

DEVELOPMENT OF INTERACTIVE MODULE BASED ON REALISTIC MATHEMATICS EDUCATION FOR THE MATERIAL OF NUMBERS**Haqqi Hidayatullah**

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Abstract

During the Covid 19 pandemic, which required distance or online learning makes learning material difficult for students to understand, especially number material in junior high schools. One of the ways that teachers can use to facilitate students in learning is by taking approaches, one of which is the Realistic Mathematics Education (RME) approach. To support online learning where students can study independently with teacher guidance so that learning media is very important. One of the learning media developed is an interactive module based RME. The purpose of this research is to describe how the process of developing interactive modules based on realistic mathematics education on numbers and how the results of developing interactive modules are measured from the aspects of validity, practicality, and effectiveness as an alternative learning media. This study used research and development methods, the model used in this research was ADDIE (Analysis, Design, Development, Implementation, and Evaluation). The subjects of this study were 15 students in grade 7 junior high school. The test results showed that the module is valid with a percentage of 76,13% valid, from teachers 92,49% practical, from students 86,33% practical, and 88,66% effectiveness. The uniqueness of this interactive module is that it has interactive features such as videos, practice questions, and related learning media. Based on the research conducted, the interactive modules can be said to be a good mathematics learning medium so that teachers and students can use this media as an alternative to learning number material.

Keywords: interactive module, realistic mathematics education, numbers, ADDIE.

Abstrak

Selama pandemi Covid 19 yang menuntut pembelajaran jarak jauh atau *online* membuat materi pembelajaran sulit dipahami siswa, terutama materi bilangan di sekolah menengah pertama. Salah satu cara yang dapat digunakan guru untuk memfasilitasi siswa dalam belajar adalah dengan melakukan pendekatan, salah satunya dengan pendekatan *Realistic Mathematics Education (RME)*. Untuk menunjang pembelajaran *online* dimana siswa dapat belajar secara mandiri dengan bimbingan guru maka media pembelajaran menjadi sangat penting. Salah satu media pembelajaran yang dikembangkan adalah RME berbasis modul interaktif. Tujuan penelitian ini adalah untuk mendeskripsikan bagaimana proses pengembangan modul interaktif berbasis *realistic mathematics education* pada materi bilangan dan bagaimana hasil pengembangan modul interaktif diukur dari aspek validitas, kepraktisan, dan keefektifan sebagai media pembelajaran alternatif. Penelitian ini menggunakan metode penelitian dan pengembangan, model yang digunakan dalam penelitian ini adalah *ADDIE (Analysis, Design, Development, Implementation, dan Evaluation)*. Subjek penelitian ini adalah 15 siswa kelas 7 SMP. Hasil pengujian modul valid dengan persentase 76,13% valid, dari guru 92,49% praktis, dari siswa 86,33% praktis, dan keefektifan 88,66%. Keunikan modul interaktif ini adalah memiliki fitur-fitur interaktif seperti video, soal latihan, dan media pembelajaran terkait. Berdasarkan penelitian yang telah dilakukan, modul interaktif dapat dikatakan sebagai media pembelajaran matematika yang baik sehingga guru dan siswa dapat menggunakan media ini sebagai alternatif pembelajaran materi bilangan.

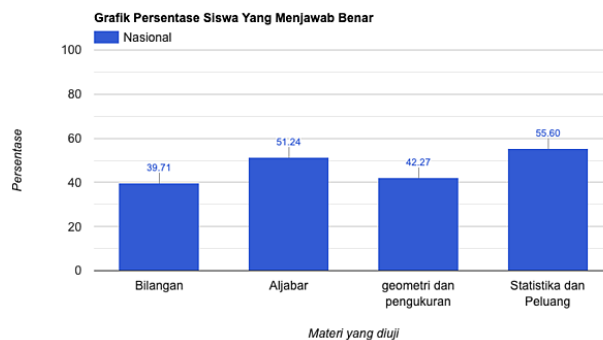
Kata Kunci: modul interaktif, *realistic mathematics education*, bilangan, *ADDIE*.

INTRODUCTION

The Covid 19 pandemic has changed various aspects of life including education. The government recommends that learning activities be carried out by distance learning or online learning. This was confirmed by the issuance SE Mendikbud nomor 4 tahun 2020 which was strengthened by SE Sesjen nomor 15 tahun 2020 concerning guidelines for the implementation of SFH (Study from Home) during the Covid-19 emergency (Ministry of Education and Culture of Republic of Indonesia, 2020). Based on the research conducted by Sulistyawati (2020), it was said that there was a decrease in student interest in learning with a distance learning system or online. To support a study from home where students can study independently with teacher guidance so that learning media is very important.

Learning media is one of the facilities that can help carry out learning from home. The role of the media is very important in the learning process so that the material delivered by the teacher is fast and easily accepted by students (Wicaksono, 2016). However, according to (Suprpti, 2016) there is still a lack of use of media in the process of learning in class and the lack of support for the textbooks and student worksheets used by students. ICT-modules that are used as student books are an important part of learning, especially during online learning, ICT-modules must also be easily accessed by students, one of which is by creating a module, which is an electronic module that can be accessed using a device. In addition, the module must also be interesting so that the material is easily understood by students in learning, the module must be made as interactive as possible with students. Many interactive modules have been developed, such as research conducted by (Kuswanto, 2019) which developed interactive modules on integrated science subjects for grade VII, and Aryawan (2018) conducted research which developed the interactive modules on junior high school social studies subjects. However, until now there has not been much development of interactive modules on number material for grade VII SMP. According to Rahmatin (2019), the weakness of the current module is that many modules are not based on student experiences and are not related to real life.

Number material at the junior high school level is one of the materials that is difficult for students to understand. This is evidenced by the results of the 2019 Mathematics Middle School National Examination that number material occupies the lowest material controlled by students compared to other materials with a percentage of only 39.71% of students who answered correctly (Education assessment center, 2019).



Graph 1. Results of the 2019 Junior High School Mathematics Material National Examination

One of the ways that teachers can use to facilitate students in learning is by taking approaches, one of which is the Realistic Mathematics Education (RME) approach. Realistic Mathematics Education abbreviated as RME is a mathematics teaching theory with the characteristic that rich and realistic situations are given an important position in the mathematics learning process which serves as a source to initiate the development of mathematical procedures, tools, and concepts (Heuvel-Panhuizen, 2020). There are three principles of realistic mathematics education, namely guided reinvention or progressive mathematizing, didactical phenomenology, and self-developed models (Gravemeijer, 1994). There are five characteristics of realistic mathematics education, including use of context, use of models, use of student production and construction, use of interactive, and learning unit linkages (Treffers, 1991). Realistic mathematics education combines the advantages of various approaches to other learning so that it can be said to be a "superior" approach (Hobri, 2009). The advantages of realistic mathematics education include contextual mathematics where mathematics is linked to real life, so mathematics becomes close to daily lives of students and students become easier to understand mathematics. The results of research conducted by Kasim (2017) revealed that the realistic mathematics education approach can improve learning outcomes. From the above advantages, the RME-based module can be a good learning medium for students. The purpose of this research is to describe how the process of developing interactive modules based on realistic mathematics education on numbers and how the results of developing interactive modules are measured from the aspects of validity, practicality, and effectiveness as an alternative learning media.

METHODS

This study is a research and development study, implementing the ADDIE model. ADDIE stands for Analysis, Design, Development, Implementation, and Evaluation. This model was used to plan, develop,

implement and evaluate (Fernandes et al, 2020). ADDIE has five clear and sequential steps for producing a product and is specially designed for learning.

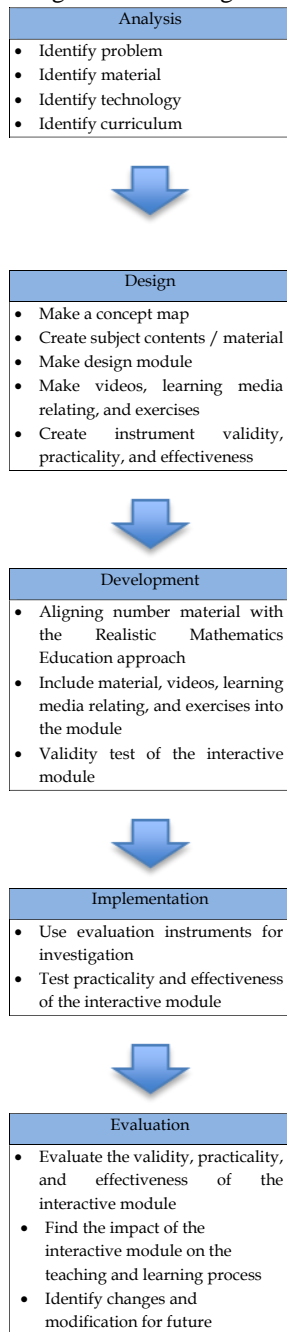


Diagram 1. ADDIE models used in this study

The subjects in this study were 15 students of the first semester of VII-grade junior school. The data collection technique in this study used a validation test with a questionnaire given to the expert, a practicality questionnaire given to the mathematics teacher to determine the practicality of the module, and the effectiveness test that was tested on students to determine the effectiveness of the module. All questionnaires were given and filled in after the expert, teacher, and students tried the module.

Validity

The learning media developed is said to be valid if it is by the theory and the components of the interactive module are consistently interrelated (Akker, 1999). The criteria for the results of expert validation are as follow

Table 1. Criteria of expert validation results

Percentage (%)	Category
0-55	Invalid
56-70	Less Valid
71-85	Valid
86-100	Very Valid

Practicality

The practicality test uses a response questionnaire to the math teacher and students. The interactive module developed is said to be practical if the module makes it easy for teachers and students to use mathematics learning in schools, student's motivation, and attention in class (Akker, 1999). The criteria for the results of practicality are as follow

Table 2. Criteria of practicality

Percentage (%)	Category
0-20	Very Impractical
21-40	Impractical
41-60	Reasonably Practical
61-80	Practical
81-100	Very Practical

Effectiveness

Indicators of the effectiveness of the use of instructional media can be seen from learning outcomes of students using learning outcomes tests and assessment instruments, namely the results of the learning test at the end of the lesson. An interactive module is said to be effective if student learning outcomes are above for effectiveness and help students to better understand mathematics (Akker, 1999). The criteria for effectiveness are as follow

Table 3. Criteria of effectiveness

Percentage (%)	Category
<75 from KKM	Ineffectiveness
≥75 from KKM	Effectiveness

Learning media is said to be effective if students get a score above 75% from KKM.

RESULT AND DISCUSSION

In classroom learning, students usually use textual modules with the help of direct explanations from the teacher in class to understand the material. In addition to learning with teachers, students can also learn online independently with interactive modules. The interactive module was created by the module creator to be applied as an alternative learning media to increase learning motivation and help students understand mathematics material. The test results showed that the module is valid with a percentage of 76,13% valid, from teachers 92,49% practical, from students 86,33%

practical, and 88,66% effectiveness. The ADDIE stages can be explained as follows.

Analysis

The development of an interactive module aims to increase learning motivation and help students understand numbers material. In developing this interactive module, the following analysis stages are required.

- Identify problems

From the 2019 National Examination data in Indonesia, which was followed by interviews with several seventh-grade students of junior high school, there were obstacles in understanding the difference in numbers, distances, the addition of negative numbers in the number material. For example, many students have difficulty understanding the subtraction of negative numbers from negative numbers. For this reason, an attractive learning media is needed to increase student learning motivation and help students understand the material of numbers.

- Identify material

The identification of the material was carried out by analyzing the material in the teacher's book and seventh-grade mathematics student book, the 2013 curriculum revision edition of odd semesters. In the student books, there are already many examples of story questions, but some of the questions are not contextual to real life.

- Identify technology

From discussions with experts, technology or software that can be used to create interactive modules is flip pdf. Flip pdf is software to create an e-book in the form of a flipbook that utilizes various media such as audio, video, and links that can be linked to make the e-book more attractive and interactive.

- Identify curriculum

The 2013 curriculum in Indonesia has competency standards, basic competencies, and competency achievement indicators. The curriculum is used as the basis for developing interactive modules on numbers. In this interactive module what you want to develop is related to the sequence of integers (positive and negative), integer count operations, and fractions by making use of the various properties of the operation, the problem associated with multiple sequences of integers and fractions.

Design

After identifying the problems, materials, technology, and curriculum. The interactive module design includes the following stages.

- Make a concept map

Making concept maps starting from the material of adding whole numbers to fractions was done to

connect the material to produce a good and ordered learning design.

- Create subject contents / material

The material in the interactive module was linked to real-life to make it more contextual, such as the said line associated with the GMT division.

- Make design module

The module design was made as attractive as possible, such as displaying a world map image of the GMT division and an explanation video to increase student motivation by using a design application.

- Make videos, learning media relating, and exercises

The material for adding whole numbers to fractions that have been prepared can be used as a video, related learning media using GeoGebra to visualize fraction comparisons, and practice questions using google form which can be accessed online.

- Create instrument validity, practicality, and effectiveness

The instrument was made to measure validation tests to experts, practical tests to teachers, and effectiveness tests to students to obtain research data.

Development

At the stage of developing this interactive module, there are several processes as follows

- Aligning number material with the Realistic Mathematics Education approach.

Incorporate the characteristics of realistic mathematics education into the interactive module. Interactive module using contextual problems. As in real life, GMT is located at 0 degrees geographic longitude in England. In this case, students want to know the time in Yogyakarta when in Greenwich it shows 00.00 GMT so that this question can stimulate students to find the concept of adding numbers.



Picture 1. Part of use context

The interactive module using a model. A model is a measuring tool. In this case, students use division of world time as “model of” and number lines as “model for” to find the concept of adding numbers.



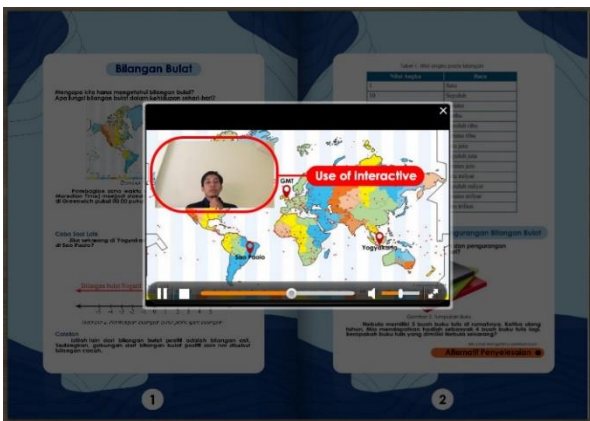
Picture 2. Part of models use

After the students did modeling with number lines then the students constructed a point in Greenwich and a point in Yogyakarta so that two points were obtained to add numbers.



Picture 3. Part of use student production and construction

The module using interactive. In case there are interactive videos that help students solve contextual problems.

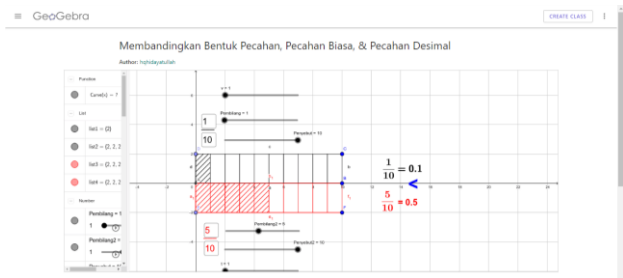


Picture 4. Part of use interactive

Interactive module learning unit linkages. In this case linking the location of an area, local time, and the sum of the numbers.

- Include material, videos, learning media relating, and exercises into the module.

Interactive modules contain material, offline videos, learning media relating to GeoGebra, and online exercises on numbers material.



Picture 5. Learning media relating from GeoGebra in interactive module

- Test validity of the interactive module

The module validation test was tested by experts which resulted producing in produce revisions to some material and information on module features. Experts come from expert lecturers and senior mathematics teachers in junior high schools.

Implementation

After the revision of the module by the validator, the interactive module was tested on grade 7E students of *M.Ts. Terpadu Roudlotul Qur'an Lamongan*. This implementation is carried out to obtain practical and effective data from the interactive module. Previously, students had received material using textbooks that are commonly used in class. Based on the interviews conducted, the students still did not understand the material before using the interactive module. Students find it easier to understand the material using interactive modules with the RME approach.

Evaluation

At the evaluation stage, a valid, practical, and effective interactive module analysis was carried out. The results of testing the data obtained through the results of a validity questionnaire from 2 experts obtained 76.15% valid and showed that the interactive module developed could be categorized as valid. Whereas from the data obtained through the results of the instrument test from 2 junior high school mathematics teachers got a score of 92.49% while through the instrument test results from 15 students got a score of 86.33% then analyzed as above shows that the interactive module developed can be categorized as very practical. After students use the interactive module, then they were given a test result of learning from 15 students as many as 13 students above the KKM while based on the average value obtained 86.66% then analyzed as above shows that the interactive module developed can be categorized as effective.

CONCLUSION AND SUGGESTION

Based on the stages of development and research that have been tested on experts, junior high school teachers, and students, it can be concluded that the RME-based interactive module developed has valid criteria according to expert lecturers and senior mathematics teachers in junior high schools, very practical according to junior high school teachers and students, effective according to students. RME-based interactive modules are effective for improving student learning outcomes. The uniqueness of this interactive module is that it has interactive features such as videos, practice questions, and related learning media. Of the categories above, the interactive module can be said to be good learning medium for learning mathematics.

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