

Development of SETS E-Module Integrated with POE Model for Science Learning

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Abstract. *This research developed Science, Environment, Technology, Society (SETS) e-module integrated with predict, observe, explain (POE) model on the subject matter of Earth Layer and Its Dynamics for grade VII students. This study aimed to reveal i) the feasibility of the developed e-module for grade VII students, and ii) the practicality of the developed e-module and its dynamics. This is a developmental research adopting the ADDIE model consisting of five stages, i.e.: analysis, design, development, implementation, and evaluation. The subject of the limited test consisted of 15 students of grade VIII.G of Public Junior High School 8 Yogyakarta. The data were collected using a product feasibility assessment sheet for material and media experts, a product practicality assessment sheet for teachers, and a product readability assessment sheet for students. The results show that the developed e-module was feasible to be used according to the material and media experts and the developed e-module is practical according to teachers and students.*

Keywords: E-Module; SETS; POE Model.

INTRODUCTION

With the arrival of industrial revolution era 4.0 in the 21st century, the world is now experiencing changes that are increasingly fast and competitive. Responding to this phenomenon, it is necessary to provide provision in the world of education to prepare generations to survive the challenges in the 21st century. One of them is through learning science in schools. In relation to science education and 21st century skills development, the National Research Council for 21st Century Skills (2010), states that students should emphasize more on 21st century skills learning such as adaptability to their environment, communication skills, the ability to solve problems that are not routinely found by students, self-management or self-development, and thinking systems. These skills

need to be learned to face today's global demands.

Science learning in the 21st century cannot be separated from the application of technology and information. Technological developments are marked by the emergence of various technology-based activities, such as e-commerce, e-government, e-medicine, e-laboratory, and e-education, all of which are electronic based (Hamzah, 2011). Technological developments can be felt, especially in the teaching materials in learning (Ghaliyah et al., 2015). Furthermore, as time progresses, many students prefer to bring laptops or gadgets instead of textbooks. Thick and heavy textbooks are troublesome for students to take to school (Pramana & Dewi, 2014).

A teaching material that utilizes the latest technology is electronic module (e-module). E-

module is a form of independent learning material presentation arranged systematically into specific learning units, which are presented in an electronic format (Direktorat Pembinaan Sekolah Menengah Atas, 2017; Suyoso & Nurohman, 2014). Unlike the printed module, e-module has the advantage of helping students visualize abstract concepts so that students understand the material more easily (Osman & Lee, 2013). The use of e-modules in learning can also foster creativity, productive thinking habits, creates active, effective, innovative, and fun conditions (Budiarti et al., 2016). Moreover, using e-modules can train students' skills to operate technological devices, students can learn with easier access, and can allow students to study anywhere and anytime. This shows the need for developing learning modules in schools in digital form or e-modules.

Teaching materials are very important means in the learning process. Asmuri et al., (2018) stated that science learning materials should be used by both teachers and students to make it easier for them to understand science concepts. Science learning materials that can relate science materials to everyday life are obtained by involving the aspects of science, environment, technology, and society or SETS.

SETS is a form of education that gives an emphasis on the environmental consequences of scientific and technological developments. SETS is an umbrella that supports various types of theories in the relationship between science, technology, society, and environment (Chowdhury, 2016). Ariyanti & Wilujeng (2018) stated that the aim of SETS is to present science and technology as a methodology by involving students. Students can make the best decisions by comparing scientific advantages and disadvantages that arise as a result of scientific developments when solving problems occurring in the society. A similar statement was also expressed by Sugiarto & Djukri (2015), which stated that through SETS learning students were trained to be able to solve problems in a creative way. Wilujeng (2011) also added that the SETS learning applied by a teacher will be able to change students' thinking process because science and technology knowledge is taught by the application of the principles of science and technology and their impact on society and the environment. The implementation of the SETS approach in learning has several stages. Poedjiadi (2010) explained that the SETS approach is applied

through 5 stages as shown in Figure 1.

Based on the results of field analysis through interviews with science teachers and through a questionnaire on student needs in Public Junior High School 8 Yogyakarta, the following points were identified, i.e.: i) students' interest in science learning was good with a percentage of 83.61%, but from interviews conducted with science teachers it was known that students' interest in learning science have not been matched with the independent attitude of students in finding concepts and are more dominated by teachers in conveying concepts. So that the essence of the implementation of the 2013 Curriculum has not been properly achieved. ii) The science learning activity given by the teacher was good but not optimal with a percentage of 79.17%. This is because based on the results of interviews with teachers; the learning model used by the teacher is still not variative, which tends to pursue the target of completing the material for each basic competency due to time constraints so that teachers only focus on science material and rarely associate the science concept with technology, environment, and current issues relating to problems in people's lives. iii) The module used by the teacher in the science learning activity was good with a percentage of 81.88%. The module used is a module developed by the teacher. However, the modules used have not been able to fully support the science learning process. This is evidenced by the fact that teachers often involve technological devices to help explain or visualize material in the form of videos and animations in the module so that it is easier for students to understand. The modules developed by teachers in schools are still in printed forms so teachers often use digital technology to visualize the material so that it is easier for students to understand. iv) The condition of information and communications technology (ICT) in schools and students' interest in learning science through ICT is considered good with a percentage of 81.46%. The activity of learning science in the classroom generally already involves ICT. However, learning science with the help of ICT used by teachers is still not variative, e.g.: teachers only use power points (PPT) and learning videos.

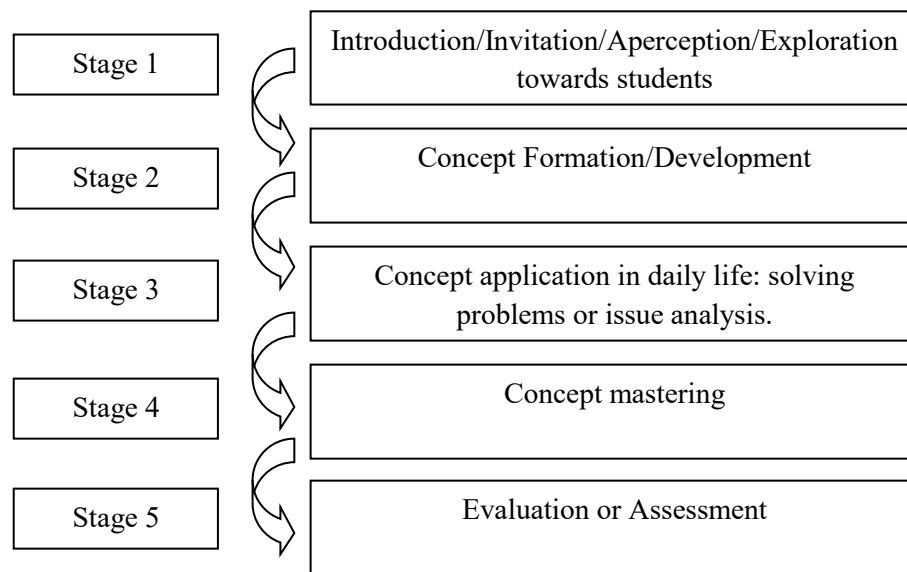


Figure 1. The SETS Approach Stages

Starting from various facts and problems that have been analyzed, it can be seen that there is a mismatch between the methods, models or media used and students' characteristics during the learning activity. Science learning objectives can be achieved when the learning activity is understood by students. Students can understand the concept of science, phenomena, or natural events through scientific processes carried out. This means that science learning is not only in the form of declarative knowledge, but also procedural knowledge such as how to obtain information, scientific work, and thinking skills (Syahrani et al., 2016). Not only that, teachers should have the skills to choose learning models that are in accordance with the characteristics of the learning material (Suranti et al., 2016). One of them is through the predict, observe, and explain (POE) learning model.

The POE model is a learning model that begins by exposing students to problems and then inviting the students to predict at the beginning of learning activities to find out the initial concepts that students have, then proving predictions through experimental activities and making explanations. This model is student-centered and efficient in generating student ideas. Özdemir et al., (2011) explained that the POE model is a model that can develop students' self-expression and communication skills where students are invited to connect old with new knowledges. So that students can correct misconceptions. The results of Yulianto et al., (2014) showed that the application of the POE learning model in physics learning can

improve students' critical thinking skills and cognitive abilities. The POE learning model can also improve students' understanding of physics concepts compared to conventional learning models (Restami et al., 2013).

Based on the results of the analysis found in the field and also several other facts related to the advantages of using e-modules in learning, it is important to develop a learning material product, namely the SETS e-module integrated with the POE model. The specification of this e-module contains the stages of SETS approach and integrated with the POE model. The use of the SETS elements is intended so that the science learning material presented is not limited to theory but is more contextually taught so that the science concept becomes more embedded in students' lives. Asmuri et al., (2018) explained that the SETS-based module can open insights about the nature of science education, environment, technology, and society as a whole so that it can improve students' critical thinking skills. The development of the SETS model is not only writing concepts, but something more tangible that can be understood, felt, analyzed, and become alternative solutions in problem solving (Rosana et al., 2019). The relationship between the learning material and real life proves that the SETS approach is to teach science and technology in the context of human experience. Integrating the POE model in this e-module is expected to be student-centered learning. Rahayu et al., (2015) also revealed that the application of the POE model in science learning can improve students' understanding of

concepts and science process skills. Learning using the POE model is also proven to be able to improve science learning outcomes and student retention (Shofiah et al., 2017). The e-module

specification developed in this study contains 5 stages of the SETS approach and one of the stages is integrated with the POE model. The integration scheme can be seen in Figure 2.

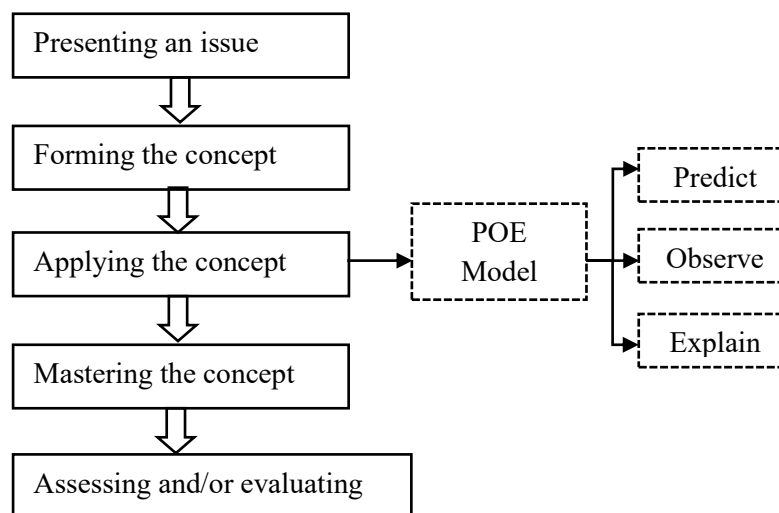


Figure 2. The integration of the POE model into one of the SETS approach stages.

A software that can produce interesting e-module products and make learning more enjoyable is Flipbook. Flipbook is one of the learning media in the form of e-books, e-modules, e-papers, and e-magazines, which have the advantage of being able to insert files in the form of pdf, images, videos, animations, have template designs and features such as a control button, navigation bar, and hyperlink, so that the developed Flipbook is more interesting (Maf'ula et al., 2017).

Flipbooks or e-books are different from textbooks. Textbooks have several weaknesses including appearance, production process, and usage. Printed books are easily damaged and torn and the use of printed books is boring and makes students rarely study them because of their unattractive appearance (Arsyad, 2007). Flipbooks can be presented in an electronic format, which is able to display interactive simulations by combining animation, text, video, images, audio, and navigation that make students more interactive, so that learning can be fun and attract students' attention (Diani & Hartati, 2018).

Applications that can be used to create e-modules include eXeLearning (Pilt et al., 2014); Kvisoft Flipbook Maker (Sugianto et al., 2013); 3D Page Flip Professional and Flip PDF Professional (Seruni et al., 2019). The Flip PDF Professional application has more advantages, namely that it is easy to use because it is easy to operate for beginners who do not master the

HTML programming language.

Flip PDF Professional is a feature-packed flipbook maker, which has a page edit function. This application can also create interactive book pages by inserting multimedia such as videos from YouTube, images, MP4, audio video, hyperlink, quiz, flash, and others (Seruni et al., 2019). Watin & Kustijono (2018) in their research also revealed that the Flip PDF Professional application has a few advantages over other flipbook applications, e.g.: Flip PDF Professional is more compatible on laptops and mobile devices.

Based on these descriptions, the researchers are interested in conducting a study entitled: "The Development of SETS E-module Integrated with POE Model in Science Learning". The e-module developed in this study is made with several advantages and has novelty, i.e.: i) contains natural science material with SETS approach; ii) contains experimental activities by integrating the stages of the POE model; and iii) presenting interactive science materials in the forms of videos, animations, hyperlinks, quizzes, flash, and can be easily accessed via laptops, computers, mobile devices either online or offline. This study aims to reveal the feasibility and practicality of SETS e-module integrated with the POE model on the topic of Earth Layer and Its Dynamics for grade VII junior high school students.

METHOD

This is included in the development research using the ADDIE model, which consists of five stages, i.e.: analyze, design,

develop, implement, and evaluation (Branch, 2009). Each stage of the ADDIE procedure can be seen in Figure 3.

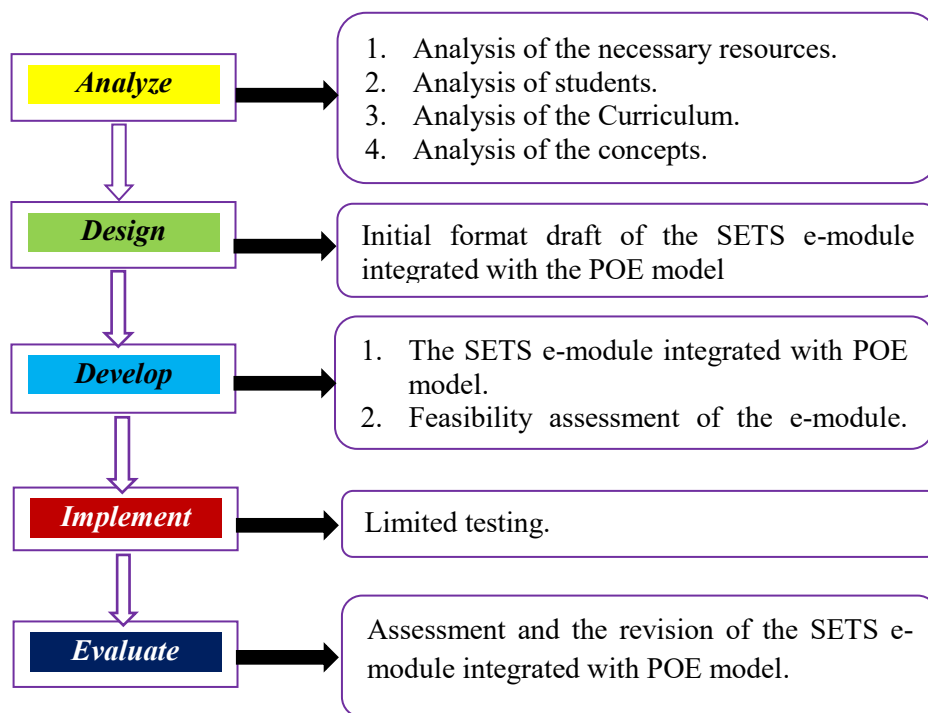


Figure 3. The procedure in the development of SETS e-module integrated with POE model.

Before entering the first stage, i.e.: analyze, the researcher conducted a preliminary study to collect data related to the problems in science learning and the needs of teachers and students for science learning. After obtaining the data from the preliminary study, the analyze stage is then carried out to describe the causes of the gap between the expected conditions and the reality in science learning that occur upon the target users of the developed product. Next is to make an e-module design based on the information from the preliminary study. The third stage is the develop stage of the e-module according to the initial design until a product is obtained in the form of a POE model integrated SETS e-module, which is feasible based on the expert judgment. The fourth stage is the implement stage. The e-modules that have passed the assessment process, declared feasible by experts, and have been completely revised in the develop stage, are implemented in the school in a limited trial. The limited trial conducted was product practicality and readability tests by the teachers and students through the practicality and readability assessment instruments, respectively. The practicality test of the product

was carried out by several science teachers, while the product readability test involved 15 students of grade VIII in Public Junior High School 8 Yogyakarta who represented the categories of students with high, medium, and low abilities. The fifth stage is the evaluate stage, which aims to assess the quality of the e-modules developed both before and after the implementation. The general procedure associated with the evaluate stage is the analysis stage of the assessment and revision of the product.

The data collection instruments used in this study consisted of 1) product feasibility assessment sheets by material and media experts; 2) the product practicality assessment sheets by the teachers; and 3) students' readability assessment sheets. Feasibility assessment by material experts consists of two aspects, i.e.: material substance and learning design. The feasibility assessment by media experts consists of two aspects, i.e.: appearance (visual communication) and software utilization. Furthermore, in the assessment of product practicality by the teachers, there are four aspects of assessment, which include material

substance, learning design, display (visual communication), and software utilization. The assessment of product readability by students consists of three aspects, viz.: material substance, appearance (visual communication), and benefits.

The product feasibility and practicality analysis technique used in this study includes

the following steps: 1) tabulating all data obtained from each product feasibility assessment sheet; 2) calculating the average number of scores from each of the assessed aspects; and 3) converting the total average score into a qualitative value (interval) on a scale of five. The conversion of the scores into the interval data is shown in Table 1.

Table 1. The product criteria interval.

Score Interval	Value	Category
$X > X_i^- + 1.80 sb_i$	A	Very Good
$X_i^- + 0.60 sb_i < X \leq X_i^- + 1.80 sb_i$	B	Good
$X_i^- - 0.60 sb_i < X \leq X_i^- + 0.60 sb_i$	C	Moderate
$X_i^- - 1.80 sb_i < X \leq X_i^- - 0.60 sb_i$	D	Low
$X \leq X_i^- - 1.80 sb_i$	E	Very Low

(Widoyoko, 2009)

The product readability questionnaire analysis used two alternative answers, i.e.: 'yes' with a score of 1 and 'no' with a score of 0. The steps for analyzing the product readability questionnaire were as follows: 1) recapitulating each item of the questionnaire statement; 2)

calculating the total score on each aspect; and 3) converting the total score for each quantitative aspect into qualitative values based on the conversion of the score to a scale of five. The reference for changing the score to a scale of five is given in Table 2.

Table 2. The conversion of the score into a scale of five.

No	Percentage (%)	Value	Category
1	86 - 100	A	Very Good
2	76 - 85	B	Good
3	66 - 75	C	Moderate
4	55-65	D	Low
5	≤ 54	E	Very Low

(Purwanto, 2002)

RESULTS AND DISCUSSION

Results

The SETS e-module integrated with the POE model developed in this study uses the ADDIE development model, starting from the preliminary test until the resulting POE model integrated SETS e-module. The SETS e-module integrated with the POE model is developed on the material of Earth Layer and Its Dynamics for grade VII junior high school students. The product development is carried out using the Flip PDF Professional software, which can produce two types of output, i.e.: the application and the android versions. This e-module can be accessed offline or online via a computer,

laptop, android, tab, or other similar electronic devices. The displays of the android and application versions of the e-module can be seen in Figures 4 and 5, respectively.

This e-module consists of several components, i.e.: the cover, preface, table of contents, introduction, learning activities, glossary, and bibliography. Each of these learning activities includes the title of the learning activity, the learning objectives, the material description with the SETS approach, the integration of the POE model, a summary, the critical thinking box, scientific facts, and evaluation (formative tests).

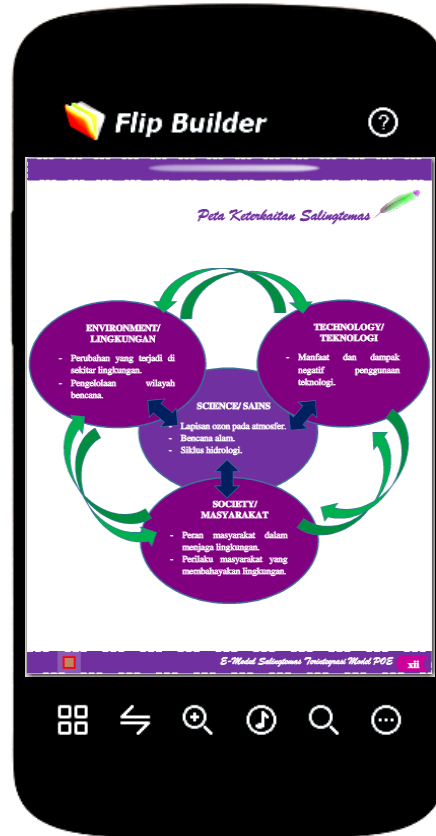


Figure 4. The display of the SETS e-module in the android version.

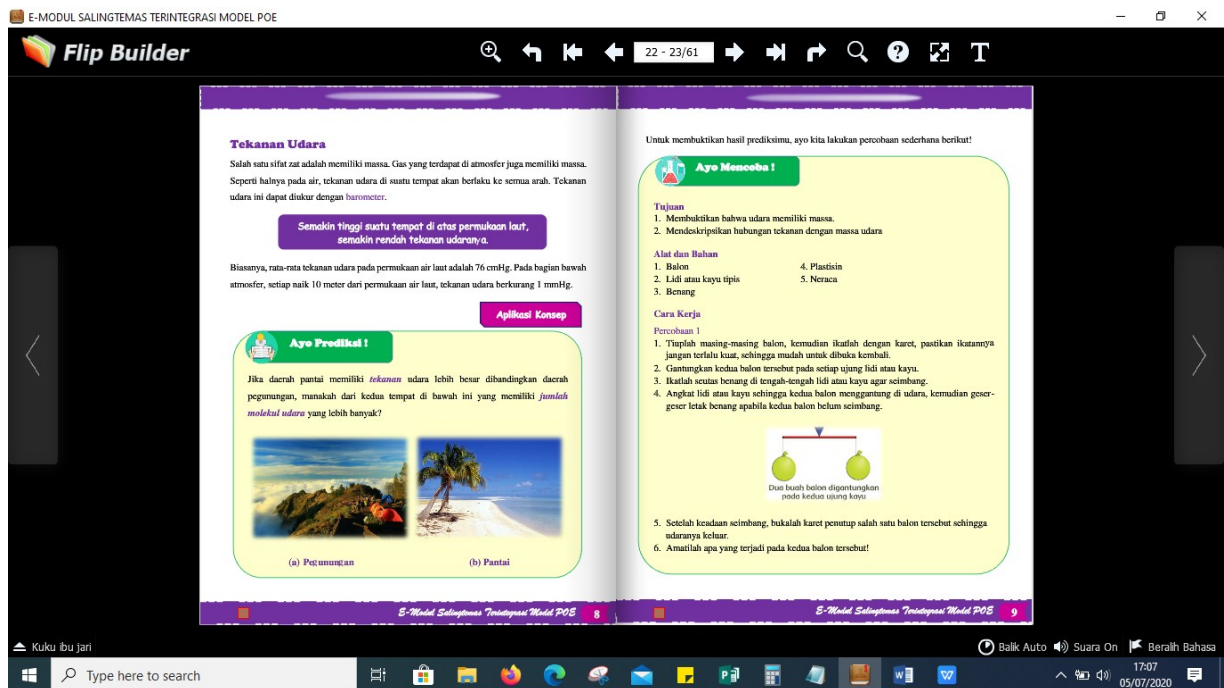


Figure 5. The display of the SETS e-module in the application version.

The design of the e-module also has other advantages such as the addition of videos, animations, the interactivity of the evaluation tests made in the form of educational games, availability of links in the table of contents, and

navigation buttons on each page. The design of the e-module is in accordance to the SETS approach with one of the stages is integrated with the POE model.

The e-module feasibility assessment was

given by two experts, namely material and media experts. The results of the assessment given by the material expert cover two aspects, namely material substance and learning design. The material substance and learning design aspects consist of 7 and 4 indicators, respectively. Furthermore, the feasibility assessment by the media experts also includes two aspects, i.e.: the display (visual communication), which consists of 6 indicators

and the software utilization, which consists of 3 aspects. Each of these indicators contains 4 criteria. The quality of the feasibility assessment refers to the score intervals in Table 1 and has been adjusted to the number of indicators in each aspect. The results of the feasibility assessment of the SETS e-module integrated with the POE model can be seen in Tables 3 and 4.

Table 3. The results of the feasibility assessment by the material expert.

No	Aspect	Average Score	Assessment Quality
1	Material Substance	28	Very Good
2	Learning Design	16	Very Good

Table 4. The results of the feasibility assessment by the media expert.

No	Aspect	Average Score	Assessment Quality
1	Display (Visual Communication)	22	Very Good
2	Software Utilization	12	Very Good

Tables 3 and 4 show that the average value of each aspect of the feasibility assessment of the SETS e-module integrated with the POE model is in the Very Good category. Moreover, the results show that the SETS e-module is feasible for use in science learning on the material of Earth Layer and Its Dynamics according to material and media experts.

The trial test was conducted to obtain information on the practicality and readability of the product by the teacher and students, respectively. This limited trial was conducted upon 15 students in grade VIII.G of Public Junior High School in Yogyakarta. The

practicality assessment by the teacher consists of four aspects, namely material substance with 5 indicators; learning design with 3 indicators; display (visual communication) with 4 indicators; and software utilization with 2 indicators. Each of these practicality assessment indicators contains 4 criteria. The quality of the practicality assessment refers to the score interval in Table 1 and has been adjusted to the number of indicators that exist in each aspect of the practicality assessment. The results of the product practicality assessment by the teacher can be seen in Table 5.

Table 5. The results of the practicality of the SETS e-module integrated with the POE model.

No	Aspect	Average Score	Assessment Quality
1	Material Substance	20	Very Good
2	Learning Design	12	Very Good
3	Display (Visual Communication)	16	Very Good
4	Software Utilization	8	Very Good

The assessment of the readability of the SETS e-module by students consists of 3 aspects, namely the material substance with 3

indicators, the learning design with 5 indicators, and the benefit with 4 indicators. The range of scores used in the product readability

assessment is a scale of 1 to 100 according to Table 2. The results of the e-module readability

assessment are presented in Figure 6.

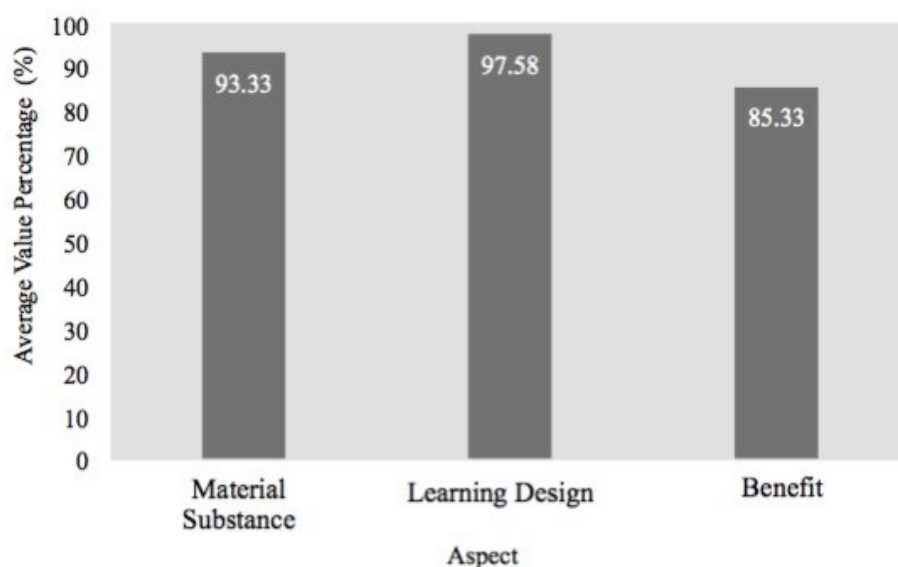


Figure 6. The results of the SETS e-module readability by students.

Figure 6 shows the average value of each aspects of the SETS e-module readability. The average value in the aspect of material substance is 93.33% with a Very Good category. Furthermore, the second aspect is the learning design with an average score percentage of 97.58% with a Very Good category. The third aspect is the benefit aspect with an average percentage value of 85.33%, which is in the Good category.

The last step in the product development is the evaluation of the product being developed. Product revisions are carried out after obtaining an assessment, namely assessments before and after the product trial test.

Product revisions are carried out after product test trials, namely after getting the assessments of product practicality and readability by the teacher and students, respectively, on the limited trials. The average assessments given by the teacher and students upon the SETS e-module is Very Good. Comments are also given by the teacher regarding the SETS e-module, e.g.: the product is good and can be used in a user friendly and attractive manner. However, there are several pictures in the Competency Test 3 (Formative Test 3) that are less interesting because of the gray scale. However, overall it is very good.

As for the comments or responses given by the students after using the SETS e-module,

are as follows: a) the e-module is interesting and the material presented is easy to understand, b) the e-module can lead students to study independently, c) the e-module can increase students' enthusiasm for learning science, and d) the e-module is easily accessible and the practice questions made in the form of educational games are very interesting and can train students' ability to do it quickly.

Discussion

The results of the feasibility assessment of the SETS e-module integrated with the POE model by the material and media experts show that the quality of the e-module developed on average is in Good category. Furthermore, the teacher and students assessments of the SETS e-module show that the e-module is practical to be applied in science learning. The SETS e-module is designed by adding features that support learning materials such as videos, animations, evaluation tests in the form of educational games, and links on each page. In general, students reveal that i) the SETS e-module is practical to be used, ii) the e-module has an attractive appearance so that it does not bore students in learning, iii) the material presented in the e-module is very clear and easily understood by students, iv) the e-module increases students' enthusiasm for learning, and

v) can guide students to study independently.

The results of (Syahroni et al., 2016) show that students enjoy learning using digital modules because they contain material equipped with audio-visual animation, video, and explanations that are in accordance with the material so that they help students understand the material and to be more enthusiastic to participate in learning. The results of Susanto et al., (2013) also reveal that the use of interactive media in learning makes students more interested, active, and understands the material better. This is in line with the study conducted by (Sugianto et al., 2013), which states that flipbook-based e-modules are easy for students to understand and increase students' enthusiasm for learning because there are animations to eliminate the feeling of boredom during learning. Similar results are also obtained by Priatna et al., (2017), which stated that e-modules can help students understand the material faster and increase interaction between teachers and students.

The SETS e-module integrated with the POE model is arranged in 5 stages, i.e.: issue presentation, concept formation, concept application, concept development, and assessment. In one of these stages, i.e.: the application stage, the concept is integrated with the POE model syntax, which consists of 3 main syntaxes, namely predict, observe, and explain. The learning application that uses the SETS e-module can be a means of increasing students' interest in learning science and helping them to connect the concept of science learning with everyday life (Abualrob & Daniel, 2013).

A similar study was also conducted by Purwanto et al., (2020) who developed an electronic module for enrichment program in the form of SETS. They found that the SETS e-module developed was suitable for use as an interesting and interactive learning resource and can help students to learn independently. A study by Prihandono et al., (2017) also revealed that the local potential-based module integrated with SETS is suitable for use in learning and can improve student learning outcomes and environmental awareness attitudes.

The integration of the POE model in the SETS e-module at the application stage contained in the experimental activities is aimed to fully engage students in predicting, observing, and explaining the conclusions they obtain, so that the learning process is dominated by students in finding and conveying concepts. This

is in line with the results by Fannie & Rohati, (2014), which stated that the POE model can make students understand the concepts easier, train them to be able to learn independently, and be more active in learning activities. The learning activities using the POE model also require student cooperation actively in obtaining answers to the problems given and then looking for explanations concerning the answers obtained from the stages of the POE model so that students are more motivated and active in learning. Shofiah et al., (2017) showed that there was an increase in student science learning outcomes using the POE model with the experimental method. This POE model can also be used to correct students' misconceptions of physics (Tyas et al., 2013). The results by Farikha et al., (2015) show that learning using the POE model assisted by experiments can increase students' learning activity and achievement.

CONCLUSIONS AND SUGGESTIONS

Based on the results and discussion of the study that have been described above, it can be concluded that the SETS e-module integrated with the POE model is feasible for use in science learning for students in grade VII of junior high school on the material of Earth Layer and Its Dynamics based on the assessments by the material and media experts. Moreover, the SETS e-module integrated with the POE model is practical to be used in science learning for students in grade VII of junior high school on the material of Earth Layer and Its Dynamics based on the assessments by the teacher and students. We suggest that the SETS e-module integrated with the POE model is used as teaching materials in schools. The aforementioned e-module can also be used as a guide for teachers in developing innovative teaching materials for other science topics.

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