

Development of Interactive E-Module Integrated with Science, Environment, Technology, Society on Environmental Change Material

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Abstract: Teaching materials are one of the components needed and used by teachers when teaching. With the use of appropriate teaching materials during teaching and learning activities, it will make it easier for teachers and students to achieve competencies and learning objectives. This study aims to determine the feasibility and practicality of SETS Integrated Interactive E-Module. The type of research used is research and development with research procedures using the 4D model. The research will only be carried out until the Design stage. The results showed that the SETS Integrated Interactive E-Module is feasible to use as teaching material on environmental change material with a percentage of feasibility of 80.21% by material experts and 96.25% by media experts; SETS Integrated Interactive E-Module is practical to use as teaching material on environmental change material with a percentage of practicality of 82.11% by students, and 83.33% by biology teachers. Based on the results of the feasibility and practicality tests that have been carried out, the SETS-integrated interactive e-module is feasible and practical to use.

Keywords: E-modules; Feasibility of e-modules; Practicality of e-modules

Introduction

The education system in Indonesia has undergone a number of change processes, all of which will be crucial in the future. One of these is due to the Covid-19 pandemic (Mauliana et al., 2022). The curriculum is one of the modifications made to the education system. The goal is to replace student learning that has changed due to the Covid-19 outbreak. Curriculum changes are made by the government to improve the quality of education and reform the education system (Syamsurizal et al., 2023). So that a program that is classified as the most effective in achieving educational goals on a national scale is obtained (Ningsih et al., 2020). Various efforts have been made to improve the quality of education, one of which is through improving the quality of teaching materials. Teachers are expected to be able to create learning media tools

that meet student needs. The independent curriculum provides flexibility for educators to create quality learning according to student needs and technological developments. Another reason is the availability of teaching materials that adjust to the demands of the applicable curriculum (Muqodas et al., 2015).

The rapid growth of education and communication technology has become one of the learning tools for educators. Due to changes in teaching methods, most educators need to improve their skills to get the effective and best teaching style that can benefit students. Digital technology has now started to be used in educational institutions as a means of supporting learning, either as an information tool or as a learning tool (Kasanah et al., 2022). Technology is a potential tool for instructors to motivate and engage their students in learning. For example, it will help students improve their learning skills such as drill and practice,

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information inquiry, participatory learning, and increasing their responsibility. This is why educators need to know how to adapt effective teaching tools for use in the classroom (Phosuwan et al., 2013).

Teaching materials themselves are one of the important components in learning that can help smooth student learning (Ardiansyah et al., 2016). The existence of teaching materials will facilitate the implementation of learning and will more easily help students in learning. Teaching materials can be used by teachers and students to improve learning (Hariyanto et al., 2022). Teaching materials are also one of the learning components that have an important role to help achieve predetermined competencies and learning objectives (Mauliana et al., 2022).

The observation conducted at SMAN 1 Banguntapan showed that the school will soon implement the independent learning curriculum in the coming semester. So that teaching media is needed in accordance with the demands of the curriculum. However, the available teaching media has not been able to support each learning outcome in each sub-material. In addition, the need to always involve the use of technology in every learning activity is a must in teaching and learning activities. So that teaching media is needed that is suitable for curriculum changes and technological developments. Teaching materials that are in accordance with the latest curriculum must be learning media that can support students' independent learning activities, so that students' analysis and practice activities can be carried out optimally.

Teaching materials such as electronic modules will be an important learning resource that is able to adapt to the latest technological breakthroughs because they can be accessed anytime and anywhere. It is important for students to maximize the use of their smartphones for both individual learning and social interaction (Winda et al., 2021). There are many advantages to using electronic modules over printed modules. One of them is that learning becomes more interactive with e-modules, while printed modules are only limited to text and images (Ningsih et al., 2020). This is because electronic modules can display images, audio, animation, and have ease of navigation because they can add journal sites that are in accordance with the material (Ananda et al., 2023). Another advantage of using e-modules is that they can insert learning videos in them, with the existence of learning videos that can provide images or illustrations and higher-level thinking skills to students (Priananda et al., 2021). When designing an e-module, it is important to use an approach, method or model to make it more focused and systematic. In addition, the use of approaches in the creation of relevant e-modules, the organization

between subject matter content and learning outcomes in a theme, and the organization of learning outcomes in a theme are important (Krissandi et al., 2015).

Biology material is closely related to the investigation process and the ability to think analytically both inductively and deductively to solve problems in everyday life, such as in the material of environmental change (Nurulita et al., 2022). In this material, the role of teaching materials is very important in the learning process. This is because a learning topic requires several teaching substances that are in accordance with the predetermined competency standards (Aulia et al., 2023). The content of this material is related to the real world environment or contextual in nature, meaning that students will face environmental problems in their daily life situations and are required to choose the best action to overcome these environmental problems (Firdaus et al., 2020). Environmental change, including climate change, deforestation, and desertification, characterized by fragile ecosystems and high dependence on natural resources, is highly vulnerable to the impacts of environmental change will have a major impact on humans (Lietaer et al., 2024). Humans have made massive changes to the environment to suit their daily needs, from agriculture and trade to the industrial revolution that led to increased consumption. These activities include land clearing and the diversion of water flows. These changes have improved life experiences, but they have also had adverse impacts, including climate change and biodiversity loss (Meena et al., 2023).

Environmental change material is a complex problem because it is related to the surrounding environment, to understand this material an electronic module is needed which not only contains learning material. The existence of learning media in the learning process helps students understand material that is difficult to explain and understand (Hamid et al., 2020). The content in the teaching media must also show another point of view of the material studied, providing an understanding that the material does not only study science, but there are other elements such as technology, environment, and society in it. The Science, Environment, Technology, and Society (SETS) approach is an approach that has a view of these four disciplines to show how they all play a role in shaping our daily lives (Winarti et al., 2016). In the SETS approach, students not only learn science concepts, but are also introduced to technological aspects, and the role of technology in society. Thus, students are able to find the right solution to environmental problems and solve their daily problems (Khasanah, 2015).

Based on the background of the problem above, the purpose of this research is to see the feasibility and practicality of the SETS integrated interactive E-Module on Environmental Change material.

Method

This research is a research and development. The basis for the development of this research uses the 4D model (Four D Models) suggested by Thiagarajan, namely define, design, develop and disseminate. (Thiagarajan et al., 1974).

The teaching material to be developed is in the form of an interactive E-Module integrated with SETS. However, this research is limited to the Develop stage. The 4D model can be seen in figure 1.

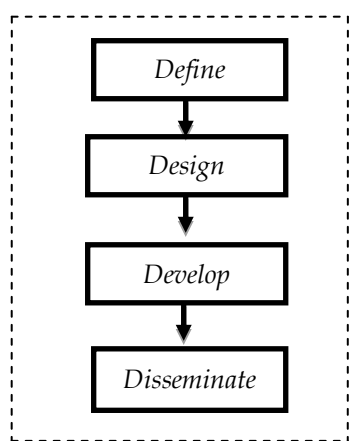


Figure 1. 4D model

This research consists of two types of data: Qualitative and quantitative. Quantitative data is obtained through questionnaire scores, qualitative data is obtained through interviews. The first stage is define, as for what is done at this stage is the initial analysis, analysis of the needs of students, and the target material that will be applied to the e-module. In the second stage, namely design, at this stage the activities carried out are the preparation of instruments such as questionnaires, format selection, and initial product design. In the third stage, namely the develop stage, a validation assessment is carried out by experts and practitioners' responses. Quantitative data from the questionnaire results in the form of an assessment of the feasibility and practicality of the development product. Expert validation consists of two validators, namely media expert validators and material expert validators. Practitioner validation consists of two validators, namely biology teachers and students as users. The questionnaire data will be converted with the score conversion reference proposed by Widoyoko (2009) can be seen in table 1.

Table 1. Reference for Converting Scores to a Five-Scale

Score range	Category
$X > \bar{X}_i + 1.80S_{Bi}$	Very good
$\bar{X}_i + 0.60S_{Bi} < X \leq \bar{X}_i + 1.80S_{Bi}$	Good
$\bar{X}_i - 0.60S_{Bi} < X \leq \bar{X}_i + 0.60S_{Bi}$	Good enough
$\bar{X}_i - 1.80S_{Bi} < X \leq \bar{X}_i - 0.60S_{Bi}$	Less good
$X \leq \bar{X}_i - 1.80S_{Bi}$	Very poor

Description:

X : Score achieved

\bar{X}_i : Average ideal score

$\bar{X}_i \frac{1}{2}$: $\frac{1}{2}$ (Ideal highest score + ideal lowest score ideal)

S_{Bi} : Standard deviation of ideal score

The data obtained from the validity results were analyzed using the formula according to (Akbar, 2013) As equation 1.

$$P = \frac{\sum x}{\sum xi} \times 100 \% \tag{1}$$

Description:

P : Validation

$\sum x$: Total validation assessment score

$\sum xi$: Expected/maximum score

The percentage results of the feasibility of all components used for decision making are feasible or not feasible to use in teaching materials in the form of SETS-integrated Interactive E-Modules. The category of feasibility test decision making according to Akbar (2013) is seen in Table 2.

Table 2. Validity Criteria

Percentage (%)	Category	Description
$80 < P \leq 100$	Very feasible	Very feasible, no need to revise
$60 < P \leq 100$	Feasible	Feasible, needs revision
$40 < P \leq 100$	Feasible enough	Feasible, can be used but with moderate revision improvements
$20 < P \leq 100$	Not feasible	Needs major revision
$0 < P \leq 100$	Very unfeasible	Unusable

The data obtained from the practicality test were analyzed using the formula according to Apsari et al. (2014) as equation 2.

$$(P) = \frac{A}{B} \times 100 \% \tag{2}$$

Description:

P = Response Percentage

A = Total score achieved

B = Maximum number of scores

The percentage results of the overall practicality of the components used for decision making in teaching materials in the form of SETS integrated Interactive E-Module. Practicality test decision-making categories according to Apsari et al. (2014) are seen in table 3.

Table 3. Response Criteria

Response score (%)	Response criteria
80 < P ≤ 100	Very practical
60 < P ≤ 100	Practical
40 < P ≤ 100	Practical enough
20 < P ≤ 100	Less practical
0 < P ≤ 100	Very Less practical

The validity test in this study consisted of media experts and material experts. The aspects assessed in the validity test to media experts include: aspects of quality, effectiveness, graphics, and presentation. The validity test for material experts is about the aspects of presentation, material content, learning design, and language. Practicality test in this study was conducted to biology teachers and students to respond to the results of the development of SETS integrated interactive E-Module. The aspects assessed in the teacher's practical test are aspects of learning, quality, practicality and presentation. While the aspects assessed in the practicality test of students are aspects of learning, practicality, presentation and usefulness.

Result and Discussion

Define

The initial analysis aims to determine the basic problems faced in learning. Based on pre-research observations conducted at SMAN 1 Banguntapan, problems were found such as when learning was being carried out the teacher often found that students did not focus on following learning activities. This is because students often play cellphones either to play games, social media, and chat applications. Thus, the learning outcomes obtained are not optimal. After various considerations, learning media is needed that can be an alternative and solution that can help students understand theory and practice and become a source of student learning such as E-Module.

Based on the analysis of student needs that has been carried out, it is known that students often use smartphones for learning. In addition, the use of teaching materials that can be accessed through Smartphones can make it easier for students to understand biology material. The material chosen is environmental change material, especially global warming material. This consideration is due to environmental problems, especially global warming, which is the most intensively discussed global issue in

the current era. The teacher invites students to relate global warming material with SETS elements, namely science, environment, technology, and society. This is done in order to create a meaningful learning condition, with the creation of contextual and meaningful learning conditions that are expected to improve student learning outcomes and in their implementation in everyday life.

Design

Preparing assessment instruments such as assessment questionnaires for the feasibility and practicality of the E-module. The media was designed using Articulate Storyline 3. What was done included: making outlines of the subject matter, compiling material in accordance with learning outcomes, collecting videos and images that are in accordance with teaching materials, adding research articles that help students to get additional information on teaching materials. Creating E-Module designs such as the cover, main menu, and navigation buttons. Sketching the main points that will be the content of the e-module, making sure to include a combination of science, technology, environment, and social elements. The main purpose of this stage is to show the importance of the SETS component of the developing E-Module.



Figure 2. Cover of e-module



Figure 3. Main menu of the e-module



Figure 4. Outline of e-module material content



Figure 5. SETS content in e-modules



Figure 6. Learning videos in e-modules

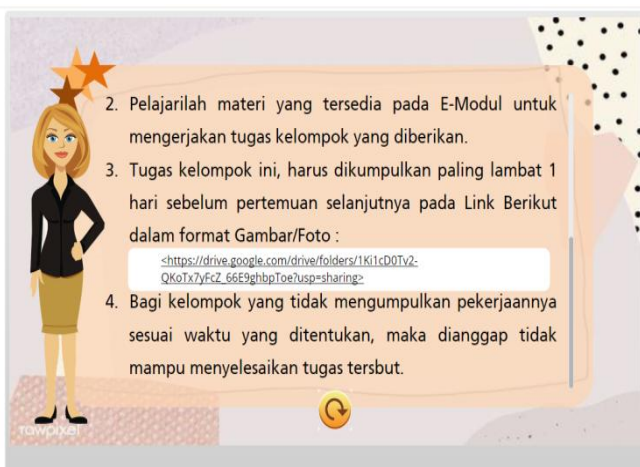


Figure 7. Student activities in the e-module

Develop

Feasibility and practicality tests were carried out on the e-module, for the feasibility test, validation was carried out by material experts and media experts. According to Sukardi in Emilyya et al. (2023) A product is said to be feasible if the instrument measures what should be measured. Material expert validation is an assessment and evaluation of the feasibility of the material used in developing the E-Module. According to Anggreni in Masaguni et al. (2023) using expert validation or validator the goal is to obtain expert opinions related to devices and products made based on certain aspects. Validation uses a questionnaire that must be filled in by the validator. Media expert validation is an assessment and evaluation of the feasibility of the media used in developing the E-Module. Validation uses a questionnaire that must be filled in by the validator. The results of the original assessment of material and media experts are as follows.

Table 4. Summary of Material Expert Validation Results

Assessment aspect	Score earned	Category
Learning design	13	Feasible
Content	24	Feasible
Learning objectives	12	Feasible
Language	28	Very feasible

Table 5. Material Expert Assessment Score

Assessment	Percentage score (%)	Description
Material	80.21	Very feasible, no need to revise

Table 6. Summary of Media Expert Validation Results

Assessment Aspect	Score earned	Category
Quality	23	Very feasible
Effectiveness	12	Very feasible
Graphic	27	Very feasible
Presentation	15	Very feasible

Table 7. Media Expert Assessment Score

Assessment	Percentage score (%)	Description
Media expert	96.25	Very feasible, no need to revise

Based on the assessment of the material expert consisting of aspects of learning design, material content, learning and language aspects are in the feasible category. According to Anjaswuri et al. (2023) proper teaching media can make it easier for teachers to convey material to students. The overall assessment for the material expert assessment obtained a percentage of 80.21% in the very feasible category, with confirmation that no changes were needed. Teaching materials should be selected by considering the needs of

students. As a result of a rigorous assessment, media with the right material is expected to be used in learning activities to the fullest (Hills et al., 2020). Subject matter is customized according to academic level. Can make modules more interactive and dynamic than printed modules which are more static (Sugianto et al., 2023).

Based on the assessment of media experts consisting of aspects of quality, effectiveness, graphics, and presentation aspects are in the very feasible category. For the overall evaluation results, the e-module produced has an average percentage of 96.25%, which is in the very feasible category. These results are in line with the results of research by *Abi et al. (2023)* with the results of media expert assessment which has a percentage of 95.3% and is included in the very feasible category. Media expert validators provide suggestions and input to improve the development of e-module learning media. These results indicate that decent and quality teaching materials are expected to have a positive impact on education. In accordance with the opinion of *Azhar (2013)* that appropriate learning media can be utilized to achieve learning objectives. In addition, according to *Syuzita in Afian et al. (2023)* states that the development of e-modules from the results of expert validation can be adjusted for learning activities.

Products that have been assessed for feasibility according to material and media experts can then be tested on a small scale (*Azmi et al., 2022*). Practicality test is to test whether the product developed is practical and easy to use. In this case, the product assessment was carried out by 1 biology teacher and 15 students of class X MIPA 1 SMAN 1 Banguntapan. The assessment includes an assessment of the SETS-integrated interactive E-Module developed by the researcher. The results are as follows.

Table 8. Summary of Learner Assessment Results

Assessment aspect	Score Earned	Category
Learning	463	Very practical
Practicality	773	Practical
Presentation	331	Practical
Usability	222	Practical

Table 9. Learner Assessment Scores

Assessment	Percentage score (%)	Description
Learner	82.11	Very practical

Table 10. Summary of Biology Teacher Assessment Results

Assessment aspect	Score earned	Category
Learning	19	Very practical
Quality	18	Practical
Practicality	11	Very practical
Presentation	12	Practical

Table 11. Biology Teacher Assessment Score

Assessment	Percentage score (%)	Description
Biology teacher	83.33	Very practical

Based on the assessment of students consisting of aspects of learning, practicality, presentation, and usability are in the practical category. Student evaluation results are standardized into a percentage to measure the practicality of the e-module. The results of the E-Module assessment obtained a percentage of 82.11% with a very practical category. Excellent standards have been met in making e-modules. According to *Nurmayanti et al. (2021)* teaching materials can be said to be practical if they are easy to access, easy to use, and useful for end users. It is also supported by *Plomp's opinion (Mantoviana et al., 2023)* which states that the learning media in the practical category is the product developed can be used easily and in accordance with the research objectives.

Based on the assessment of biology teachers consisting of aspects of learning, quality, practicality and presentation of e-modules are in the very practical category. The results of the assessment by biology teachers on the e-module developed have an average percentage of 83.33%. These results are in accordance with the results of research by *Adelia et al. (2023)* which obtained the results that educators gave a high practitioner response with an average score of 91.33% with a very good category, meaning that the developed module is in accordance with the independent curriculum of SMA stage F, and is very easy to apply in learning. The developed E-Module is in the very practical criteria. Practical teaching media has conveniences contained in the use of these media both in preparing, using, interpreting, obtaining results, and the ease of storing them (*Lestari et al., 2021*).

Conclusion

The Feasibility Test conducted on teaching media in the form of SETS Integrated Interactive E-Module received a percentage score of 80.21% by Material experts and 96.25% by Media experts. The Practicality Test conducted by Biology teachers received a percentage score of 83.33% and 82.11% by students. Based on the feasibility and practicality tests that have been carried out, teaching media products in the form

of SETS Integrated Interactive E-Modules developed are declared feasible and practical for use in learning, and can be used for further research.

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Authors Contribution

H M, contributed in conceiving the research idea, developing the research product, analyzing the results, and writing the article. Paidi is a supervisor in research activities to writing articles.

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Conflicts of Interest

The authors declare no conflict of interest.

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