Development of e-module using context of the Muara Enim traditional house on polyhedron materials

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Abstract: This study aims to produce e-module teaching materials based on PMRI on polyhedron material for class VIII SMP using the context of the Muara Enim traditional house using the Canva application, as well as to find out whether this e-module is valid, practical and has a potential effect on problem solving abilities in students. The research method used is R&D using Tessmer. The research process consists of two stages, the first preliminary stage which includes the preparation and design stages, and the second assessment is a formative flow which includes self-evaluation, expert review, one-to-one, small groups, and field tests. Compiled with the PMRI approach and linked to the context of the Muara Enim traditional house, the stages of testing the e-module teaching materials. The e-module learning materials were given to class VIII students of Junior High School. At this time, it shows that the use of e-modules in making teaching materials is valid and practical with qualitative analysis. The validity of teaching materials is carried out at the expert review stage using the validator's comments and suggestions. Validity aspects in terms of content, construct and language of the E-module. Practicality is carried out in the one-to-one, small group and field test stages by looking at comments and suggestions from students. The potential effect is the result of student evaluation tests used in field tests. The developed e-module teaching materials have a potential effect with an accuracy rate of 72.6% so that the e-module has a potential effect category on solving mathematical problems. The researcher suggests for future researchers to make the questions in the e-module more varied. Questions vary by providing questions from cognitive levels from C1 to C6.

Keywords: E-Module, Muara Enim Traditional House, PMRI, Polyhedron


INTRODUCTION

Humans will not be separated from what is called education, because basically education is one of the main factors in shaping character, mindset, and even mentality in humans. Quality human resources can be realized with quality education. One of the essential subjects in the realm of education is mathematics, often regarded as the monarch of the sciences. In our daily life we cannot be separated from mathematics, both from small things and advanced technology. But the problem now is that many students experience difficulties in mathematics (Guner, 2020; Saifiyyah & Retnowati, 2019). Students often have difficulty imagining abstract things in mathematics and solving contextual problems such as calculating the area and volume of blocks and prisms for objects in the shape of blocks and prisms (Aziiza & Juandi, 2021). The need for innovative teaching materials to make learning mathematics easier. Monotonous mathematics learning using printed books as learning references makes students only focus on
one reference (Eronen & Kärnä, 2018). In facing the challenges of the globalization era where educational technology plays a major role in solving learning problems, one solution is to create innovative learning media by creating educational resources presented as electronic modules.

E-modules are learning media modified from printed modules into electronic form that present writing, images, animations, and can be reached using a computer or smartphone. Advances in technology also allow e-modules to be displayed via smartphones (Dewi et al., 2019). E-module can also be said to be a module that is printed and can be viewed on a computer or electronic device and crafted with the required software. The advantages of e-modules can also reduce the use of paper in the learning process, the use of e-modules is not limited by place and time, thus The created electronic module is accessible at any time and from any location (Laili et al., 2019). The electronic module is accessible at any place and at any moment. because it is online so if there is an internet connection it can be used. Apart from that, e-modules can also be accessed repeatedly and are interactive in their use.

Besides instructional materials, a captivating teaching methodology is essential. Furthermore, throughout the teaching and learning procedure, there is a focus on fostering increased student engagement. An instructional method that can fulfill these learning requirements is the Indonesian Realistic Mathematics Education (PMRI) approach. The PMRI approach is a mathematical approach that emphasizes the starting point of learning by raising real problems in everyday life (Aspriyani & Suzana, 2020). In mathematics education realistic problems are used as a basis for building mathematical concepts or also known as learning resources. Therefore, in learning the PMRI approach emphasizes the importance of real (real) contexts that are related to the everyday experiences of students (Ningrum & Rohim, 2023). The PMRI principles consist of Guided Reinvention, Didacting Phenomenology, Self-Developed Models. The e-module development carried out by researchers used an approach from PMRI so that it could make students actively learn to build flat-sided spaces.

Several studies have developed E-modules, research by Safaati and Yunianta (2022) that produced Android-Based EDUGSIA (flat-sided building e-module) as a Learning Supplement for Class VIII Middle School Students. Then research by Wibowo and Pratiwi (2018) that Created educational materials utilizing the Kvisoft Flipbook Maker application for compiling resources. Then research by Kurniasari et al. (2018) that produced E-modules Characterized by Ethnomathematics on Flat Side Building Materials" . Then research by Safitri (2017) that produced Development of E-modules with a Realistic Mathematics Learning Approach Assisted by Flipbook Maker on Flat Side Building Materials. Then research by Maulidah (2022) that produced Mathematics E-module Based on Approach PMRI on Class XI MA Raudatussyubban Class Material for the 2021/2022 Academic Year. From several of these studies, valid and practical e-modules have been produced. From several studies, there is no e-module that uses the Muara Enim traditional house context. The Muara Enim context is significant because it is near to the local pupils. Polyhedron content is challenging for students, making it particularly significant. Employing a context familiar to students will facilitate a more accessible learning experience for polyhedron materials. The use of e-modules with real life contexts can improve learning outcomes on polyhedron material (Etanastia et al., 2022).

One of the subjects of mathematics that is often related to everyday life is the material of flat sided geometric shapes which are taught in class VIII even semester. The scope of this flat side building material includes, beams, and prisms. Here the researcher develops research using the context of traditional houses. The traditional house is one of the highest cultural representations in a tribal or community. Indonesian traditional houses consist of various characteristics from each region. In addition to being exquisite and distinctive in design, traditional homes also have symbolic meanings that are specific to their intended uses. (Wahidin, 2019). One of them is the traditional house of Muara Enim itself, namely the traditional house of the Semende tribe. The context of the traditional Semende house is in line with the learning objectives of polyhedron because there are parts of the house that are shaped like blocks and prisms. Incorporating contextual materials related to everyday problems can
enhance students' proficiency in solving mathematical problems. The objective of this study is to produce an E-module using the Muara Enim traditional house context on polyhedron material that is valid, practical, and has a potential effect on mathematical problem-solving abilities.

**METHOD**

This research uses the type of R&D research or development. The participants in this research comprised eighth-grade students from a Junior High School. School selection was based on students’ proximity to the traditional Semende home context in Muara Enim and who had difficulty learning polyhedrons. In this research process which consisted of two stages, namely the preliminary stage and the formative evaluation stage of the Tessmer model which included the self-evaluation and prototyping stages (expert review, one-to-one, small group and field test). The following is a picture of the formative flow of the Tessmer model in Figure 1.

![Figure 1. Formative Evaluation Design Flow](image)

*Note. Source Tessmer (1993)*

At the preliminary stage, the researcher prepared and designs. In the preparatory stage an analysis was carried out which consisted of an analysis of the school's applied curriculum, an analysis of the material to be used, and an analysis of the students. The analysis’s conclusions are that the two thousand and thirteen curriculum is being used, and polyhedron will be the material used to create the E-Module, the research subjects are eighth grade students. At the design stage the researcher collected information related to the source material used block and prism, created instructional materials in the format of e-modules using the Canva design application, and designed an iceberg for implementing PMRI in e-modules, designing expert validation sheets, designing practicality questionnaires with a Likert scale and creating evaluation questions for the field test stage. These instruments were deliberated with colleagues before undergoing validation during the expert review.

This stage consists of self-evaluation and prototyping (expert review, one-to-one, small group and field tests). At the self-evaluation stage, the researcher reviews the visible errors by asking for suggestions and comments from the supervisor. These comments and suggestions will be revised and become prototype I. Then at the expert review stage, researchers use a Likert scale of 1-5 which involves expert experts to assess aspects of content, design, language, e-modules, and PMRI characteristics. Comments and suggestions from the expert review stage will be used as material for revision and produce prototype II. Along with the expert review stage, trials were also carried out at the one-to-one stage which included students with 3 types
of high, medium, and low mathematical abilities seen from the results of students’ mathematics learning which are different students from the small group and field test stages. The aspects assessed at this stage are clarity, attractiveness and errors seen in the teaching materials which contain comments and suggestions. Then interviews were conducted regarding written comments and suggestions on a one-to-one questionnaire. The result of the one-to-one revision is prototype II. Furthermore, the small group step involves students to assess practical aspects consisting of attractiveness, effectiveness, and applicability. The results of the practicality questionnaire contained data with comments and suggestions which were then conducted with interviews related to suggestions and comments and then produced prototype III. Suggestions and comments at each stage of the formative evaluation were analyzed qualitatively. Researcher improved the e-module by looking at comments/suggestions at the expert reviews, one-to-one and small group stages.

In the last stage, namely the field test stage, an evaluation test was carried out on students to see the potential effect on students' mathematical problem-solving abilities. The test is carried out by providing evaluation questions which contain realistic questions and are assessed based on problem solving indicators. Problem solving abilities have criteria based on the results of the student's score. The problem solving indicators used are understanding the problem, planning a solution, implementing the plan, and reinterpreting the results obtained (rechecking the answers) (Wafiqoh et al., 2016). The categories of mathematical problem-solving abilities in Table 1.

Table 1. Mathematical Problem-Solving Ability Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>$85 &lt; x \leq 100$</td>
</tr>
<tr>
<td>High</td>
<td>$70 &lt; x \leq 85$</td>
</tr>
<tr>
<td>High enough</td>
<td>$50 &lt; x \leq 70$</td>
</tr>
<tr>
<td>Not high enough</td>
<td>$30 &lt; x \leq 50$</td>
</tr>
<tr>
<td>Low</td>
<td>$0 \leq x \leq 30$</td>
</tr>
</tbody>
</table>

**RESULTS AND DISCUSSION**

Results

**Preparation and design**

This stage is in the form of preparation and design. Preparation was carried out by analyzing the curriculum used by the school, it was found that in this school implemented the 2013 curriculum in its learning. The examination of the students' data revealed that they had trouble learning maths material because there was no diversity of teaching materials which were only centered on printed books so that it was difficult to understand material related to everyday life. The difficulties experienced by students, especially in learning polyhedron material, especially block and prism sub-material. Students still have difficulty determining the area and volume of block and prism. Next, the researcher carried out the process of designing electronic teaching materials. The teaching materials to be developed are e-modules. E-modules are designed through the Canva application. First, the researcher collects references related to cuboids and prism material through books, the web or personal sources in the form of object images. The two researchers carried out the material design and also the PMRI implementation sequence in the e-module through the created iceberg. The results of the Canva e-module design are based on the following design procedure in Figure 2.

In the Figure 2, this is the initial part of the e-module, there is an image used in the form of a traditional Muara Enim house, in which the body of the house is in the form of a cuboids and the roof is in the form of a prism space. The presentation of the e-module is based on the characteristics and principles of PMRI. The implementation of PMRI in the e-module is poured into student activities through Iceberg in Figure 3.
In e-module learning that uses the PMRI approach contains four levels which are visualized by using Iceberg, namely 1) situational (contextual problem), 2) referential (model of), 3) general (model for), and 4) formal. In contextual problems, students are given problems regarding traditional Muara Enim houses to discover the concept of block surface area. In the model the students found a scheme with a grid of block structures from parts of a traditional Muara Enim house building. In the model for students to build knowledge by calculating the entire area of the grid of a traditional Muara Enim house in the form of block structures. Students find the formula for a block's surface area during the formal stage.
**Self-Evaluation**

The next stage is that the researcher evaluates the developed e-module teaching materials. This stage consists of self-evaluation and prototyping. In the self-evaluation, the researcher asked for comments and suggestions from colleagues the product being developed as prototype I. The researcher used a sheet of comments/suggestions from colleagues.

**Expert Review and One-to-One**

Furthermore, the results of prototype I were tested at the expert review stage involving 3 experts, namely 3 mathematics education lecturers and 1 mathematics teacher. Following are comments/suggestions from validators in Table 2.

<table>
<thead>
<tr>
<th>Number</th>
<th>Validator</th>
<th>Comment and Suggest</th>
</tr>
</thead>
</table>
| 1      | Validator 1 | 1. The image context circle is changed to be more specific  
2. Short history of traditional houses plus more clarity and detail  
3. The name of the traditional house is written on it  
4. All images are animated/don't be still |
| 2      | Validator 2 | 1. Create a scheme that addresses the PMRI context  
2. The PMRI's features are the basis for the creation of the e-module's contents.  
3. There are examples or practice questions that are made to calculate house board units |
| 3      | Validator 3 | 1. Check the writing of the preposition above at the space above  
2. Correct the wrong sentences such as (above, below, etc.)  
3. Add some HOTS C4 and C5 questions  
4. Page 12 of the command blocks, give letter notation at the point why it is not the same as the command in the prism material  
5. Page 15 uses Roman letters in the explanation (looks like the number 1)  
6. Page 26 use another editorial so that it is not monotonous because the sentences are exactly the same as those on the block page  
7. Page 34 contains repetition of words in the top line and an introduction to the conclusion of the formula, just to the point  
8. Correct typo words such as missing letters in sentences |
| 4      | Validator 4 | Correct typo sentences and words |

After receiving suggestions from the validator, the researcher revised the e-module developed. Researchers improve based on suggestions and comments from validators. The following represents the outcome of the revision decision made during expert review stage in Table 3.

<table>
<thead>
<tr>
<th>No</th>
<th>Revision decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The circle of houses is less clear</td>
</tr>
<tr>
<td>2</td>
<td>There are still typo words</td>
</tr>
<tr>
<td>3</td>
<td>It’s fun to learn e-modules because you can study independently</td>
</tr>
<tr>
<td>4</td>
<td>Interested in learning e-modules because they are practical and easy to understand</td>
</tr>
<tr>
<td>5</td>
<td>Appearance of letters, colors and images are appropriate</td>
</tr>
<tr>
<td>6</td>
<td>It is commendable as it includes supplementary explanatory videos that can assist students in comprehending the material description.</td>
</tr>
</tbody>
</table>

According to the validation sheet outcomes, all three validators affirmed the validity and appropriateness of the e-module teaching materials. However, they also provided comments and suggestions for several enhancements, as documented in the comments and suggestions.
section. Following the researcher's decision to revise, adjustments will be made to the teaching materials. Subsequently, the e-module will undergo retesting during the one-to-one stage.

During the one-to-one practicality questionnaire, feedback and suggestions from students regarding the tested e-module teaching materials were collected. The subsequent decision for revision at the one-to-one stage in Table 4.

<table>
<thead>
<tr>
<th>No</th>
<th>Revision decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E-module learning is easy to understand and understand</td>
</tr>
<tr>
<td>2</td>
<td>There are still typo words</td>
</tr>
<tr>
<td>3</td>
<td>Interested in using e-modules with the PMRI approach</td>
</tr>
<tr>
<td>4</td>
<td>There is a learning video that cannot be played</td>
</tr>
<tr>
<td>5</td>
<td>Add animation on a blank page</td>
</tr>
<tr>
<td>6</td>
<td>Views are interesting</td>
</tr>
<tr>
<td>7</td>
<td>It’s fun learning to use e-modules</td>
</tr>
<tr>
<td>8</td>
<td>Display pictures, letters are appropriate</td>
</tr>
<tr>
<td>9</td>
<td>There is still a need for direction and guidance at the beginning of using the e-module</td>
</tr>
</tbody>
</table>

In addition, interviews were also conducted with several students regarding the suggestions and comments given. Subsequently, the researcher incorporated revisions in line with the received comments and suggestions. The outcomes of the one-to-one revision stage will yield Prototype II, which will undergo testing in the small group stage.

**Small Group**

Furthermore, prototype II trials were carried out in small group phase with 6 students in eighth grade at Junior High School. Students will evaluate e-module teaching materials developed based on aspects of attractiveness, effectiveness and applicability. These aspects are included in the small group practicality questionnaire. Based on the practicality questionnaire at small group phase students' suggestions and comments were obtained. Furthermore, the researcher conducted interviews with several students regarding the suggestions and comments written. The feedback and suggestions received will be incorporated into the revision of Prototype II. The revised Prototype II will then lead to the development of Prototype III, which will undergo testing in the field test phase. The following outlines the outcomes of the revision at the small group phase in Table 5.

<table>
<thead>
<tr>
<th>No</th>
<th>Before revision</th>
<th>After revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Correction of words that are still wrong</td>
<td></td>
</tr>
</tbody>
</table>
Field Test

At field test phase, a trial was carried out on prototype III to one class consisting of 15 students. Each student uses their respective smartphone to open the e-module link that has been shared by the researcher. At this stage students work on evaluation questions in the form of realistic problems that are worked on based on indicators of mathematical problem solving. The objective of field test phase is to assess the potential effect on students' mathematical problem-solving abilities through the administered test questions. The results of the student evaluation exercise, then calculated the average percentage of students' conceptual understanding abilities. Percentage of mathematical problem-solving ability category in Table 6.

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>$85 &lt; x \leq 100$</td>
<td>1</td>
<td>13%</td>
</tr>
<tr>
<td>High</td>
<td>$70 &lt; x \leq 85$</td>
<td>9</td>
<td>53%</td>
</tr>
<tr>
<td>High enough</td>
<td>$50 &lt; x \leq 70$</td>
<td>5</td>
<td>34%</td>
</tr>
<tr>
<td>Not high enough</td>
<td>$30 &lt; x \leq 50$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Low</td>
<td>$0 \leq x \leq 30$</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
According to the Table 6, it can be inferred that students exhibit a high level of mathematical problem-solving abilities, with 13% falling into the "very high" category, 53% in the "high" category, and 34% in the "high enough" category. Through the aforementioned calculations, the outcomes indicate that the e-module on beam and prism, developed using the PMRI approach with the Muara Enim traditional house context, has a substantial potential effect on students' mathematical problem-solving abilities, reaching 72.6% in the "high" category. The researcher conducted an analysis of students' responses based on the various stages of problem-solving abilities. The following are the answers of students in the evaluation of question no 2 in Figure 4.

**Figure 4. Student's Answer**

The results obtained from students' responses to question number 2 indicate, they have stated exactly what is known and what is being asked so that it meets the indicators of understanding problem solving. Furthermore, students plan to solve the problem accurately. Indicated by the responses of students who prioritize writing down the formula and connecting it to the relevant concept, then in carrying out the plan, students can write the solution in a coherent, complete and precise manner and pay attention to the units in the results obtained, namely by changing the unit becomes m² and on the indicator interprets and makes conclusions students write down the answers from the conclusions about which it can be concluded that the surface area of the house is 306 m².

**Figure 5. Student's Answer**
In Figure 5 is the answer of student in the evaluation of question number 4. The results obtained from students' responses to question number 4 indicate, they have stated exactly what is known and what is being asked so that it fulfills the indicators of understanding the problem. Furthermore, students plan to solve the problem correctly, indicated by the responses of students who prioritize writing down the formula and connecting it to the relevant concept, then in implementing the plan, students can write the solution in a coherent, complete and precise manner, and students recheck the answer by writing 5000 liters.

Discussion

In the process of developing the cuboids and prism building e-module in the context of the Muara Enim traditional house, the PMRI approach was used, which aims to determine the validity, practicality, and potential effect on students' mathematical problem-solving abilities on the resulting product. The initial stage of research is the (preliminary) stage which will produce an initial prototype, followed by the product validation stage (prototype I), namely expert review and one-to-one. Prototype I was revised to become prototype II. Then at the small group stage it will become a reference for the revision process which will produce prototype III. This process will produce e-modules that are valid, practical and have potential effects.

After going through a development process consisting of two stages, namely preliminary and prototyping, results were obtained that were valid, practical, and had a potential effect on the mathematical problem-solving ability of the block and prism building e-module in the context of the Muara Enim traditional house using the PMRI approach. Validity can be seen by analyzing expert validation data by revising it based on validator suggestions and comments. At the expert review stage, the validity of the e-module is assessed from the aspects of content, language, appearance, e-module and PMRI characteristics which are assessed by the validator so that it can be used and can be continued to the next testing stage. Content aspects of suitability of KI, KD and material indicators of blocks and prisms. Constructive aspects of the suitability of the traditional house context for block and prism materials. Language aspect of the suitability of word use with EYD 6. The e-module product is said to be qualitatively valid by experts through an assessment that is suitable for use (Jannah et al., 2019; Nizar, 2023; Riyanto et al., 2018; Yansen et al., 2019). So that the beam and prism e-module in the Muara Enim traditional house context using the PMRI approach has valid criteria.

In terms of practicality in one-to-one and small group support, it is generally found that the e-module for building blocks and prisms in the context of the Muara Enim traditional house using the PMRI approach developed has a very practical category. Then e-modules are practical because they are easy to use by students (Jannah et al., 2019; Nizar, 2021; Nizar et al., 2018a, Nizar et al., 2018b, Nizar et al., 2022; Nusantara et al., 2021). This is based on analysis of the results of one-to-one and small group questionnaires seen from the answers to statements as well as comments and suggestions on the questionnaire sheet. Practicality is obtained when students find it easy to use the E-module being developed. It is easy for students to use e-modules because e-modules are online which can be accessed from cellphones, computers or laptops, then the traditional Semende home context is used close to students. Based on the potential effect on students' mathematical problem-solving abilities, the potential effect on students' mathematical problem-solving abilities is reviewed based on mathematical problem-solving indicators. In this case, the researcher carried out an evaluation test at the field test stage which assessed students' answers based on a sequence of indicators for solving mathematical problems. The percentage of completeness of student learning outcomes was 72.6 so that the e-module developed had a potential effect on problem solving. Students' mathematical problem-solving abilities are very high 13% in the very high category, 53% in the high category and 34% in the high enough category. So, the E-module developed contributes to problem solving abilities. The percentage of 72.6 was obtained from calculating students' scores for working on questions based on indicators of problem-solving ability.
Apart from that, the e-module for building blocks and prisms using the PMRI approach in the context of the Muara Enim traditional house also contains problem solving indicators in the questions presented. This can be seen from the evaluation questions given which contain realistic problems in the context of traditional houses. The problem-solving indicator can be seen from the systematicity of students' solutions in solving problems, where it was found that students' mathematical problem-solving abilities were rated at 13% in the very high category. Students have mathematical problem-solving abilities of 53% in the high category, and 34% of students have mathematical problem-solving abilities in the quite high category. Based on these results, the e-module developed is appropriate and can help students improve their mathematical problem solving abilities (Heldawati et al., 2023; Novianti, 2018; Nugroho et al., 2017; Putri et al., 2023; Ristiningsih et al., 2021; Safaati & Yunianta, 2022; Widiazizah et al., 2022; Yuni et al., 2022).

CONCLUSION

E-module building blocks and prisms using PMRI in the context of Muara Enim traditional houses is declared valid. This can be seen from the validator's improved comments and suggestions. The e-module building blocks and prisms using PMRI in the context of the Muara Enim traditional house developed at Junior High School has practical criteria. This can be seen from the comments and suggestions filled in by students on the one-to-one, small group, and field test questionnaires. Students can easily use the developed E-module.

E-module building blocks and prisms using PMRI in the context of the Muara Enim Traditional House which was developed at Semende Darat Ulu Public Middle School 1 has a potential effect on mathematical problem-solving abilities in terms of the indicator of achievement of problem-solving abilities with a percentage of 72.6 with high intervals indicating that the developed e-module has a potential effect on students' mathematical problem-solving abilities. Students' mathematical problem-solving abilities are very high 13% in the very high category, 53% in the high category and 34% in the high enough category. The researcher suggests for future researchers to make the questions in the e-module more varied. Questions vary by providing questions from cognitive levels from C1 to C6.

DECLARATIONS

Author Contribution: HN: Conceptualization, Writing - Original Draft, Editing and Visualization; EI: Writing - Review & Editing, Formal analysis, and Methodology; ADV: Validation and Supervision

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