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# Validity of the Elementary School Mathematics E-Module on Fractional Material Based on The Realistic Mathematics Education (RME) Approach

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**Abstract.** This research is motivated by observations that show the lack of additional teaching materials in schools that facilitate students in communicating mathematical ideas (symbols, pictures, and graphs) as well as concepts related to fractions by presenting the surrounding environment as a source of learning. The purpose of this study is to reveal the level of validity of mathematics e-modules on fractional material based on the RME approach developed. The type of research used is research and development, and the research model used is the ADDIE model, namely the analyze, design, develop stage, implementation stage, and evaluate stage. The validity sheet is the instrument used in this study. Researchers analyzed validation sheets with a scale of 5 (five) to determine the quality of the e-modules developed. The results of material expert validation got a score of 0.9 with a very valid category; media expert validation got a score of 0.89 with a very valid category; and linguist validation got a score of 0.9 with a very valid category. So that the mathematics e-module on fractional material based on the RME approach is valid and very feasible to be used as a mathematics module, especially fractional material because it has met the assessment criteria.

**Keywords:** E-Module; Mathematics; Fraction; RME; Validity.

## 1. Introduction

Mathematics has been a very important subject to be taught to learners since elementary education (Hered, F., Bentri, A., Fauzan, A., & Fitria, Y. 2021). Mathematics is the science that deals with abstract concepts. The abstract nature of these concepts can make students find it difficult to understand math, although learning math can be an enjoyable experience. Children in Elementary School, between the ages of 7 and 11, often still think concretely, so they may find it difficult to understand abstract mathematical concepts. Students can understand mathematical ideas if they are connected to real life or the world that is close to them (Acharya, 2020). Based on the observation conducted by the writer, it was found that the instructional materials provided at school do not present illustrations, pictures, or problems closely related to everyday life. They are still very abstract, filled with formulas, symbols, or numbers. In addition, there are practical teaching materials applied in schools as supplementary instructional materials. The teaching material is made from uncolored recycled paper, which makes students unenthusiastic and uninterested in the material. One of the reasons for students' dislike and lack of ability to learn mathematics is that educators utilize teaching materials that do not engage students (Syaspasbandah et al., 2018). The main standards in mathematics learning contained in the National Council of Teachers of Mathematics Standards (NCTM, 2000) are problem-solving skills, communication skills, connection skills, reasoning skills, and representation skills. These five standards have an important role in the mathematics curriculum. One of the objectives of learning mathematics is to learn to communicate (Hidayat, R. A., & Wijayanto, Z., 2021). The ability to communicate mathematics is one way for us to explain mathematical ideas or symbols to others. Mathematical communication skills involve not only verbal communication but also the use of

symbols, images, and graphs (Triana et al., 2019). To improve students' mathematical communication skills by training students to symbolize and use mathematical modeling to solve problems. The problems presented should be contextual problems, namely problems that are close to the real lives of students. Communication in the subject of mathematics is very important because students can express how to find concepts and represent them in the form of symbols or mathematical language. There are two reasons why communication in mathematics needs to be developed in students. First, mathematics is not only a tool for thinking, solving problems, and drawing conclusions, but it also has infinite value in clarifying various ideas precisely and accurately. Second, mathematics and learning mathematics serve as a place for interaction between students and communication between educators and students (Kamid et al., 2020). In RME, learning activities are carried out using the real world and forming ideas to solve mathematical problems (Hered, F., Bentri, A., Fauzan, A., & Fitria, Y. 2021). The author develops e-modules using the RME approach to assist students in independent learning. The current technological advancements greatly support the development of e-modules, allowing for the inclusion of interesting materials, animations, and other media necessary for improving e-modules. Additionally, e-modules can be accessed from anywhere, as long as there is an internet connection. The e-module can also be downloaded and opened later, even without using an internet connection. The videos in the e-module can also be replayed if students have not yet understood the material. The developed e-module presents various topics on fractions, includes images, and also contains some interesting fraction material videos. Therefore, the purpose of this research is to reveal the validity level of the mathematics e-module on the topic of fractions based on the RME approach that has been developed.

### 1.1. Problem Statement

Mathematics learning is an educator's way to enhance students' understanding when solving real-life problems. The Program for International Student Assessment (PISA) in 2012, 2015, and 2018 showed that mathematics learning outcomes in Indonesia remain low. In 2018, Indonesia ranked 73rd out of 79 countries, with a mathematics score lower than the previous year at 379 (Hewi & Shaleh, 2020). One of the objectives of mathematics learning is to learn to communicate (Hidayat, R. A., & Wijayanto, Z., 2021). In reality, students' mathematical communication skills are still lacking in various situations (Mullis, 2012:42). Insufficient mathematical communication skills result in low learning outcomes for students. Low communication skills lead to misunderstandings of information conveyed by students. Students' difficulties in using mathematical symbols cause them to make errors when applying concepts to solve problems (Kurani & Syarifuddin, 2020). Students will easily solve a problem if they are familiar with mathematical concepts and have the skills to apply them through diligent mathematics learning (Lindquits et al., 2019). However, research findings indicate that many students at every educational level still have a dislike for mathematics learning (Mentari & Syarifuddin, 2020; Y. Fitria et al., 2019) and also lack mathematical understanding (Fernandes & Syarifudin, 2019). Students' difficulties in using mathematical symbols cause them to make errors when applying concepts to solve problems (Kurani & Syarifuddin, 2020; Syarifuddin, 2018).

The aforementioned issue cannot be overlooked, and solutions must be sought to enhance students' mathematical abilities. One of the reasons for students' disinterest and lack of proficiency in mathematics learning is that educators utilize teaching materials that fail to capture students' interest (Syaspasbandah et al., 2018) and are not aligned with real-life contexts (Fajri et al., 2020). In reality, it has been found that there has been a lack of development in mathematics teaching materials by teachers. Moreover, the textbooks currently used do not leverage students' real-life environments as stimuli to motivate them to understand mathematical concepts. Students who are constantly required to take notes on the material or formulas provided in textbooks find the learning process tedious. Teachers' dominance in the classroom prevents learning from being student-centered, and students are not encouraged to communicate their mathematical ideas, resulting in non-interactive learning. Therefore, a mathematics e-module based on the Realistic Mathematics Education (RME) approach is crucial to be developed, especially for the fractions topic.

### 1.2. Related Research

So far, many researchers have developed mathematics modules. One of them is an e-module based on the RME approach using traditional Bengkulu cakes to enhance problem-solving abilities on the topic of two-dimensional shapes for fourth-grade elementary school students (Putriani et al., 2023). The study conducted by Putriani et al. (2023) aims to assess problem-solving abilities on the topic of fractions in fourth-grade classes. Other researchers have developed an e-module based on RME in mathematics learning for fourth-grade elementary school (Anisah et al., 2023). The study conducted by Anisah et al. (2023) aims to examine learning outcomes on the topics of GCD and LCM. Furthermore, another researcher has developed an e-module based on the Realistic Mathematics Education (RME) model using the traditional five-roofed house to enhance conceptual understanding of the topic of two-dimensional shapes in fourth-grade elementary school (Nirmala et al., 2023). The study conducted by Nirmala et al. (2023) aims to assess conceptual understanding of the topic of two-dimensional shapes for fourth-grade students.

### 1.3. Research Objectives

The objective of this research is to develop a valid mathematics e-module on the topic of fractions based on the Realistic Mathematics Education (RME) approach. Although many similar studies have been conducted to date, the author considers several factors that differentiate this research from previous ones, including the focus on fraction material for fifth-grade elementary school students.

## 2. Theoretical Framework

Modules are instructional materials that require learners to seek sources of information, understand the material, and solve problems independently (Najuah, 2020). Modules are also defined as learning units in the form of printed materials that effectively achieve clear and specific learning objectives and present evaluation questions along with answer keys (Syafri, 2018:7). Electronic modules are commonly known as e-modules and are educational media that deliver content, methods, exercises, and evaluations systematically to achieve predetermined learning objectives. E-modules are information presented in book format electronically using hard drives, CDs, flash drives, or other e-book readers. The Realistic Mathematics Education (RME) approach utilizes the real world as a starting point for discovering mathematical concepts. RME places reality and experience at the forefront of the learning process, making learning meaningful for learners (Sembiring, 2010).

Fractions are parts of a whole unit. In diagrams, they are usually represented by shading, known as the numerator, while the whole part is the unit called the denominator (Dhani, V., & Ahmad, S., 2022). Consistent with the view of Karso et al. (2018), fractions represent the comparison of equal parts of an object to the whole object. Mathematical communication skills are a way for us to explain mathematical ideas or symbols to others. Mathematical communication skills are not only verbal but also involve using symbols, pictures, and graphs (Triana et al., 2019). In line with Abidin's opinion (2019), mathematical communication skills involve learners solving problems using ideas, symbols, pictures, tables, and graphs.

### 2.1. Characteristics of Realistic Mathematics Education (RME)

The learning process will be more effective if educators pay attention to the characteristics of the learning. There are six characteristics of the RME approach: 1) motivating learners; 2) communicating learning objectives; 3) posing problems; 4) problems are aligned with the intended goals; 5) creating or developing symbolic models; 6) interactive learning takes place (Wibowo, 2019:31). As clarified by Fuzan et al. (2018), RME has five characteristics, including: (1) Use of contextual problems: the learning process begins with learners' involvement in solving contextual problems (learning using contextual problems based on previous experiences and knowledge); (2) Vertical instruments: Learning utilizes vertical instrument directions, such as models, schemes, diagrams, and individualized. This means learners create their own models within their reasoning; contextual problems are the relationship between relevant real-world

situation models and the learners' environment into mathematical models; (3) Learner contribution: meaning that a significant contribution to the learning process is made by learners, not teachers; (4) Interactive activities: Learning takes place interactively. This means there is interaction in the learning process, such as negotiation, explanation, justification, agreement, questioning, or reflection, used to achieve informal forms of mathematical knowledge. (5) Topic interconnectedness: learning is related to other topics. This means the topic being learned is integrated with other mathematical topics. The characteristics used by the researchers are those described by Fauzan et al. (2018).

### 2.2. Mathematical Communication Ability Indicators

The indicators of mathematical communication ability are: 1) organizing and integrating their mathematical thoughts through communication; 2) communicating their mathematical thinking logically and clearly to their peers, teachers, and others; 3) analyzing and evaluating the mathematical thinking and strategies used by others; 4) Using mathematical language to express mathematical ideas correctly (NCTM, 2000). Consistent with the communication indicators proposed by Chasanah et al. (2020), namely: 1) stating mathematical situations or everyday events in the form of mathematical models and solving them; 2) stating mathematical models (pictures) in plain language; 3) providing explanations for mathematical models and/or patterns; 4) formulating questions about given situations accompanied by reasons. From these various communication ability indicators, the researcher selected the indicators proposed by Chasanah et al. (2020).

## 3. Method

### 3.1. Research Design

The researcher utilized research and development with the ADDIE model. ADDIE stands for analysis, design, development, implementation, and evaluation (Suni, F. H., & Ahmad, S. 2023). The first stage is the analysis stage, where the researcher conducts needs analysis (for educators and students) and curriculum analysis. The second stage is the design stage, where the researcher designs instruments and designs a mathematics e-module on the topic of fractions based on the RME approach. The third stage is the development stage, where the researcher conducts validation tests on the developed e-module. The validation includes experts in the field, media, and language. The media is validated by three subject matter expert validators, one media expert validator, and one language expert validator. The fourth stage is the implementation stage, where the researcher conducts practicality tests on the developed e-module with one-to-one evaluations for three students, small group evaluations for eight students, and field tests for 24 students and one fifth-grade teacher. The final stage is the evaluation stage, where the researcher assesses the effectiveness of students' mathematical communication abilities. The researcher will further discuss the validation of the developed e-module.

### 3.2. Respondent

This research involves one fifth-grade elementary school teacher and four individuals from UNP higher education institutions for validation, consisting of three subject matter expert validators, one media expert validator, and one language expert validator. The researcher also involves 35 students and one fifth-grade teacher teaching at an elementary school in Kota Pariaman. Three students from SDN 01 Balai Naras for one-to-one evaluation trials, eight students from SDN 01 Balai Naras for small group evaluation trials, and 24 students from SDN 23 Balai Naras for field tests are included.

### 3.3. Data Collection

The instruments used in this study are validation questionnaire sheets consisting of validation aspects of content validity (material), media aspects, and language aspects. Validation of the material aspect is assessed based on several aspects of feasibility, including aspects of independent learning feasibility, completeness of learning, stand-alone feasibility, adaptability, user-friendliness, e-module components, characteristics of the RME approach, and indicators

of mathematical communication ability. Validation for media experts is related to graphical aspects. Validation of the language aspect is assessed on the feasibility of text readability, fluency, conformity with language rules, and effective and efficient language use. The measurement scale uses a 5-point scale. Each statement has a score as follows: 1 = very poor, 2 = poor, 3 = fair, 4 = good, and 5 = very good. The validity assessment is determined based on the criteria for interpreting the scores obtained. After the percentage score of the validity test by experts is obtained using the formula, the presentation results are then interpreted using the guidelines for interpreting validity test score criteria by Arikunto (2018).

**Table 1**. Validation Test Criteria

| Score | Category |
|---|---|
| 0,81 - 1,00 | Highly Valid |
| 0,60 - 0,80 | Valid |
| 0,41 - 0,60 | Quite valid |
| 0,21 - 0,40 | InValid |
| 0,00 - 0,20 | Very invalid |

### 3.4. Data Analysis

The data obtained from the questionnaire in this study are then used to calculate the validation results on a scale of (0–1) using the formula:

$$P = \frac{X}{Y} \text{ x } 100\ \%$$

Where P is the product validity score, X is the score obtained from the validation results, and Y is the maximum score of the validation results. After the percentage score of the validity test by experts is obtained using the formula, the presentation results are then interpreted using the guidelines for interpreting validity test score criteria, which are the same as Table 1 above.

## 4. Findings

The presentation of the e-module validation results from the aspects of subject matter experts, media experts, and language experts generates three summaries, where the material aspect includes the feasibility of independent learning, completeness of learning, stand-alone feasibility, adaptability, user-friendliness, e-module components, characteristics of the RME approach, and indicators of mathematical communication ability. Validation by media experts focuses on graphical aspects. The summary of the language aspect is assessed based on the readability of the text, fluency, conformity with language rules, and effective and efficient language use. For each of these sections, the percentage of respondent answers for each statement item is presented in a table.

### 4.1. Material Expert Validation Results

Validation by subject-matter experts is conducted by three experts. The validation by these experts includes the feasibility of independent learning, completeness of learning, stand-alone feasibility, adaptability, user-friendliness, e-module components, characteristics of the RME approach, and indicators of mathematical communication ability. Table 2 presents a summary of the validation results by subject matter experts.

**Table 2.** Recapitulation of Material Expert Validation Results

| No | Aspek Kelayakan | Skor | Keterangan |
|---|---|---|---|
| 1 | Self instruction | 0,91 | Highly Valid |
| 2 | Self contained | 0,93 | Highly Valid |
| 3 | Stand alone | 0,87 | Highly Valid |
| 4 | Adaptif | 0,87 | Highly Valid |

| | | | |
|---|---|---|---|
| 5 | Friendly | 0,88 | Highly Valid |
| 6 | Components of the e-module | 0,9 | Highly Valid |
| 7 | Characteristics of Realistic Mathematics Education (RME) | 0,89 | Highly Valid |
| 8 | Mathematical Communication Ability Indicators | 0,92 | Highly Valid |
| Total average | | 0,9 | Highly Valid |

Based on the assessment of material aspects, which consist of the feasibility of independent learning, completeness of learning, stand-alone feasibility, adaptability, user-friendliness, e-module components, characteristics of the RME approach, and indicators of mathematical communication ability, the results obtained are as follows: The feasibility of independent learning is 0.91, categorized as highly valid; the completeness of learning is 0.93, categorized as highly valid; stand-alone feasibility is 0.87, categorized as highly valid; adaptability is 0.87, categorized as highly valid; user-friendliness is 0.88, categorized as highly valid; e-module components are 0.9, categorized as highly valid; the characteristics of the RME approach are 0.89, categorized as highly valid; and indicators of mathematical communication ability are 0.92, categorized as highly valid. From these values, it can be calculated that the total average for the material aspect is 0.9, with the category being highly valid.

### 4.2. Media Expert Validation Results

Media expert validation was carried out by one UNP lecturer on graphic aspects. There are fifteen item statements on the graphic aspect. Table 3 displays a recapitulation of the results of media expert validation.

**Table 3.** Recapitulation of Media Expert Validation Results

| No | Statement Item | Validator assessment |
|---|---|---|
| **GRAPHICS** | | |
| 1. | Simple or easy-to-understand e-module display design | 5 |
| 2. | Clear consistency of e-module structure on every page. | 4 |
| 3. | Blend of background colors with text, and images | 4 |
| 4. | There are study instructions | 4 |
| 5. | The image used supports the display quality to be attractive | 5 |
| 6. | Ease of reading and watching materials, as well as doing evaluations | 5 |
| 7. | Absence of splash pages on the homepage, such as "Welcome" or "Click here to enter" | 4 |
| 8. | The learning video file is not directly run when the visitor opens the e-module page so that it focuses the user on understanding the writing on the material | 4 |
| 9. | The text writing used in the e-module is easy to understand | 5 |
| 10. | The image quality on the e-module is good | 5 |
| 11. | The quality of learning videos in the e-module is good | 5 |
| 12. | The image used supports the display quality to be attractive | 5 |
| 13. | There is a teacher contact or e-module author on my teacher profile that provides information so that students can easily contact the teacher | 4 |

| | | |
|---|---|---|
| 14 | E-modules can help students in the learning process | 4 |
| 15 | E-modules can improve students' communication skills | 4 |
| **Scores obtained from validation results** | | **67** |
| **Product validity value** | | **0,89** |

Based on the data in Table 3, it can be seen that the validation of the media aspect based on the assessment by validators shows an average validation value of 0.89, thus the e-module meets very valid criteria.

### 4.3. Linguist Validation Results

Linguist validation is carried out by a UNP lecturer, and the language aspect is assessed on the feasibility of text readability, straightforwardness, conformity with language rules, and effective and efficient use of language. Table 4 shows a recapitulation of validation results by linguists.

**Table 4.** Recapitulation of Linguist Validation Results

| No | Aspek Kelayakan | Skor | keterangan |
|---|---|---|---|
| 1 | Text readability | 1,00 | Highly Valid |
| 2 | Businesslike | 1,00 | Highly Valid |
| 3 | Compliance with language rules | 0,96 | Highly Valid |
| 4 | Effective and efficient use of language | 1,00 | Highly Valid |
| Total average | | 0,99 | Highly Valid |

Based on the assessment of language aspects, which consist of the readability of text, fluency, conformity with language rules, and effective and efficient language use, it can be observed that the readability of text is 1.00, categorized as highly valid; fluency is 1.00, categorized as highly valid; conformity with language rules is 0.96, categorized as highly valid; and effective and efficient language use is 1.00, categorized as highly valid. From these values, it can be calculated that the total average for the language aspect is 0.99, with the category being highly valid.

## 5. Discussion

The validity of the RME-based e-module on fractions, which has been obtained from the validation results conducted by expert validators (subject matter experts, media experts, and language experts), is as follows: Firstly, the validation of content validity (material) consisting of the feasibility of independent learning, completeness of learning, stand-alone feasibility, adaptability, user-friendliness, e-module components, characteristics of the RME approach, and indicators of mathematical communication ability yielded the following results: The feasibility of independent learning is 0.91, categorized as highly valid; the completeness of learning is 0.93, categorized as highly valid; stand-alone feasibility is 0.87, categorized as highly valid; adaptability is 0.87, categorized as highly valid; user-friendliness is 0.88, categorized as highly valid; e-module components are 0.9, categorized as highly valid; the characteristics of the RME approach are 0.89, categorized as highly valid; and indicators of mathematical communication ability are 0.92, categorized as highly valid. From these values, it can be calculated that the total average for the material aspect is 0.9, with the category being highly valid.

Secondly, the validation of presentation aspects (media) indicates that the presentation of the e-module is simple or easy to understand, the images used support quality, making the presentation attractive, and the quality of images and videos is good with an average validation score of 0.89, meeting the validity criteria (highly valid).

Thirdly, the validation of presentation aspects (language) consisting of text readability, fluency, conformity with language rules, and effective and efficient language use resulted in the following: text readability is 1.00, categorized as highly valid; fluency is 1.00, categorized as highly valid; conformity with language rules is 0.96, categorized as highly valid; and effective

and efficient language use is 1.00, categorized as highly valid. From these values, it can be calculated that the total average for the language aspect is 0.99, with the category being highly valid.

Overall, the validation results by subject matter experts, media experts, and language experts confirm that the design of the RME-based e-module on fractions has met the validity criteria (highly valid). This indicates that the material, media, and language used in this study meet high-quality standards as established guidelines, providing a positive indication that this research has successfully developed high-quality and relevant learning materials in the field under investigation.

These findings are consistent with research by Atikah (2021), where the validation results by subject matter experts received a score of 93.8%, categorized as highly valid, and the validation results by design and language experts received a score of 93%, categorized as highly valid. Therefore, the RME-based elementary school mathematics e-module is valid and highly suitable for use as mathematics teaching material, especially for fractions. Furthermore, the research findings by Annisa (2023) show that the RME-based e-module is categorized as suitable for use. The average score of the validation results by subject matter experts is 0.785, indicating moderate validity. Meanwhile, for material suitability using a Likert scale showing 84% results, the validation results from the language expert validator obtained an average score of 0.833, indicating high or very high validity. This is also consistent with the research findings by Nirmala (2023), who stated that the RME-based e-module is suitable for use in mathematics learning in Grade IV of elementary school.

### 6. Conclusion

The validity test of the RME-based e-module on fractions, based on the assessment results of subject matter experts, obtained a score of 0.9 with the category highly valid, while the media/design expert obtained a score of 0.89 with the category highly valid, and the language expert obtained a score of 0.99 with the category highly valid. This indicates that the RME-based e-module on fractions can be used and is suitable for use as teaching material in teaching fractions at the elementary school level.

## Limitation

The e-module was developed only for the fraction material. Then, the trials conducted were still limited to two schools, including SDN 01 Balai Naras and SDN 23 Balai Naras, both located in the same city. In each school, the number of classes was limited, with only one class, and on average, there were about 25 students in one class. This may result in limitations in conducting practicality tests and effectiveness tests, which require larger variations and control groups to obtain more meaningful results. Additionally, the e-module that was developed needs to be accessed and downloaded by students using laptops, computers, or gadgets that have internet access. Therefore, elementary school students may need guidance from educators and parents.

### Recommendation

It is recommended that subsequent researchers conduct development research on broader subjects. Further researchers are expected to be able to improve the quality of e-module development based on the RME approach on fractional materials even better.

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## Conflict of Interest

The author states that there is no conflict of interest.

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