kejadian, serta menerapkan pengetahuan prosedural pada bidang kajian yang spesifik sesuai dengan bakat dan minatnya untuk memecahkan masalah.
4. Mengolah, menalar, dan menyaji dalam ranah konkrit dan ranah abstrak terkait dengan pengembangan dari yang dipelajarinya di sekolah secara mandiri, bertindak secara efektif dan kreatif, serta mampu menggunakan metode sesuai kaidah keilmuan.

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**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



This problem-based learning E-Modules on global warming has several components that differentiate it from other e-modules, such as "Did You Know", which contains interesting

general knowledge related to global warming, as well as discussion results, formative tests, and summative tests that are presented using I Spring Suite 8 so that students can immediately write down the results of a discussion and fill in answers, which will then be e-mailed to their educators (Sari, et al., 2019). This E-Module is also equipped with pictures and videos, making it easier for students to understand the material presented (Sholeha, et al., 2019).

The explanation above is the result of a problem-based e-module on global warming. 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 observation stage through to the design stage (Serevina, et al., 2018; Sari, et al., 2019). Validation is then done, predominantly material validation, learning validation, and media validation. The validator provides suggestions and critiques for the electronic module. Validation continues until the validator states that the e-module has met the requirements for use.

#### 1. Media Validation

This includes an assessment by media experts on the problem-based learning e-module. The media experts assess two aspects of the module: the aspect of appearance and aspect of use. Data from the assessment by media experts can be seen in Table 1.

**Table 1:** Evaluation of Media Experts

Aspects	Expert Media 1	Expert Media 2	Average Score	Category
View	77	79	78	Good
Use	32	30	31	Good
Total Score	109	109	109	Good

The table above shows the results of an assessment by two media experts who scored the module 108 out of a maximum of 148 (76%), placing it in the "Good" category. The assessment data from the media is shown in the form of a bar chart below (Figure 5).

**Figure 5.** Validation results of media experts

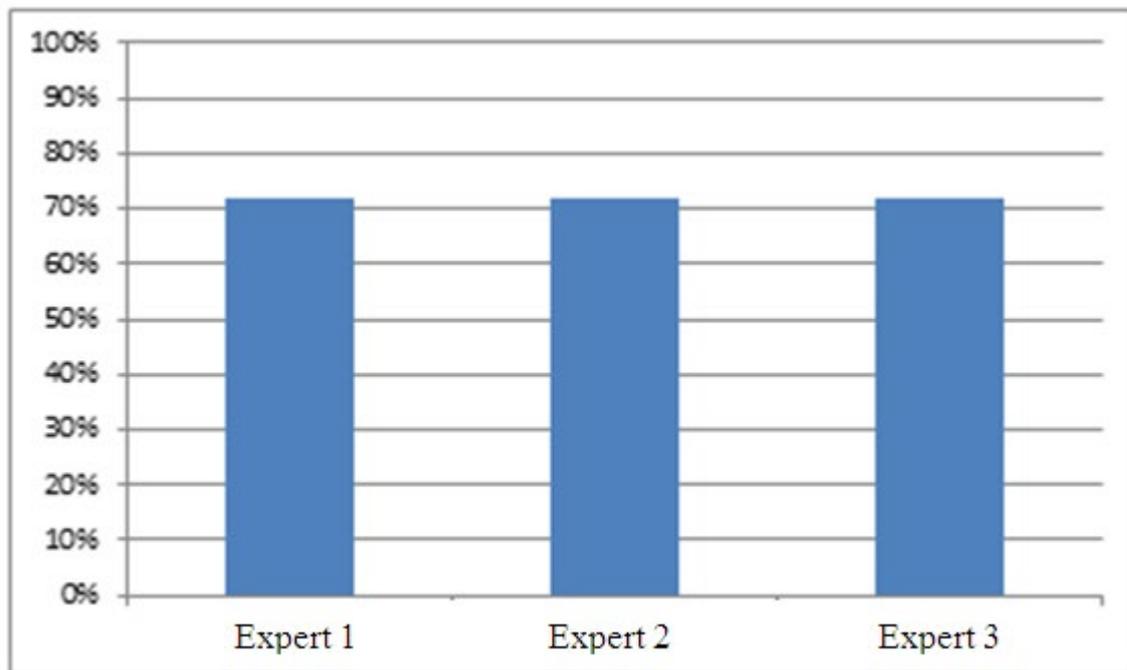


Figure 5 shows that research on the development of e-modules is included in the category but is not maximized. The module obtained a percentage score of 76%, according to media experts.

## 2. Material Aspects

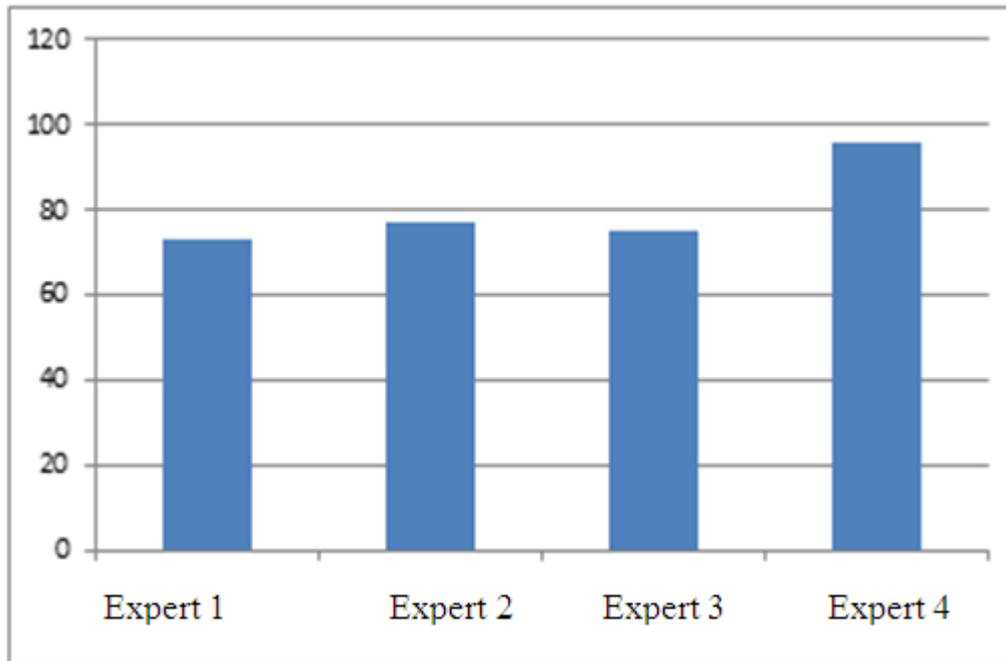
Ecosystem assessment is based on the results of teacher and teacher assessments. The assessment by human resources is assessed based on five aspects: instructional aspect, aspect contained therein, stand-alone aspect, adaptive aspect, user-friendly aspects. The results of this assessment can be seen in Table 2.

**Table 2:** Expert judgment of the material

Aspects	Expert Material 1	Expert Material 2	Average Score	Category
Self-instructional	79	100	89.5	Very Good
Self-contained	12	16	14	Very Good
Stand alone	7	6	6.5	Good
Adaptive	9	10	9.5	Good
User friendly	9	12	10.5	Very Good
Total Score	1		126	Very Good

Based on the data in Table 2, the module's total score was 75 out of a maximum score of 96 (78%), placing it in the "Good" category. The data from the expert material can be seen in the bar chart below.

**Figure 6.** Experts validation of learning results



The chart above shows that, according to media experts, the research on e-module development is in the "Good" category (78%). So, the e-module 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 the making of this module, some software was needed, including:
  - a. Macromedia Flash, which was used to create the animations.
  - b. I am Spring Quiz Maker, which was used to make the quizzes.
  - c. Movie Maker, which was used to edit videos.
  - d. Photoshop, which was used to make backgrounds and book covers.
  - e. Microsoft Publisher, which was used to create modules in PDF format.
2. E-module design layout includes an attractive colour palette.
3. The material in the e-module covers global warming, the greenhouse effect, and alternative energy.



4. The material is presented in depth and is clearly accompanied by pictures, videos, and animations.
5. Learning activities are in accordance with the steps of the Problem-Based Learning model: examples of problems are accompanied by explanations and are present in each learning unit.
6. The e-module is also complete with practice questions and competency tests at the end of each lesson. The module comprises 10 lessons that practice higher-order thinking skills.

### **Conclusion**

Based on the results of research and discussion of the global warming e-module, the following conclusions can be drawn. The validation by material experts returned an average percentage score of 85% overall, 72% by media experts, 78% by learning experts, and 88% by middle school physics teachers. While the student trials showed that 77.7% of small groups and 82% of large groups scored within the very good category. This shows that the global warming e-module is feasible as a learning module. E-modules on global warming and energy are effective tools for improving the higher order thinking skills of middle school students. The suggestion that can be offered by the researchers for subsequent researchers is that the development and research of e-modules should incorporate smartphone access, and e-modules that cover other learning environment materials should be explored.



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