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Development of SETS (Science Environment Technology and Society) Based E-Modules on Environmental Pollution Materials to Increase Learning Interest and Critical Thinking Ability

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Abstract: The background of this research stems from the minimal number of learning resources E-module Science E-module for class VII SMP, learning activities which are still monotonous and are still little used, there is a dichotomy of science and a learning model that is still teacher-centered which is synonymous with lectures, there is no module that contains SETS values, and UN results that do not meet the KKM on environmental pollution. The objectives of this research are: (1) Development of IPA E-module products. (2) Knowing the feasibility of the SETS-based IPA E-module, (3) Knowing the effectiveness of the application of SETS-based IPA modules. The product developed in this study is the SETS-based IPA E-module. Specifications for the science module in the form of printed media as a competency-based 2013 implementation curriculum. The subjects in this study were class VII students of junior high school. The sample consisted of teachers belonging to the Siak MGMP, and class VII students of SMP Nurul Furqon Siak. The validity test of the developed module can be seen from the validity test using the Pearson product moment test using SPSS 25 for windows software and so that the questionnaire used in this research is truly reliable as a data collection tool and can see the concentration of the questionnaire used, the questionnaire is tested for reliability or the level of trust can carry out Cronbach's alpha inferential test with the help of SPSS.The data analysis technique used is descriptive qualitative. The conclusion of this research is; First, SETS-based Science E-Module Development on environmental pollution material. Second, the development of SETS-based Science E-Modules can be said to be very practical in terms of the material aspect 3.25 the presentation is very good in language and graphics is very good so that it can be interpreted that the modules developed are said to be very good for use in science learning. Third, the development of well-developed SETS-based Science modules is effectively used to improve student learning outcomes. So it can be concluded that learning outcomes using SETS-based science modules are better than conventional learning.

Keywords: Environmental pollution; Science E-Module SETS.

Introduction

Education is a place to explore the potential possessed by human resources in terms of knowledge, morals, and skills. Education always appears together with the development and improvement of students' abilities, existing environmental situations and conditions, the influence of information and culture Nurdyansyah (2020). Education is a basic need that has a very important role for humans and can improve the quality of life of a nation and is a significant factor in the development of individuals and national culture. Through education, individuals can develop the resources within themselves so as to create productive individuals, and can utilize the resources found in their environment, and advance the nation Masdul (2019).

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The low aspect of students' current thinking skills is also caused by several factors, namely the lack of active involvement of students in ongoing learning (Ulfah et al., 2021). Students at school are used to working on questions that are commonly discussed, so when they are given questions about improving critical thinking skills they will experience the ability to answer and solve the problems given Ridho et al., (2020); Wasis, (2015).

Specifically for creative thinking, Beghetto (2010) writes that researchers have identified obstacles in the development of creativity (including critical thinking) in the classroom, namely convergent teaching practices, teachers' attitudes and beliefs about creativity, environmental motivation, and students' own beliefs. towards creativity.Supported by the results of preliminary research conducted by researchers through interviews with questions that have been prepared that lead to the object to be studied. Interviews were conducted by distributing the google form link to SMP or MTs science teachers who were still within the scope of Riau. It was found that students' critical thinking skills were still low because only 13.3% of students were always able to answer questions well with indicators of critical thinking skills and 66.7% of teachers who always had difficulty training students' thinking skills. (appendix 3).

This problem is also something that must be resolved immediately, and how to teach thinking skills in schools so that it can be something that can improve student learning Zubaidah (2010). This is a challenge for teachers and requires reform and innovation in the education system, especially through the learning process in schools Akinoglu and Baykin (2015). There are many ways that can be done to solve the problem of students' low critical thinking skills. One of them is the application of the Science, Environment, Technology and Society (SETS) model and approach in science learning, so that students can associate any knowledge gained with the use of existing technology. exists and is useful to society Minarti (2022).

The SETS approach is a learning approach that focuses on problems from the real world in the environment around us, one example is environmental problems, which have science and technology components from the student's perspective, in which there are concepts and processes, then students are invited to investigate, analyze and apply the concept Fatchan et al (2019). SETS learning is very suitable to be applied to science learning because with SETS science learning is more interesting, fun and meaningful, so that the knowledge gained by students is not quickly forgotten.In previous research conducted by Maulidaty 2020, the application of the SETS approach can improve students' critical thinking skills. This is in line with Arif Rahman's (2021) research, that the SETS approach provides significant results on student enthusiasm and interest in learning.

E-modules are able to increase the competence and understanding of students through interactive processes, facilitate navigation, have feedback, are able to display audio, images, videos, and animations Arsal et al. (2019), Laili et al., (2019). E-module is independent so that it can overcome space and time problems according to the needs of the mass media. Princess et al. (2021), one of the software that facilitates the creation of e-modules is the flipbook maker Oktaviara Pahlevi (2019).

In addition to applying appropriate learning models and approaches, the use of e-modules also influences the ability to think critically and students' interest in learning. In research conducted by Setyowati et al 2020, the use of e-modules as a support for learning is also important so that students become interested in the science material itself which in the end will be able to improve students' critical thinking skills. In addition, the approach used by the teacher in learning science is also able to influence interest in learning and students' thinking abilities. Likewise with the research results of Muthia Ulfa (2021), explaining that e-modules are effective for increasing students' interest in learning and mastering the material. Based on the effect size value, the experimental class learning interest value was 0.109 in the medium category and the experimental class was 0.284 in the very large category.

Meanwhile the results obtained by the researchers from the respondents' answers were that there were still few teachers who were familiar with e-modules and had little knowledge about SETS. From the results of the preliminary research, it was found that 73.3% of teachers were not familiar with the SETS approach, only 13.3% occasionally used the SETS approach in learning science. Meanwhile there are 60% who have never used IPA e-modules.

The cause of students' low critical thinking skills, less active classes and lack of student enthusiasm is also due to learning activities carried out in class only utilizing existing textbooks and not being linked to the student's environment, as seen from the analysis of students' needs, 70% of the teaching materials that are always used are books student. Then 56.7% of class activities using the lecture method are continued by doing practice questions. Activities like this can make students become bored and students' interest in learning decreases. Activities like this can make students become bored and students' interest in learning decreases.

Method

This type of research is Research and Development (R&D), which is development research with steps to develop a new product or improve existing products and can be accounted for. For preliminary data is qualitative data, in the form of the results of interviews with science subject teachers. Then the data obtained from product development is qualitative and quantitative data. Qualitative data is in the form of expert advice and input regarding the e-module, while quantitative data is in the form of expert validation sheets and student answer sheets on pretest and posttest results. The development model used is the ADDIE model adopted by Lufri (2017) consisting of 5 stages of development, namely Analyze, Design, Development, Implementation, and Evaluation.

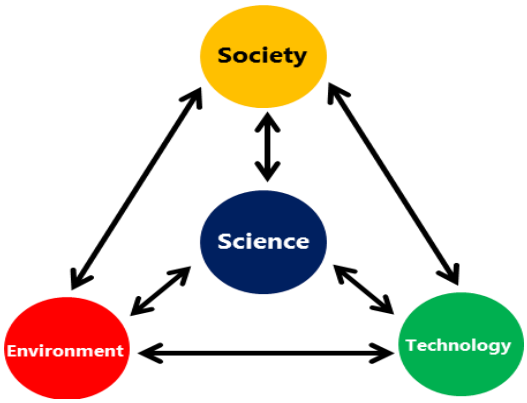

Figure 1. Display of SETS

Result and Discussion

By following the steps of the ADDIE paradigm (Analyze, Design, Development, Implementation, and Evaluation), such as the following, environmental pollution teaching materials are developed using online flipbook software.

1. The first step is analysis The two processes that make up this analysis stage are the literature review and the field research. The literature analysis looked for references in theory and related research. To discover accurate information concerning issues with classroom learning, field research is performed. At this point, both teachers and students were the subjects of observations and interviews. This is consistent with the viewpoint expressed by Puspasari & Suryaningsih (2019), who believe that outcomes are obtained through analysis phases that are examined by researchers before being improved upon by team evaluations. According to Puspasari & Suryaningsih (2019), the steps of analysis that produce the results are examined by researchers, who then conduct an evaluation with colleagues to enhance the analysis's findings.
2. Style
   The E-module product is created during the design phase. This type of e-module design is known as a storyboard, and it is at this point that the framework for the e-module is created. All of the e-module's components are included in the storyboard, including the cover and backdrop, the typeface and font size that are used, the resources that are compiled, the assignments, and quizzes that are included in the e-module.
   The overall framework is divided into five sections, including an introduction, learning exercises, assessment and answer books, vocabulary, and references. That is the module usually ends with a glossary and bibliography. A list of words that are regarded difficult with explanations is called a vocabulary (glossary). It is intended that by using this language (glossary), pupils will become more independent learners (Kustandi, 2020).
3. Designated e-modules will be made public and verified by media and material experts. E-module designed with Microsoft Office 2010 software to organise content, include images, and also include quizzes and videos. using the Canva software, to create the covers and backdrops for e-module teaching materials.

In addition, moving away from curriculum analysis, research are done on Basic Competency (KD) KD 3.8: Analyzing the presence of environmental pollution and its effects on ecosystems. The metrics utilized for this research are based on the ministry of education and culture's requirements for core competencies and fundamental skills in secondary scientific education. demonstrates that despite the fact that students are encouraged to participate more actively in the 2013 curriculum, instruction still takes a teacher-centered approach. In addition to placing more emphasis on Basic Competencies (KD), the student-centered approach. According to Moh Roqib (2011), being capable, creative, autonomous, and developing into a democratic and responsible citizen are all signs of religion.

The next stage is to identify the necessary sources once the analysis of the student characteristics has been completed. Learning resources are everything that enables students to get learning experiences, such as classrooms, tools and materials that may be used, lecturers, teaching resources, and anything else that has an impact on the success of the experience Study. The next step is to identify the sources that are required after the analysis of student characteristics has been put into practice. Learning resources are everything that enables students to get learning experiences, such as classrooms,

tools and materials that may be used, lecturers, teaching resources, and anything else that has an impact on the success of the experience Study. Define a source after determining the one that is required.

After determining the required source, create an appropriate learning plan by choosing the best approach or strategy as a means judged suitable to fill the gap discovered by the steps and analysis of participant characteristics. The plan is to use the SETS (Science, Environment, Technology, and Society) framework to construct a learning module on colloidal systems.

Planning the e-module creation process is the last step in the analysis phase. This is done to estimate the quality, time, and costs involved in generating e-modules, even if the reality often differs from the estimates made during the analysis phase. At this point, the design stage (Design) is concerned with finding solutions to the learning issues that the analysis step has revealed. The first thing that needs to be done during this design phase is to identify the essential learning experiences that belong to the students. Learning experiences are activities that students engage in to gain new knowledge and skills in accordance with the goals to be attained while taking into account instructional objectives, materials lessons, learning resources, and also student characteristics Sanjaya (2010).

This learning experience is represented by the creation of an electronic module that aims to address any issues or gaps found during the analysis phase. Once it is established that there is a gap in the analysis phase, the steps of e-module development design are carried out. As for what was done during the design stage, such as developing the e-module test/assessment and strategy analytical assignments and content analysis.

Task analyses are created in accordance with instructional objectives that have been developed, learning indicators derived from instructional goals and stage considerations for students, subject matter that is devoted to the main sub-material, and what tasks will be formulated and included in the e-module learning chemistry so that students can accomplish instructional objectives that have been established. Both substance and submatter Chapters and Subchapters will design the created e-modules using this structure.

It is modified to the learning strategy in the module's task formulation section. The strategy employed is called the SETS approach, and it consists of four stages: conceptualization, concept application, and idea formation. Chemistry learning e-modules contain the SETS phases in each CHAPTER. At the initial stages, Emphasizing the discussion of societal concerns or problems during the introduction stage is one way to spark students' interest. Stages

The next step is concept formation, which emphasizes asking questions about the previously presented discourse. Concept formation can also take the form of a brief explanation of a problem or of useful experiments that help students gain knowledge of the concept. Following the step of concept formation, comes the stage of concept application, which focuses on providing queries and real-world applications of the colloid system. This is an effort to help students use concepts they already understand to analyze the problem or a portion of the solution challenges. This is an effort to help students examine issues or portions of solutions using previously known principles. It is intended that students would be able to use this notion in their daily lives. Consolidation of the concept is the following step. Actual material review was highlighted at this time to avoid misunderstandings.

Following task analysis, it is time to consider the content and construct test-taking strategies or e-module evaluations for chemistry learning. The e-module's content was compiled using material from a variety of sources, including books, journals, articles, the internet, and other supplementary materials. The content of e-modules is based on the structure of based learning SETS, and a number of factors are taken into account when creating e-modules, including. The plan is to use the SETS (Science, Environment, Technology, and Society) framework to construct a learning module on colloidal systems. The dimensions of this e-module are 21 cm x 29.7 cm (A4) in pdf file format. The author's name, the title of the e-module, and an image illustration pertaining to the colloidal system of the content make up the cover.

Figure depicts the e-module cover's appearance. The author's name, the title of the e-module, and an image illustration pertaining to the colloidal system of the content make up the cover. Figure 1 depicts the e-module cover's look.

Figure 2. Display of the E-Module Cover

The next stage is publishing once the E-Module has been finished. The electronic module's download step is the publishing stage in the online flipbook format. This enables students to access it online through smartphone or computer in the form of a link, or offline via laptop or computer in the form of an exe format. Video quizzes are used in the publishing process, and the table of contents will be included at this point. This is in line with Rindaryati's assertion (2021) that the Flip Flipbook program Professional allows for the addition of movies, a table of contents, and quizzes that are accessible immediately from the e-module.

The product will be validated to determine the viability of the e-module to be built after it successfully completes the publishing stage. Three validators—material specialists, pedagogics, and media experts—who teach at the University of Riau are involved in this validation. This material underwent three rounds of validation, and the findings led to a number of recommendations for enhancements to the environmental pollution content. The findings of the material expert validation in cycle 1 are shown below. 85% of the results were categorized as "Very Valid," but the validator made numerous helpful critiques and suggestions. The results of the second cycle of material expert validation receive a score of 85% and are classified as "very valid." Although it falls under the category of highly valid, there are certain ideas and changes linked to the product currently under development. Results from the third cycle of material expert validation receive an approval rating of 87% in the "very valid" category.

The material expert validator does not offer comments or suggestions for improvement during the third cycle of validation. The outcomes of the cycle validations 1, 2, and 3 are shown in Figure 4, 5, 6.

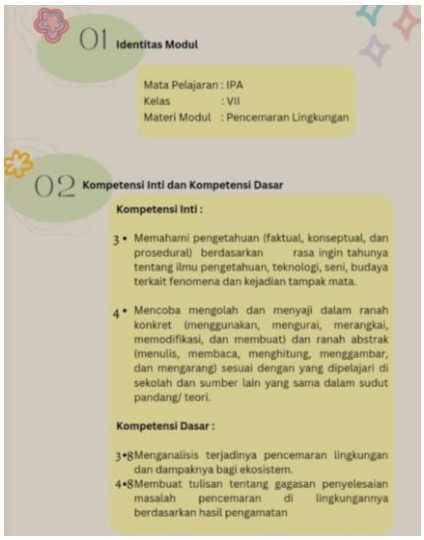

Figure 4. Display of Basic Competency and Indicators Learning in E-Modules

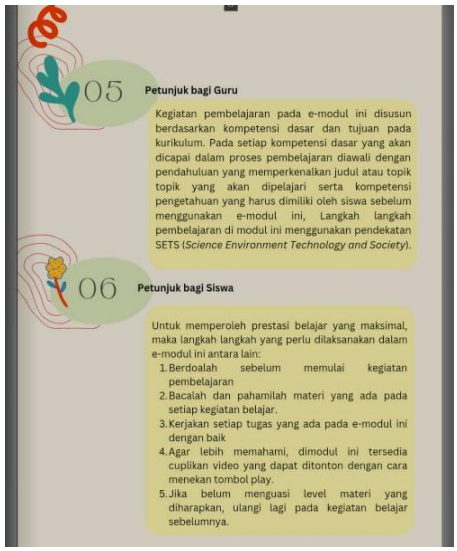

Figure 5. Display of Instructions for Using the E-Module

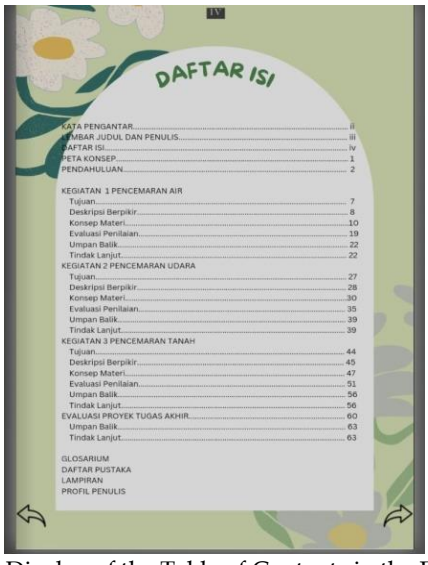

Figure 3. Display of the Table of Contents in the E-Module

Figure 6. Display of the Concept Map in the E-Module

Figure 7. Cover display for each topic

The title subchapters, learning objectives, keywords, and content / content of the subject to be studied make up the e-module's main section. Three subchapters water, air, and soil pollution—make up the e-module. Based on the stages SETS in each subject matter and sub-material tree, the presentation content and material content. The majority of the time, this stage is directly applied to the learning process, however The title subchapters, learning objectives, keywords, and content / content of the subject to be studied make up the e-module's main section. Subchapter

Three subchapters water, air, and soil pollution make up the e-module. Based on the stages SETS in each subject matter and sub-material tree, the presentation content and material content. This level typically pertains to the educational process. This stage is often directly applied to the learning process, however in this instance the SETS stage was poured into the medium, namely the form of an e-module.

Every CHAPTER, this E-Module takes system material and mixes it with some basic submatter. Each chapter's front cover includes learning objectives and keywords, after which the chapter's material is introduced in stages. The introduction usually takes the form of a discourse on a topic that pertains to daily life or questions meant to pique students' interest in the content being delivered and help them connect it to prior knowledge they may already have.The SETS stage, namely the shape of an e-module, poured into this development.

Such an E-Module Every CHAPTER, this E-Module takes system material and mixes it with some basic submatter. Each chapter's front cover includes learning objectives and keywords, after which the chapter's material is introduced in stages. The introduction usually takes the form of a discourse on a topic that pertains to daily life or questions meant to pique students' interest in the content being delivered and help them connect it to prior knowledge they may already have.

The stage is set once the e-module has been compiled.The e-module needs to be validated after that. The goal of this validation is to ensure that the e-module can be tested or implemented by consulting professionals for guidance and feedback. Two lecturers who are subject matter specialists and one science teacher from SMP Nurul Furqon Siak have approved the program. Results of validation from after analyzing the validator, which validates the validity of the material, presentation, language, and graphics, an average value of 3.75 is reached, which satisfies the "Very Eligible" standard. In addition to rating the e-module, the validator offers recommendations for e-modules. Therefore, based on recommendations and feedback validators, there have been some improvements. To make reading easier, Figure 7 illustrates the e-module validation as a whole of the four components evaluated by two lecturers and one instructor to help with the reading of the score results.

Ahli	Validasi	Skor Validasi Aspek ke-																										Skor Total	Rerata	Rerata Total
		Kelayakan Isi							Pedagogik							Penilaian			Kegrafikan											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
Materi (V1)	1	4	3	4	4	4	4	4	4	4	4	3	4	4	4	4	3	4	3	4	4	4	4	4	4	4	4	4	4	108	3,857	3,8571
	2	4	3	4	4	4	4	4	4	4	4	3	4	4	4	4	3	4	3	4	4	4	4	4	4	4	4	4	4	108	3,857	
Media (V2)	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	112	4	4
	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	112	4	
Pedagogik (V3)	1	3	4	4	3	3	3	3	4	4	4	3	3	3	3	3	2	3	2	2	2	2	3	3	3	3	2	3	3	83	2,964	3,4464
	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	4	3	4	4	4	4	4	4	4	110	3,929	
Rerata		3,8333							3,854								3,5				3,7592											3,7367

Figure 8. Illustrates the e-module validation

The time the product is being developed, revisions are made. This adjustment was made in response to comments and suggestions made on the validation questionnaire sheet by media and material experts in accordance with the evaluation criteria. Additionally, feedback and recommendations from teacher and student pilot responses were assessed at the implementation stage. This is done to enhance and perfect the product that is currently being created. This is done in accordance with Sari's (2021) belief that the evaluation step is crucial for identifying or minimizing faults so that the finished output is good and usable.

Asrial et al. (2019)Based on prior research, including Ningsih's (2020) work on the development of chemistry learning modules. Teachers and students respond well to the teaching materials created for the character-based integrated education program SETS using salt hydrolysis material. Module for integrated learning. Character education using SETS and the subject By category, salt hydrolysis is explained realistically by the chemistry teacher and pupils in

school, particularly with a row following a row, namely 93.10% and 90.77%.

Additionally, Safitri (2022) research from before, which focused on the development of an e-module for SETS-based chemistry, produced encouraging findings regarding the level of validity and level of applicability of the created e-module, with successive percentages of 96.8% for very valid and 89% for very applicability. However, until the effectiveness test, this research had not been completed.

In Herdianti's research, et al. (2021), the creation of instructional materials based on SETS is specifically discussed in order to increase students' scientific literacy. According to data analysis findings, teaching materials that have been created are generally 82.625% viable for specialists to use and can help students become more scientifically literate. Similar to how students' replies indicated that instructional materials were created to improve literacy science.

Conclusion

Considering the findings of the research after which the following conclusions can be drawn: (1) From the analysis and questionnaire data that has been given, it can be concluded that the validation results of teaching material-based products e-modules using Online Flipbook software on environmental pollution material for junior high school science classes at SMP Nurul Furqon Siak were declared "very valid" by the first, second, and third expert validators. From the results of the trial response of e-module-based teaching material products using Online Flipbooks on material pollution in junior high school natural sciences. The development was declared "very practical" by educators and students because it can be used anywhere. The trial results by looking at the learning outcomes of students found that this e-module product was "very effective" to use; (2) Based on the results of validation and limited trials and practicality it was determined to be very valid and very practical. Overall, the SETS-based electronic module on environmental pollution material was developed to increase interest in learning and critical thinking skills in junior high schools. with the ADDIE model which is considered as a very valid criterion. Therefore, the use of e-module media as an alternative teaching tool for students who study science in class is very practical. The author is optimistic that these electronic teaching materials can be improved and help people easily access better and more information. Therefore, it is very important to establish the right rules for the raw materials that are produced and managed, and provide the right infrastructure and support services.

Author Contributions

The module contribution using Online Flipbook software on environmental pollution material for junior high school science classes at Nurul Furqon Siak Middle School was declared "very valid" by the first, second, and third expert validators. From the results of the response test for e-module-based teaching material products using Flipbook Online on pollution material in Middle School Science. The development was declared "very practical" by educators and students because it can be used anywhere.

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Conflicts of Interest

The authors declare no conflict of interest

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