



The Problem-Based E-Module as Learning Supplement to Improve Students' Learning Outcomes

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Abstract

Regulation of Education Minister number 65 of 2013 urges teachers to utilize information and communication technology in learning as well as 97% of students' preference to read material on a laptop or smartphone emphasize the need of learning tools development. The research aims to develop feasible, effective and practically used problem-based e-modules as a learning supplement of environmental change material to improve students' learning outcomes. This is a Research and Development (R&D) with 34 students of SMAN 2 Kebumen class X MIPA 2 as the subject. The feasibility of e-module from material experts got 80.6% and 94.37% from media experts. It also meets the feasible category for learning. The small-scale test obtained 81.2% from students with feasible categories. The responses on the large-scale test got an average score of 83.5% from students and 82.5% from teacher with feasible category. Problem-based e-module is effectively proven improving student learning outcomes with the N-gain of 0.56 in the medium category and classical completion of 100%. The practicality test from students got 85.4% and from teacher 82.5% with very practical category. The results showed that problem-based e-module on environmental changes material is feasible, effective for improving student learning outcomes and practically used in learning.

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INTRODUCTION

The development of technology nowadays is moving rapidly along with the advancement of science. It cannot be denied that science is very influential on human life. The development of science and technology has resulted in major changes in various fields, one of which is the field of education. In the Regulation of the Minister of Education and Culture number 65 of 2013 several principles have been set for carrying out the learning process, one of which is by utilizing information and communication technology to improve the efficiency and effectiveness of learning (Kemendikbud, 2013).

Teachers are required to have the ability to be able to create and develop teaching materials needed for students in learning activities. Along with the era development and advanced technology, teachers are required to innovate in developing teaching materials in digital form. Based on the student characteristics questionnaire, 97% of students prefer to read material on a laptop or smartphone. According to Faisal et al. (2020) in the current era students find it easier to learn by using technology and they are more interested in digital teaching materials that can be accessed through electronic devices such as smartphones.

One of the digital-based teaching materials that can be used is e-module. E-modules or electronic modules are part of electronic based learning in which learning activities are carried out utilizing technology using electronic devices (Aryawan et al., 2018). E-module as a teaching material is a development of a printed module because it has integrated with technology. The e-module also provides a display containing images, video, audio and equipped with an evaluation in the form of a test (Suarsana & Mahayukti, 2013). In addition, this e-module is more practical, students can read it anytime and anywhere because it can be accessed through devices both smartphones and notebook. Therefore, this e-module is very suitable to be applied in online-based learning activities or e-learning that utilizes internet technology.

E-module can be used as learning supplements. Learning supplement is supporting component that can be used in the learning process to complement the teaching material that are already available. E-module as learning supplement can be applied to learning activities in the classroom or at home to help students learn and increase their knowledge insights. (Novana et al., 2012). The development of this e-module is also equipped with a syllabus and lesson plans as a guide for carrying out learning activities.

Biology as a subject matter in its learning is closely related to the investigative process and analytical thinking skills either inductive or deductive to solve the problems in life. Problems solved in the form of cases about biological problems. Therefore, biology subjects support learning models and learning resources that can lead students to problem-solving activity.

Environmental problems have always been a problem in many countries in the world, one of which is Indonesia. An example of an environmental problem that occurs is plastic waste being dumped into the sea. Knowing the existing environmental problems, the role of education is very important to educate students about environmental changes, environmental pollution and how to overcome these environmental problems, therefore there is environmental change material in class X SMA. In environmental change material, students are required to be able to think critically in solving problems related to environmental problems and their impacts, so that environmental change materials can be applied using learning models that can direct students to problem solving activities (Margareta & Purnomo, 2018).

The results of interview with biology teacher at SMAN 2 Kebumen said that environmental changes material in teaching material did not present real cases of environmental problems that occurred (up to date). Therefore, the role of teaching materials is needed to be able to provide students with problem-solving activities for cases of environmental problems. The developed e-module will be integrated with a problem-based by applying PBL method (problem based learning). PBL learning begins with the teacher giving a problem to students, then students solve the problem using the knowledge they already have (Maolani, 2016). Environmental change material can be linked to cases regarding environmental problems, so that it can encourage students to learn actively through problem solving activities.

Based on the results of interview with biology teacher at SMAN 2 Kebumen, it is also known that teaching materials in the form of e-modules have never been applied in biology learning. The teaching

materials provided by the teacher to students are only in the form of printed books and UKBM (Independent Learning Activity Unit). In addition, the results of interviews with students stated that the environmental change material in the textbook looks monotonous and does not attract students' interest in learning, it resulting in low student learning outcomes on environmental change material. The results of the necessity questionnaire that were filled out by students, as many as 63.33% of 30 students said they still found it difficult in environmental changes material. Research from Mardiyanti (2020) states that student learning outcomes on environmental change materials are low with classical completeness obtained only 75% below the standard. Especially during the COVID-19 pandemic, which requires learning activities to be carried out at home (online based learning), this results in less effective learning because the delivery of material from teachers is not optimal and students are required to understand the subject matter by studying independently at home.

Based on problems mentioned, it is important to conduct research on "Development of Problem-Based E-Module as Learning Supplements of Environmental Change Material to improve students' learning outcomes".

RESEARCH METHOD

The research was conducted at SMAN 2 Kebumen in the even semester in the academic year of 2020/2021. The research subjects were 10 student from class X for small-scale tests and 34 student from X MIPA 2 for large-scale tests without control classes. This types of research method is Research and Development (R&D) with 10 research steps namely (1) potential and problems, (2) data collection, (3) E-module design, (4) validation of e-module design by experts of material, media, and teachers, (5) E-module design revision, (6) small-scale test, (7) first revision of e-module, (8) large-scale e-module usage test, (9) second revision of e-module, and (10) final product of e-module.

The method of data collection is observation, interview, questionnaire, and test questions using non-test research instruments, namely validation sheets, feasibility response questionnaire sheets, and E-Module practicality sheets, while the test instruments are pre-test and post-test. The data analysis in this research namely e-module feasibility validation data from validators, e-module practicalities data from teacher and students, teacher and student responses for e-module, and student learning outcomes.

RESULTS AND DISCUSSION

This development research produces a final product in the form of an electronic module or e-module in order to attract students to learn and increase understanding of environmental change material. This development of problem-based e-module is designed with Canva, which is an application for graphic design. The results of the e-module development are distributed to students in the form of a link and can be opened via a web browser either through a notebook or smartphone. E-module developed consists of several parts. The beginning section contains covers, prefaces, table of contents, KD and indicators, and introductions (material descriptions, instructions for use, and material maps). The content or main section contains units of learning and evaluation activities. The last section of the E-Module contains answer keys, glossaries, and bibliography.

Feasibility of Problem-Based E-Module Of Enviromental Changes Material

The feasibility of the e-module developed in this study is obtained through the validity assessment of material and media experts as well as the assessment of responses from teacher and students. Material and media experts in this study are biology lecturers of Universitas Negeri Semarang and biology teacher of SMAN 2 Kebumen. The results of the E-Module feasibility assessment from the material expert can be seen in Table 1.

Table 1. The Results of the E-Module Feasibility Assessment (Material Expert)

No.	Material Expert Validator	Percentage (%)	Category
1.	Biology lecturer of UNNES	65.10	Feasible
2.	Biology teacher of SMAN 2 Kebumen	96.1	Feasible
Average percentage		80.6	Feasible

The results of the problem-based e-module feasibility assessment by the material expert obtained an average percentage of 80.6% with "feasible" category. The e-module assessment component on expert validation of the material consists of aspects of content, language, and presentation. The results of the material expert's assessment for the feasibility of the e-module given by the validator lecturers and teachers have quite a significant difference. This is because lecturer validator give assessments on some assessment indicators lower than teacher validator. The difference in assessment results between lecturer and teacher validators shows that there is validator objectivity in providing assessments. Overall, from the average percentage results of the assessment score given by validators are still in the feasible category.

The assessment of e-module by media experts concerns aspects of the ease of running the e-module, creativity, graphics, and usefulness. The results of the E-Module feasibility assessment from media experts can be seen in Table 2.

Table 2. The Result of The E-Module Feasibility Assessment (Media Expert)

No.	Media Expert Validator	Percentage (%)	Category
1.	Biology lecturers of UNNES	91.87	Very Feasible
2.	Biology teacher of SMAN 2 Kebumen	96.87	Very Feasible
Average percentage		94.37	Very Feasible

The results of problem-based e-module feasibility assessments by media experts obtained an average percentage of 94.37% with "very feasible" category. Based on the results of feasibility assessments by experts, it can be stated that problem-based e-module of environmental change material are feasible from material and media aspects for use in learning.

In this E-Module presents problems or cases related to environmental problems. This indicates that the problem or case presented in the E-Module is in accordance with the PBL learning model used in learning activities. PBL is a method of learning where the teacher presents a problem at the beginning of learning and then students are required to solve and relate the problem with the learning material being studied. The problem is given a real problem in life, so it will encourage students to gather various information to find answers to existing problems (Anisah et al., 2018). The implementation stages of the PBL model in learning are (1) orienting students to problems, (2) organizing students to learn, (3) guiding individual and group investigations, (4) developing and presenting the results of investigation, and (5) evaluating the problem-solving process (Arends, 2008).

The material in the e-module is presented in the order, making it easier for students to understand the learning material (Haspen et al., 2021). The presentation of learning activities in e-modules is also equipped with pictures and videos that are in accordance with the learning material. In addition, in the e-module there are evaluations or practice questions that are expected to encourage students to be responsible for their own learning activities (Larasati et al., 2020). E-modules can be used as additional teaching materials for student self-study activities. As Meilana et al. (2017) said that the module can have a function as a learning supplement so that students can better understand the material being studied.

In addition to the results of the e-module validation assessment, there are several suggestions from validators that researchers use to revise e-module. The results of the e-module suggestions and revisions can be seen in Table 3.

Table 3. The Results of the E-Module Suggestions and Revisions

No.	Suggestion	Revision
1.	The initial cover of the e-module should be replaced with a more attractive image	Replacing the cover with a more attractive image
2.	Concept map replaced with material map	Change the title of a concept map to a material map
3.	Change the indicator box section to make it better and attractive	Change the box design in the indicator section
4.	The PBL syntax has not seen in the e-module	Add an obvious PBL syntax to the e-module
5.	There is no sub-chapter of material about the type of waste based on its form.	Add material about the type of waste based on its form
6.	The image on the cover if it is not your own is better to be given the source	Write the source at the bottom of the image on the cover

The feasibility of problem-based e-modules is also assessed by students and teacher. E-module that has been declared valid, then e-module through a small-scale test is assessed by 10 students. On a small-scale test, students fill out an E-Module readability response questionnaire. The results of e-module readability assessments on small-scale tests by students obtained an average percentage of 81.2% with the category "very feasible". E-module get good results because it is easy to use, have an attractive appearance, and the material contained in the e-module is written in an easy-to-understand language (Pramana et al., 2020)

The results of e-module feasibility assessment by students and teacher are also implemented on large-scale tests after the use of e-module in learning with 34 student respondents. The results of the response are obtained from the response questionnaire sheet that has been given to students and teacher. The results of teacher and student response assessments regarding the feasibility of problem-based e-module can be seen in Table 4.

Table 4. The Result of Teacher and Student Response (Large Scale Test)

No.	Data Source	Percentage (%)	Category
1.	Biology teacher of SMAN 2 Kebumen	82.5	Very Feasible
2.	Students of SMAN 2 Kebumen	83.5	Very Feasible
	Average percentage	83	Very Feasible

The result of students and teacher response assessment to the problem-based e-module on large-scale tests obtained an average percentage of 83% with "very feasible" category. Based on the results of the students and teacher responses it can be stated that the problem-based e-module is feasible for use by students and can be applied in learning environmental change material.

According to students, the problem-based e-module on environmental change material is interesting and motivate them to learn and better understand the material due to the existence of e-module developed by researcher. This is the same according to Wulansari et al. (2018) where the presentation of teaching materials in electronic form such as e-module has the advantage of being attractive and making it easier for students to learn. The use of videos in the E-Module also increase students' learning motivation and facilitate students in understanding learning materials (Wulandari et al., 2021).

Students' insights are improved by the problems or cases regarding environmental problems presented in the E-Module. The problems or cases contained in the e-module are in accordance with the used of PBL learning method. According to Wulandari & Surjono (2013), this PBL is considered suitable for use in teaching materials such as e-module because this PBL model improves students' problem-solving

skills and students becomes more understanding of the learning content and helps them develop their knowledge.

According to the teacher, the problem-based e-module on environmental change material is feasible and can applied in biology learning. Similar to research from (Pramana et al., 2020) said that e-module as teaching materials is very helpful for teachers to provide learning material to students. E-module equipped with indicators and learning goals that make easier for students to learn so that learning goals will be achieved. In addition, the e-module presents problems or cases that the teacher can use as a form of problem solving in accordance with the PBL model used in learning activities. During the problem solving process, students will develop their knowledge to find answers to the problems given by the teacher (Sujiono et al., 2017).

The problem-based e-module on environmental change material can be used by teachers as learning supplements for students so as to attract students to learn environmental change material, in addition teacher can evaluate students' learning outcomes. As said by Iswandari et al. (2020) in the e-module research that teachers can control student activities and evaluate students' understanding of the learning material. Students are also more active in learning activities with the e-module and encourage student learning motivation because the material is packaged in an interesting way.

Effectiveness of Problem-Based E-Module on Environmental Change Material

The evaluation of the effectiveness of the e-module was carried out on a large-scale test. This large-scale test was carried out on 34 students from class X MIPA 2. After the students' pre-test and post-test scores were obtained, the N-gain test and classical completeness test were then carried out. The N-gain test aims to determine whether there is an increase in student learning outcomes by knowing the difference between students' pre-test and post-test scores. Student learning outcomes after using problem-based e-modules can be seen in Table 5.

Table 5. Students' Learning Outcomes

No.	Data	Score		N-gain	Category
		Pre-test	Post-test		
1.	Lowest score	45	60		
2.	Highest score	100	100	0,56	Medium
	Average	73.08	88.23		

The results of the N-gain test of 34 students who took part in the environmental change learning activities using problem-based e-module obtained an average pre-test score of 73.08 and a post-test score of 88.23. Based on the N-gain test, an N-gain score of 0.56 is obtained with a "medium" category. In addition to the N-gain test, the classical learning mastery test was also conducted to find out how many students succeeded in exceeding the KKM score after the e-module was applied in learning. Classical completeness is known from the number of students who can complete the material on environmental change by meeting the KKM score from the school, which is 75. Recapitulation of the results of the classical learning completeness can be seen in Table 6.

Table 6. The Classical Learning Completeness

No.	Data	Score	Student Learning Completeness
1.	Highest score	98	
2.	Lowest score	76	
3.	Average final score	86.58	100%
4.	Number of students who exceed KKM	34	
5.	Number of students who do not exceed KKM	0	

The final score of students obtained 86.58 with students who successfully pass the KKM totaling 34 students and students who fail to pass the KKM are 0 or none, so that the classical learning completeness obtained 100%. A learning is considered classically successful (classical completeness) if at least 85% of the number of students exceeds the KKM that has been determined based on the student's final score (Royani, 2017). Based on the student learning outcomes above, it can be stated that the problem-based e-module based on environmental change material is effective in improving student learning outcomes.

The application of this problem-based e-module in its learning activities contains a PBL learning syntax. The PBL method used has a positive impact on students' problem solving skills and makes students active in learning because the learning activities present students to real problems in the environment so that students can improve students' understanding of the concepts and principles of the material being studied (Ionita & Simatupang, 2020). E-modules that are integrated with problem-based have the advantage that problem solving can develop students' knowledge and abilities, besides that it can improve students' critical thinking skills, and motivate students to learn (Anggraini & Masykur, 2018). The PBL learning method presented in the e-module will practice students to learn independently in solving problems without a teacher (Pertiwi & Masugiono, 2017).

In this study, environmental change material was chosen which the problems presented to students were cases of environmental problems that actually occur in life. When conducting investigations and problem analysis with their groups, students will need high thinking skills in solving these problems, besides that students' insight also increases, so that they can better understand the subject matter. This statement is in accordance with Zhafirah et al. (2021) which said that PBL learning helps students better understand the concepts of the material being studied because students actively find the concept themselves by using higher thinking skills to be able to solve problems. The real problems given by the teacher require students to collect the experiences they got from the environment to identify and solve the problems presented in learning.

The improvement of student learning outcomes are supported by the use of e-module in their learning activities. Some of the advantages of using e-module as teaching materials are that it equipped with pictures and supporting videos that facilitate students in learning. Evaluation of learning in e-module in the form of practice questions can be done by students themselves to determine understanding of the material after studying e-module. This e-module is a teaching material that has been integrated with today's technology and can be used as independent study material for students because it is flexible and can be read and studied anytime and anywhere via a notebook or smartphone, making it easier for students to learn.

The Directorate of High School Development said that e-modules play a very important role because they have followed developments in technology, information, and communication. E-module have important advantages to be developed in today's learning because of their interactive feature, suppressing the use of printed teaching materials and can be combined with various learning methods (Basaroh et al., 2021). The results of the research from Mutmainnah et al. (2019) also stated that the e-module was developed with an attractive design, equipped with pictures and videos, and written in a language according to the level for students to learn. E-module as independent teaching materials encourage students to construct their own knowledge, while the teacher only acts as a student learning companion.

Practicality of Problem-Based E-Module on Environmental Change Material

Problem-based E-module practicality assessments are filled by teachers and students using e-module practicality questionnaires. This practicality questionnaire aims to find out the ease of use of e-module for student learning. The practicality questionnaire of this e-module is given to biology teacher and 34 students of class X MIPA 2. The assessment component of the e-module practicality questionnaire includes aspects of ease of use, attractiveness, usability, and usefulness. The results of practicality assessment of the problem-based e-module can be seen in Table 7.

Table 7. The Result of E-Module Practicality Assessment

No.	Data Source	Percentage (%)	Category
1.	Biology teacher of SMAN 2 Kebumen	82.5	Very Practical
2.	Students of SMAN 2 Kebumen	85.4	Very Practical
	Average percentage	83.9	Very Practical

The results of the practicality assessment of problem-based e-module on environmental change materials obtained an average percentage from teacher and students of 83.9% with "very practical" category. Based on the results of the practicality assessment of e-module it can be stated that problem-based e-module on environmental change material is practical and easily used for student learning and can be applied to learning environmental changes material. As Mahadiraja & Syamsuarnis (2020) in their research on the development of online-based learning module stated that based on the recapitulation of practicality, the average practicality score obtained of 85.75% with the category "very practical".

The practicality of problem-based e-module on the ease of use aspect is indicated by clear and easy-to-understand instructions, e-module are easy to run or operate without error, and can run well on notebook and smartphone. According to Kusaeri & Suprananto, this practicality shows that the e-module used does not make it difficult for students or teachers to use it (Zainuddin et al., 2021).

The attractiveness aspect in the practicality of the e-module shows that the text and images can be seen clearly and the video presented in the e-module can be played properly and students can use to make it easier to understand the material. This practicality shows that e-module can provide easiness for students to use, attract attention and encourage students to learn. (Alfiriani & Hutabri, 2017)

The usability aspect in e-module practicality shows that the development of this problem-based e-module helps teacher to be able to provide real examples in the environment to students regarding to the learning material. This e-module can also be studied independently by students anywhere and anytime and it is more practical because it can be viewed at any time as they wish. Same as the results of research from (Hilaliyah et al., 2019) that the online version module (e-book) developed is more practical because it is easy to open anytime and anywhere and has utilized today's technology.

The usability aspect in the practicality of e-module refers to the use of problem-based e-module that can make it easier for teacher to provide environmental changes material. In addition, e-modules can act as supplements (complements) and self-study resources for students. According to Depdiknas, the module is used to help students understand learning materials because of their concise and complete presentation as teaching materials in learning activities (Setiawati et al., 2017).

Based on the results of the response from teachers and students on the feasibility and practicality questionnaire, the problem-based e-module of environmental change material has the following advantages and disadvantages:

1. Advantages of E-Module:

- a. E-module can be opened either through notebook or smartphone anywhere and anytime.
- b. E-module can be opened without any additional applications.
- c. In the e-module there is videos to support the material and make it easier for students to understand the material.
- d. E-module are developed with problem-based to help students learn independently.

2. Disadvantages of E-Module:

- a. E-module must be accessed online through a web browser if offline e-module are opened in pdf form but videos cannot be played.
- b. In the material of environmental change has not been presented data on contextual environmental changes in Kebumen City.

CONCLUSION

The problem-based e-module is feasible as supplement in learning environmental change material to based on the results of assessments from material and media experts as well as student and teacher responses. It is also effective to improve student learning outcomes based on the results of the N-gain test and classical learning completeness. The problem-based e-module is practical to use in learning based on the results of student and teacher responses.

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