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Research Article

Development of an e-modules for learning mathematics based on a scientific approach to help the online learning process

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ABSTRACT

This study is motivated by teaching materials that are less attractive and difficult for students to understand in participating in online learning and the lack of teaching materials used in online learning, namely using only textbooks. This has an effect on student learning outcomes and students' mathematical abilities. The purpose of this study is to produce mathematics teaching materials in the form of e-modules for learning mathematics based on a scientific approach to assist the online learning process. This study is a development-research (R&D). The E-module development process is carried out using the ADDIE development model. The researcher analyzed the validity and practicality of the e-modules that had been developed which were obtained through the validation results of the e-modules by the validator and the results of the questionnaire responses from mathematics teachers and students regarding the practicality of the e-modules. This e-module is declared valid based on the assessment of material experts with an average of 92% (very valid) and the assessment of media experts with an average of 75% (valid). Also, the results of the mathematics teacher's responses with an average of 85% (very practical) and the results of the student questionnaire responses with an average of 84% (very practical).

Keywords: e-modules; scientific approach; online learning;

1. INTRODUCTION

Mathematics is a universal science that underlies the development of modern technology. Every student needs to have mathematical skills in order to understand various phenomena and provide success in surviving today and in the future (Putra & Syarifuddin, 2019). In the 4.0 revolution era, mathematics learning requires technological innovation (Murati & Ceka, 2017; Putri et al., 2022; Fazira & Qohar, 2021). Therefore, it is very important for teachers to create a pleasant learning atmosphere, so that students are interested and motivated to learn mathematics (Saputra, Marhami, B, Mursalin, & Azmi, 2022).

Scientific-based learning supported by technology such as e-learning is needed to convey theory by considering the context, background, interests and potential of students. Learning models like this can answer distance challenges due to the covid 19 pandemic. In response to the covid-19 pandemic, the Indonesian government encourages online learning activities. As a result, schools and universities have to switch from traditional (offline) learning models to online (Mahyiddin & Amin, 2022). The Ministry of Education and Culture has issued a home learning policy that requires teachers to prepare digital teaching materials, learning that is carried out independently in online and offline classes based on teacher direction and input (Kemendikbud, 2017). Distance learning currently challenges teachers to design more creative learning programs in the 21st century and the 4.0 revolution era by developing core 21st century skills (Aziz Hussin, 2018), such as creativity and innovation in applying educational technology (Daggol, 2017).

Based on the results of interviews and questionnaire data that the researchers distributed to several grade VIII students of SMP Negeri 3 Kota Sungai Penuh, it stated that in online learning mathematics there were several obstacles experienced by students including: sometimes the lack of adequate networks, the difficulty of students in understanding the subject matter, more Furthermore, students also think that it is easier for them to understand math material when offline learning is compared to online learning.

E-Modules allow teachers to focus on results and verify processes (Argaswari, 2019). The module serves as an independent teaching material and evaluation medium for students (Serevina, Nugroho, & Fridolin, 2022). In addition, the module can increase students' motivation in learning (Marnah, Suharno, & Sukarmin, 2022). Modules have various forms, namely print and digital. The digital module is a module in the form of an application on a smartphone (Kusmaharti & Yustitia, 2022). Most of the modules are combined with various bases in module development to improve their quality. Starting from basic, inquiry (Hairida, 2016), HOTS literacy (Feriyanto & Putri, 2020) to discovery (Ellizar, Putri, Azhar, &

Hardeli, 2019). E-modules are media needed by students and teachers that can be used anywhere and anytime (Aspridanel, Lengkana, & Jalmo, 2022). In this study, an e-module based on a scientific approach was chosen to assist the online learning process.

The selection of learning tools is done through reflection on the students' initial abilities. To ensure it performs needs analysis, concept analysis, and task analysis. This is a technique for determining learning objectives, so that they can develop appropriate learning tools (Widada, Herawaty, Ma'rifah, & Yunita, 2019). Appropriate mathematics learning tools can improve student performance in the learning process (Tambunan, Sinaga, & Widada, 2021). That would make for a very good performance.

Therefore, researchers are very interested in developing e-modules, with characteristics based on interactive scientific, learning motivation, offline and online learning, using computer or mobile phone technology. This e-module supports teachers to present material according to scientific steps, namely observing, asking questions, gathering information, associating and communicating. This study aims to develop a valid and practical electronic module during distance learning.

2. RESEARCH METHOD

This study aims to develop a scientifically oriented e-module that is valid and practical. This research method is development research with ADDIE model. ADDIE stages according to (Branch, 2009). The following is an ADDIE development flowchart (see **Figure 1**).

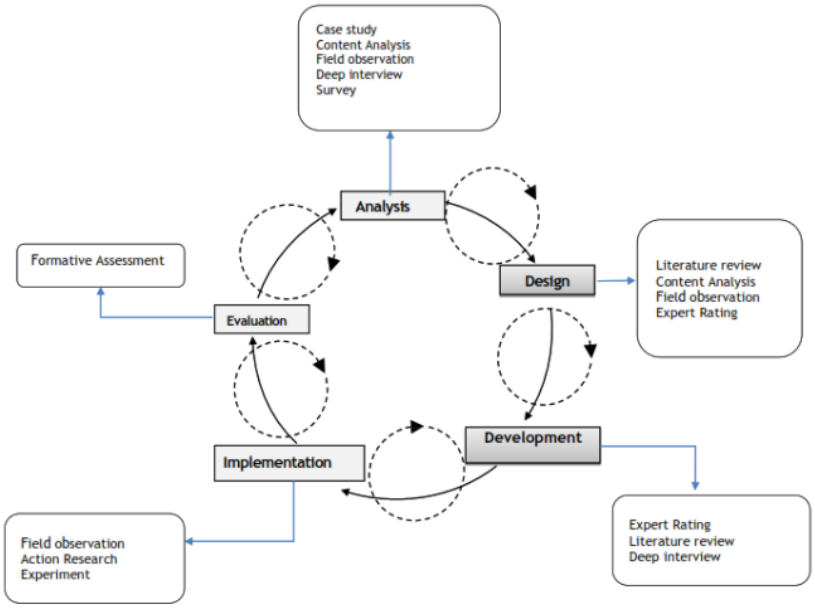

Figure 1. ADDIE Development Stages

The subjects of this study were class VIII semester I students at SMPN 3 Sungai Tenuh. Data collection techniques in this study were validation sheets, questionnaires and tests. The validation used uses two validation sheets. The first sheet contains questions from the material and learning media aspects. The research provides a qualitative assessment and in the form of comment that serve as a reference for revising the scientific-based prototype e-module the elements of the material studied: 1). The suitability of the material with Core Competencies (KI) and Basic Competencies (KD), the accuracy of the material encourages curiosity. 2). Presentation technique, presentation feasibility, learning presentation, coherence and sequence of thinking, 3). Characteristics of the scientific approach.

Meanwhile, the media expert validation sheet includes the appropriateness of the language used in the e-module and the graphical display of the module. Questionnaire sheets were distributed, teacher responses were distributed to test the practicality of the e-module. The teacher's response questionnaire contains 12 question indicators. Questionnaires were distributed to students to investigate their responses to the e-module with aspects including practicality and motivation consisting of 12 questions.

The data analysis technique used is quantitative and qualitative. Qualitative data obtained from interviews and quantitative data obtained from the results of the validity, practicality and questionnaires. The data obtained from the questionnaire illustrates whether the developed learning media has met the feasibility aspect in terms of validation and practicality aspects.

2.1 Analysis of Validity Results

Validation test obtained e-module prototype, comments, suggestions and qualitative assessments. The formula for calculating the average assessment results is as follows:

$$R = \frac{\sum_{i=1}^{n} V_i}{n} \quad V_i = \frac{\text{Score earned}}{\text{Maximum score (Total)}}$$

Then the validity value obtained is analyzed with the following criteria:

Table 1. Validity Criteria for Materials and Media

No	Validity Criteria	Validity Levels
1	85,01% - 100%	Very Valid
2	70,01% - 85,00%	Valid
3	50,01% - 70,00%	Fairly Valid
4	01,00% - 50,00%	Less Valid

The results of the validation test were analyzed descriptively, this analysis resulted in suggestions and comments from twelve questions about the suitability of the item. Research analysis revealed that the response questionnaire adopted a Likert scale with four categories of qualitative assessment: SS (strongly agree) with a score of 4, S (agree) with a score of 3, TS (disagree) with a score of 2 and STS (strongly disagree) with a score of . the results of the questionnaire were assessed on a scale of 100 using the following formula:

$$Score = \frac{Score\ obtained}{Maximum\ Score} x\ 100\%$$

2.2 Practical Analysis

The practicality of the e-modules was obtained from the teacher's response questionnaire to the use of the e-module and the student's response. Questionnaire data was obtained by calculating the scores of teachers who answered each item as contained in the questionnaire. The calculation results are interpreted as Table 2.

Table 2. Category of Teachers and Students Response Assessment

No	Practicality Levels	Practical Criteria
1	81,00% - 100%	Very Practical
2	61,00% - 80,00%	Practical
3	41,00% - 60,00%	Fairly Practical
4	21,00% - 40,00%	Impractical
5	00,00% - 20,00%	Very Impractical

3. RESULTS AND DISCUSSION

3.1 Analysis Stage

The analysis is carried out in three steps, namely: student analysis, curriculum analysis and student analysis.

1. Need Assessment

Needs analysis to gather information about student needs. Based on the results of interviews and distributing questionnaires to class VIII students, students stated that in participating in online learning students experienced several obstacles, namely inadequate network constraints, difficulty in understanding the material given or presented in books, the number of assignments given by the teacher, difficult teaching materials used. to be understood, which teaching materials used are predominantly in the form of textbooks. The teacher has not used the module as an additional teaching material. Therefore, the researchers developed an e-mathematics learning module as an additional teaching material in the implementation of online learning.

2. Curriculum Analysis

In this analysis, the researcher analyzes the curriculum used in SMP Negeri 3 Kota Sungai Penuh, where the curriculum used is the 2013 curriculum, especially on the number pattern material for class VIII Semester 1. The intended curriculum analysis is an analysis of the indicators of achievement of competence in the number pattern material. . There is no change in KD that has been determined, but there is a change in the composition of indicators, changes in the composition of indicators. The reformulation of the indicators carried out are: First, the 4.1.1 indicator was rearranged by separating the indicators on the pattern of number sequences and the pattern of object configuration numbers. It is intended that learning is focused on sequence number patterns or object configuration number patterns. Second, indicator 4.1.3 is given additional activities.

3. Student Character Analysis

Researchers analyzed the character of students based on the favorite color of a teaching material that students liked as a guide in making e-modules later and analysis when participating in online learning. Information regarding this matter was obtained based on the results of unstructured interviews and the distribution of questionnaires distributed to class VIII students. Based on the results of interviews and questionnaires that have been distributed, the dominant students like green, red, blue and several other colors. In the results of this analysis, it was also found that there were still students who did not like mathematics, they considered mathematics material to be difficult to understand. In addition, students also think that it is easier to understand the material during face-to-face learning than when learning online.

3.2 Design Phase

The first step in the initial product design is to design an attractive cover using Corel Draw, develop components in e-modules such as material adapted to a scientific approach, images, sample questions, animations, audio, video, glossaries and test evaluations. Furthermore, designing product concepts on paper, such as presenting material, providing video and image illustrations, examples of application in everyday life, sample questions, practice questions and designing product concept content. After completing the product concept content, the product in the form of an e-module is converted into a pdf form. Furthermore, designing learning devices in accordance with the curriculum used in schools, namely the 2013 curriculum.

3.3 Development Phase

The development contains activities about testing the feasibility of e-modules in terms of validators, namely material experts and media experts. After receiving comments or suggestions from the validator, the researcher then followed up by revising the e-module. The comments or suggestions given by the material expert validators are:

1) In the e-module in order to be able to divide the material in the e-module into several meetings according to the syllabus.
2) Make a formative test every meeting.
3) Adding answer keys for formative tests and summative tests which are only final answers or not complete completion steps.
4) Add scoring instructions and criteria for completeness of each formative test and summative test.

Meanwhile comments or suggestions from media expert validators are:

1) Replace the cover image of the e-module with an image related to number patterns in everyday life.
2) Give creations or change the shape used.
3) Provide an answer column for formative tests.
4) Provide image captions for each image in the material.

The results of the e-module validation by the two validators can be seen in the Table 3.

Table 3. Results of Expert Assessment on Material

No	Aspects	Percentage	Criteria
1	Content Feasibility	96%	Very Valid
2	Didactic	87,5%	Very Valid
	Average	92%	Very Valid

Based on Table 3, it can be seen that the value of the e-module validation is assessed through 2 aspects consisting of 12 statements with the percentage of assessment of the two validators being 92% with a very valid category. This means that scientific-based e-modules are feasible to use. This result is in line with the expression (Apsari & Rizki, 2018) which states that if the validation results obtained are more than 60%, then the product meets the appropriate criteria so that it can be said to be valid and can be tested. The results of media expert validation in terms of the feasibility of language and graphics or appearance obtained an average value of 75% which was categorized as valid. The results of the validation by media experts as shown in Table 4.

Table 4. Assessment Results from Media Experts

No	Aspects	Percentage	Criteria
1	Language Eligibility	75%	Valid
2	Graphics or Appearance	75%	Valid
	Average	75%	Valid

Based on Table 4, it is found that the average value is 76% with a valid category. Through the validation results of the two validators, the average value of 83.5% is categorized as valid. This is in line with previous research that the resulting e-module has a very high level of validation and a very high level of practicality by teachers and students (Asmiyunda, Guspatni, & Azra, 2018). Next, a one-on-one test was conducted. At this stage the e-learning module is piloted by the mathematics teacher to see the practicality of the product development. The product that has been validated by the expert is given to the mathematics teacher then asked to try the e-module for learning mathematics and then an assessment is carried out by providing a practicality questionnaire of learning media. The results of these practicalities can be seen in Table 5.

Table 5. Practicality Percentage based on Teacher's Feedback

No	Aspect	Percentage	Criteria
1	Content Feasibility	75%	Practical
2	Serving Eligibility	75%	Practical
3	Appearance	100%	Very Practical
4	Language/Term	75%	Very Practical
5	Equivalence	100%	Very Practical
	Average	85%	Very Practical

The results of the questionnaire on the responses of mathematics teachers to the e-module in terms of content feasibility aspects, presentation feasibility aspects, language display and e-module equivalence obtained an average value of 85% which was categorized as very practical. While the results of the questionnaire on student responses to the e-module in terms of ease of use, attractiveness and benefit aspects obtained an average score of 84% which was categorized as very practical.

Table 6. Practicality Percentage based on Student's Feedback

No	Aspects	Percentage	Criteria
1	Ease of Use	84,55%	Very Practical
2	Attractiveness	86,93%	Very Practical
3	Benefit	80,58%	Very Practical
	Average	84,02%	Very Practical

Based on one-on-one trials from both teachers and students, the e-module is in very practical criteria. This is in line with previous research that learning using e-modules makes students interested in learning, besides learning using e-modules instills digital literacy skills for students (Wahyudi, 2019).

4. CONCLUSION

The results of the study concluded about the geometric activity The validity of the e-module of mathematics learning based on a scientific approach meets the valid criteria by both validators, namely material expert validators and media experts. This e-module was declared very valid based on the assessment of material experts who obtained an overall average of 92% aspects and was declared valid based on the assessment of media experts who obtained an overall average of 75% aspects. based on the results of the teacher's responses who obtained an overall average score of 85% and the results of the student response questionnaires who obtained an overall average of 84%.

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AUTHOR'S CONTRIBUTIONS

The authors discussed the results and contributed to from the start to final manuscript.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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