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The development of a numeracy e-module on geometry for junior high school students

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Abstract
Numeracy skills are essential for daily life and must be mastered by students. However, data from PISA and TIMSS indicate that Indonesian students' numeracy skills are still low. One contributing factor is the limited availability of numeracy-based learning materials, which reduces students' familiarity with numeracy-oriented problems. Therefore, this study aimed to develop a numeracy e-module on geometry for eighth-grade junior high school students. This study employed a research and development (R&D) method using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The participants included students and teachers from SMPN 2 Banda Aceh. Data were analyzed using qualitative techniques to describe interview results and quantitative techniques to analyze validation, readability, and practicality data. The results showed that the e-module achieved an average score of 4.37 for material presentation and assessment and 4.53 for media and language aspects, both categorized as very valid. The practicality evaluation indicated positive responses, with average scores of 4.46 from teachers and 4.35 from students, both categorized as very practical. These findings indicate that the developed numeracy e-module on geometry is valid and practical for use in junior high school mathematics learning.

Keywords: E-module development, Numeracy, Geometry

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Introduction

Mathematics learning needs to be aligned with the current curriculum, namely the Kurikulum Merdeka. The Kurikulum Merdeka is a policy established by the Indonesian Ministry of Education and Culture as an additional step in the context of restoring learning in 2022-2024 (Madhakomala et al., 2022). According to the Indonesian Ministry of Education and Culture, one of the main characteristics of the Kurikulum Merdeka that can support the recovery of learning is the deepening of basic competency learning, such as numeracy. Numeracy refers to the knowledge and skills required to use various numbers and symbols related to basic mathematics to solve practical problems in various contexts and to analyze information presented in various forms such as graphs, tables, and charts (Han et al., 2017). Numeracy is very important for students to understand, analyze and be able to make decisions in various contexts based on relevant information and data (Winarno et al., 2024). A population that can

apply mathematical understanding in economic, technical, scientific, social, and other contexts can enhance employment competitiveness and economic well-being (Nashirulhaq et al., 2022). Therefore, numeracy is essential in daily life and should be developed from school age.

In the Kurikulum Merdeka era, students must strengthen numeracy skills, as these are assessed in the Minimum Competency Assessment (AKM) following the transition from the National Examination (UN) to the National Assessment (AN). However, Indonesian students' numeracy skills remain low, as shown by declining results in the PISA (Programme for International Student Assessment) tests. PISA evaluates the problem-solving abilities of 15-year-old students in real-life contexts, reflecting a country's educational state and future prospects. The PISA programme aligns with the basic principles of numeracy, which emphasize problem-solving in daily life contexts. The aspects evaluated in PISA include three types of literacy: reading, mathematical literacy (numeracy), and scientific literacy (Rahma P & Reflina, 2023). Thus, the PISA test results can be used to measure the numeracy skills of students in a country.

Based on the 2015 PISA test results, Indonesia scored 387 in mathematics, with an average score of 490. In 2018, Indonesia's mathematics score was 379 (OECD, 2018). In 2022, Indonesia's score further decreased by 13 points from the 2018 score, achieving an average score of 366 and ranking 70th out of 81 countries (Kemendikbudristek, 2023). The result of the PISA test indicate that the numeracy skills of Indonesian students are still very low.

This is further supported by results of an initial numeracy skills test conducted on January 6, 2024, with 25 eighth-grade students at SMPN 2 Banda Aceh. The findings revealed that all the tested students struggled to understand numeracy questions. They were not familiar with mathematics problems presented in daily life context. Additionally, students found it challenging to solve problems because of difficulties in creating mathematical models based on the readings. Based on the scoring criteria for the initial numeracy skills test, with a maximum score of 20, of the 25 students who took the test, 10 students scored 0, 10 students scored 1, 4 students scored 2, and 1 student scored 5. These scores indicate that the numeracy skills of the students in the class were still very low.

The low numeracy test results indicate that mathematics learning is still lacking in meaningful and contextual approaches for students, making it difficult for them to understand visual representations or models in mathematical concept explanations (Ekowati et al., 2019). The difficulties students face in answering numeracy questions require teachers to integrate numeracy materials into their learning. Students' numeracy skills will develop with consistent practice from teachers. The mathematics learning process must be meticulously planned to ensure optimal and effective learning. One essential learning tool for the Kurikulum Merdeka is the learning module (Maulida, 2022).

The use of learning modules can be complemented by leveraging technology. Implementing technology in learning is a curriculum requirement that is aligned with the 21st century. Integrating technology into learning modules helps create an engaging environment. It also makes the learning process more attractive for students. One creative solution for teachers is the use of electronic modules (e-modules). An e-module is a form of self-study material presented systematically in specific learning units. E-modules are presented in an electronic format, with each learning activity linked to navigation links that enhance the learning experience for students. E-modules are also enriched with tutorial videos, animations, and audio

to enhance the learning experience (Kemendikbud, 2017). E-modules have the potential to present mathematics learning in an engaging and non-repetitive way, increasing students' interest in learning (Rismaini & Devita, 2022). E-modules are also highly practical as they can be accessed on students' smartphones anytime and anywhere.

However, the current issue is the limited availability of learning materials for train students' numeracy skills. Based on an interview with a mathematics teacher at SMPN 2 Banda Aceh, it was found that the teachers there predominantly use government-provided learning materials and have never developed an e-module to support classroom learning. Additionally, the integration of numeracy in these learning materials is limited and only introduced at the beginning of the lessons. This lack of consistent practice makes it difficult for students to solve numeracy questions across various topics, including geometry content, particularly in the material on line and angle relationships and the properties of triangle congruence. This is supported by a study conducted by (Diyarko & Waluyo, 2016), which explains that the low numeracy skills are due to several factors, such as the lack of habitual practice from teachers in solving problems related to numeracy questions.

Line and angle relationships and the properties of triangle congruence are part of the eighth-grade geometry content. Observations at SMPN 2 Banda Aceh reveal that existing learning materials for these topics are not yet suitable for students' needs. This opens up opportunities for developing learning resources that are appropriate for students' conditions and can facilitate their learning. Moreover, geometry is considered one of the more challenging topics in mathematics. Therefore, it is necessary to adjust the teaching materials, such as e-modules, which can provide clear visual representations to simplify complex concepts and support students' numeracy skills effectively.

(Falah & Utami, 2022), previously conducted a study titled "Development of an Ethnomathematics-Based Plane Geometry E-Module for Seventh Grade Junior High School Students." However, the subtopics of geometry covered in this previous study discussed the area and perimeter of a plane figure that differ from those that are the focus of this research. While the previous study was oriented towards the Kurikulum 2013, this study is oriented towards the Kurikulum Merdeka. Another relevant study by (Setiawan et al., 2022) titled "Development of Mathematics Learning Modules on Geometry and Measurement Topics Based on the Profile of Pancasila Students," also discussed plane geometry subtopics. However, Setiawan's focus was on developing students' critical reasoning abilities, whereas this study aims to enhance students' numeracy skills. The novelty of this research is the development of learning materials that align with the demands of the Kurikulum Merdeka by incorporating technology-based learning and focusing on essential topics. This study places emphasis on improving students' numeracy skills, which is a crucial aspect of the Kurikulum Merdeka. Therefore, the materials and exercises provided are tailored to match the numeracy indicators.

Based on the research urgency outlined, the researcher proposes a solution by developing a numeracy e-module based on the Kurikulum Merdeka for the material on line and angle relationships and the properties of triangle congruence. This e-module was created using the Canva application. The e-module is enriched with contextual problems to enhance students' numeracy skills. The content in the e-module is presented from simple to abstract concepts. The e-module also includes images, illustrations, and videos to facilitate students' understanding of

the material. Additionally, the e-module incorporates links to the Quizizz website for student exercises/evaluations, making the learning process more enjoyable and less monotonous.

Methods

This study type is Research and Development (R&D), focused on creating a valid and practical numeracy e-module about Line and Angle Relationships and Triangle Congruence for eighth-grade students. It was conducted on January 6, 2024, with a limited trial, involving 25 students and a teacher at SMPN 2 Banda Aceh. The ADDIE model guided the research, which includes Analysis, Design, Development, Implementation, and Evaluation stages (Cahyadi, 2019). The analysis involved needs, curriculum, and initial skills assessments. The design included e-module content and an assessment instrument. In the development stage, validation and readability tests were conducted on the completed e-module. The completed e-module underwent validation and readability testing before being implemented in class. The practicality of the e-module was assessed by students and a teacher. The final stage is evaluation. The evaluation used in this research is formative evaluation.

The data sources used in the research consist of two types: primary data sources, namely teachers, students, and validators, and secondary data sources, namely documents of learning outcomes, learning objectives flow, the operational curriculum of the educational unit, and eighth-grade mathematics textbooks. The instruments used include interview guide and initial numeracy skills test sheets, used in the initial analysis stage, as well as validation sheets, readability sheets, and practicality sheets, used during the development process of learning materials. The validation sheets are assessed by subject and evaluation experts, as well as media and language experts. The material and evaluation expert validators consisted of three Mathematics Education lecturers and a mathematics teacher at SMPN 2 Banda Aceh, while the media and language expert validators consisted of an Electrical Engineering Education lecturer and a Communication and Islamic Broadcasting lecturer at UIN Ar-Raniry Banda Aceh. The aspects assessed in the validity indicators can be seen in Graphs 1 and 2. Meanwhile, the practicality sheets are filled out by teachers and students. The aspects assessed in the practicality indicators can be seen in Graphs 3 and 4.

The data analysis is carried out to analyze the data obtained from interviews, documentation, and questionnaires. The data analysis technique employs qualitative data analysis to present interview results, and quantitative data analysis to present data on validation, readability, and practicality sheets. To measure the levels of validity, readability, and practicality, a likert scale is used. This scale is structured in the form of statements followed by five responses (five-point scale) (Widoyoko, 2017). The responses from the validators are scored as shown in Table 1.

Table 1. Scoring Guidelines for Validation Results, Readability and Practicality

No.	Quantitative Analysis	Score
1	Very Suitable	5
2	Suitable	4
3	Quite Suitable	3
4	Not Suitable	2
5	Very Unsuitable	1

After scoring using a likert scale, the next step is to calculate the average score for each aspect using a Formula 1 (Widoyoko, 2017):

$$\bar{x} = \frac{1}{many\ validators} \times \frac{\sum_{i=1}^{n} x_i}{n} \quad (1)$$

where:
$\bar{x}$ = average score for each aspect
x_i = i-th information score
n = the number of questions for each aspect

Next, to compile a classification table, first look for the highest score, lowest score, number of classes and interval distance.

Highest score (ideal) = 5 (very suitable)
Lowest score = 1 (very unsuitable)
Number of classes = 5 (very unsuitable untill very suitable)

$$\text{Interval distance} = \frac{highest\ score - lowest\ score}{number\ of\ classes} = \frac{5-1}{5} = \frac{4}{5} = 0{,}8 \quad (2)$$

Based on Formula 2, a classification table of respondents attitudes can be prepared as a guide to the criteria for validity, readability and practicality (Widoyoko, 2017), as presented in Table 2.

Table 2. Guidelines for Validity, Readability and Practicality Criteria

Average Answer Score	Criteria
$\bar{x} > 4{,}2$	Very Suitable
$3{,}4 < \bar{x} \leq 4{,}2$	Suitable
$2{,}6 < \bar{x} \leq 3{,}4$	Quite Suitable
$1{,}8 < \bar{x} \leq 2{,}6$	Not Suitable
$\bar{x} \leq 1{,}8$	Very Unsuitable

Based on Table 2, score $\bar{x}$ is obtained using formula (1). The e-module is said to be valid, readable and practical if the minimum criteria obtained are suitable.

In another case, the guidelines for scoring numeracy abilities are presented in Formula 3.

$$Percentage = \frac{The\ total\ score}{maximum\ total\ score} \times 100\% \quad (3)$$

The obtained results are then grouped according to the numeracy ability criteria adapted from (Akbar, 2017), as presented in Table 3.

Table 3. Numeracy Ability Assessment Category

Percentage (%)	Category
81-100	Very Good
61-80	Good
41-60	Quite Good
21-40	Not Good
0-20	Very Not Good

Result

The results of this research are in the form of a numeracy e-module regarding the relationship between lines and angles and the nature of congruence of triangles for class VIII students at SMP Negeri 2 Banda Aceh. The results obtained after conducting the research are as follows.

Analysis stage

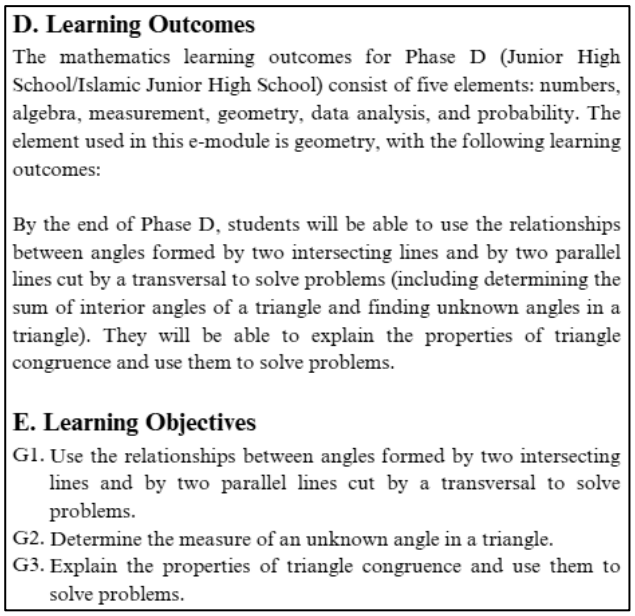
The results from the analysis stage revealed that SMPN 2 Banda Aceh has implemented the Kurikulum Merdeka in its learning. This curriculum framework provides independence for educators to develop contextual academic unit curricula that follow students' needs. The Kurikulum Merdeka provides flexibility, makes it easier for educators to apply deeper learning according to student's needs and focuses on strengthening character (Setyaningsih et al., 2024). However, the learning materials used by the mathematics teachers at the school are still not aligned with the students conditions. Teachers are still using government-provided mathematics learning materials. Based on the analysis results, the book does not fully incorporate elements of numeracy. Some topics are presented directly in an abstract manner without first relating them to everyday life, making the learning less meaningful for students. Based on the initial numeracy skills test results for 25 eighth-grade students at SMPN 2 Banda Aceh, with a maximum score of 20, it was found that the numeracy skills of students in the class are still low. The test results can be seen in Table 4.

Table 4. Student Numeracy Preliminary Test Results

Many Students	Score
10	0
10	1
4	2
1	5

Based on findings in the field, all students tested had difficulty understanding numeracy questions and no one completed the questions given. They are not used to being faced with mathematics problems packaged by contextual reading. Further, it was found that students were confused in solving problems because of difficulties in making mathematical modeling based on reading. This is the reason it is necessary to develop numeracy-based learning materials that suit students' needs.

The development of this e-module is focused on geometric elements, especially on the relationship between lines and angles and the congruence properties of triangles. The learning achievements and objectives of the material used in the e-module can be seen in Figure 1.



D. Learning Outcomes

The mathematics learning outcomes for Phase D (Junior High School/Islamic Junior High School) consist of five elements: numbers, algebra, measurement, geometry, data analysis, and probability. The element used in this e-module is geometry, with the following learning outcomes:

By the end of Phase D, students will be able to use the relationships between angles formed by two intersecting lines and by two parallel lines cut by a transversal to solve problems (including determining the sum of interior angles of a triangle and finding unknown angles in a triangle). They will be able to explain the properties of triangle congruence and use them to solve problems.

E. Learning Objectives

G1. Use the relationships between angles formed by two intersecting lines and by two parallel lines cut by a transversal to solve problems.
G2. Determine the measure of an unknown angle in a triangle.
G3. Explain the properties of triangle congruence and use them to solve problems.

Figure 1. Learning Achievements of Phase D Geometry Elements

The learning objectives were adapted from SMPN 2 Banda Aceh and have been modified according to needs in the field.

Design stage

The result of this stage is the initial product in the form of numeracy e-module learning materials on the relationship between lines and angles and the congruence properties of triangles, which is in accordance with the demands of the Kurikulum Merdeka and in accordance with the needs of students at SMPN 2 Banda Aceh. There are several activities carried out at the product design stage, namely selecting learning materials, preparing materials and designing the appearance of e-module. The selection of learning materials in the form of an e-module was based on the needs at SMPN 2 Banda Aceh, namely technology-based learning materials that enable students to learn independently and hone their numeracy skills.

At this stage, an e-module assessment instrument was also designed in the form of an expert validation sheet and student response questionnaire (Damayanti & Azhar, 2023). Based on the validation results by 6 validators, there were several significant changes in terms of appearance, material and language in the e-module, as follows:

Appearance. The significant changes were in the font and white space. Before revision, the font sizes varied greatly and were inconsistent, also the padding and margins on each page appeared cluttered and narrow. The changes can be seen in the Figure 2.

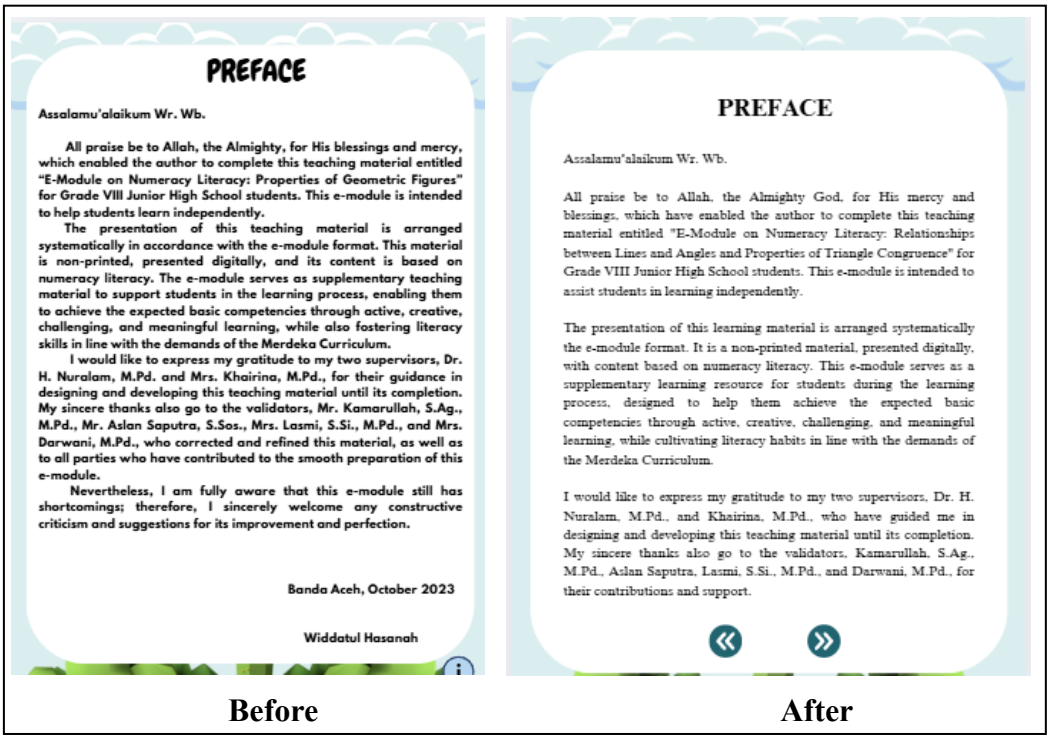


Figure 2. Improvements Appearance E-Module Before and After Revision

Materials. The significant changes were in material title, addition of prerequisite materials and addition of contextual reading in evaluation questions. The changes can be seen in the Figure 3, 4 and 5.

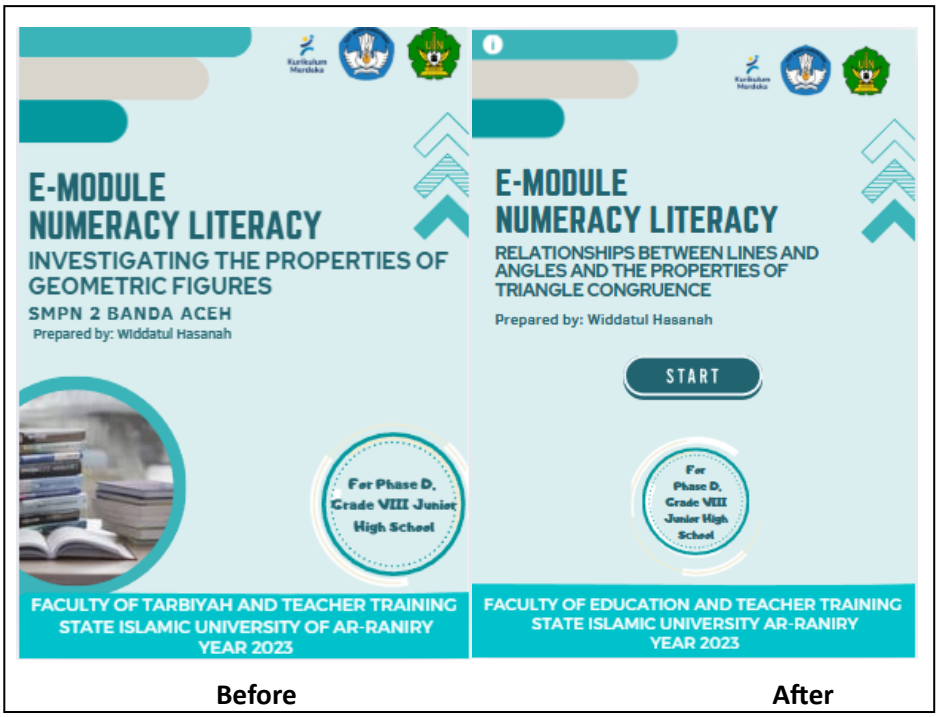


Figure 3. Improvements Material Title Before and After Revision

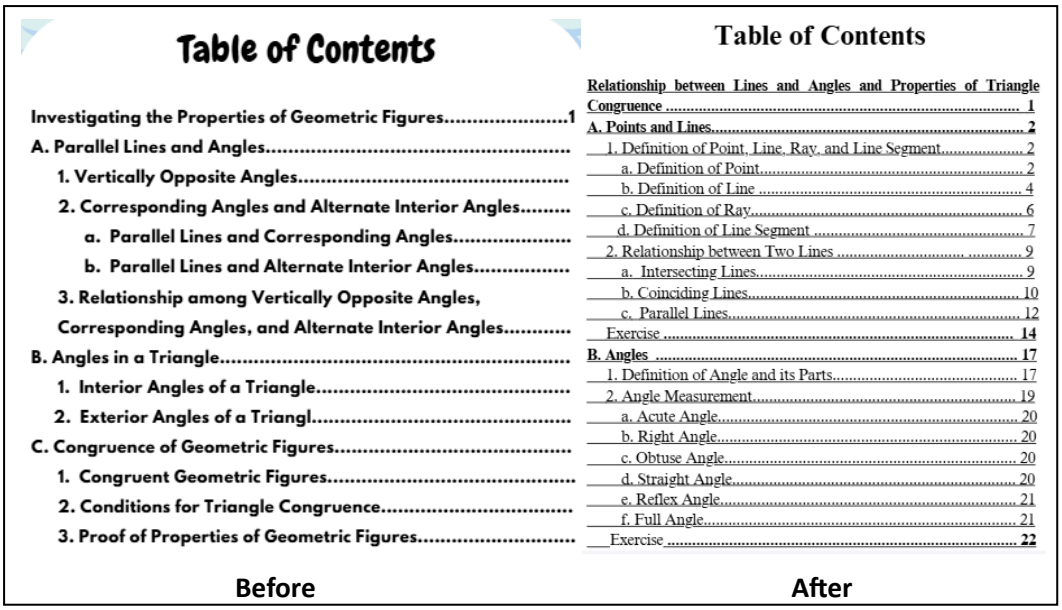


Figure 4. Improvements the Table of Contents by Adding Prerequisite Materials.

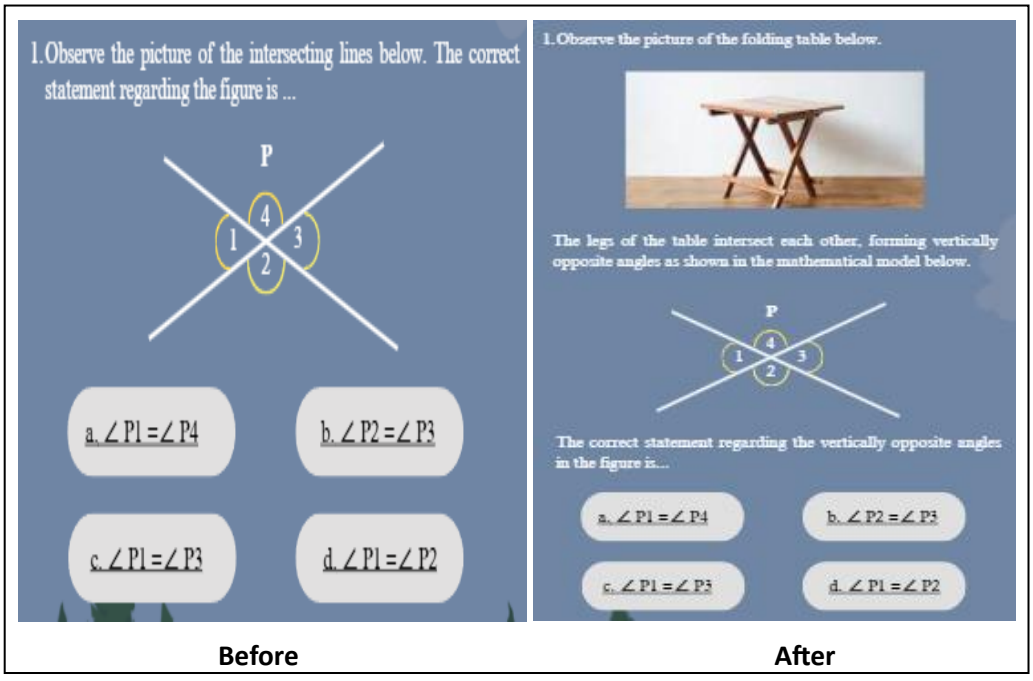
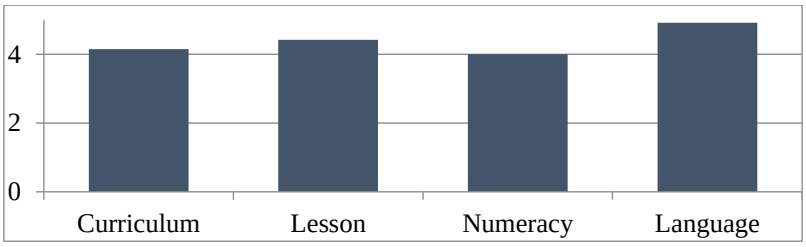


Figure 5. Improvements the Materials by Adding Contextual Reading in Evaluation Questions

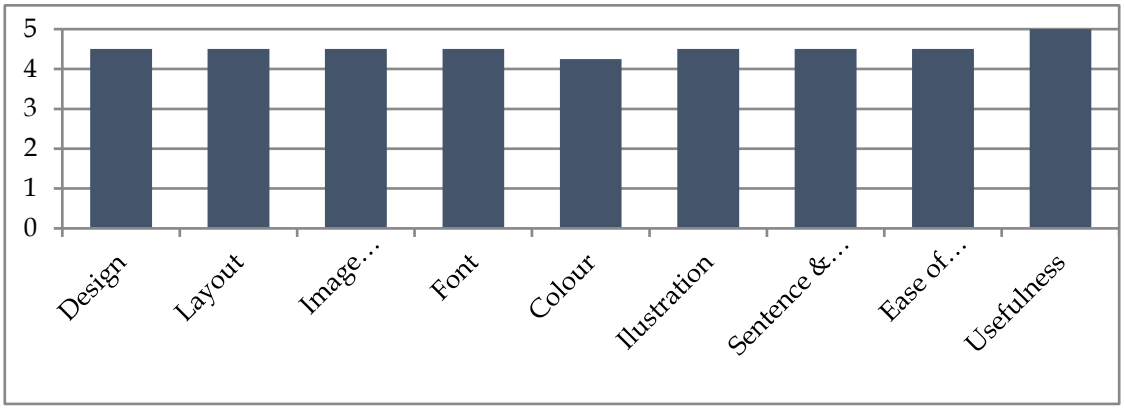
Development Stage

The development of learning materials is a process of selection, adaptation and compilation with needs analysis (Suprapto et al., 2020). At this stage, a valid and readable e-module was developed. A valid e-module is obtained from the validation results of six expert validators, guided by the validation sheet that was designed at the design stage. The validators in this research are divided into two, namely material and evaluation expert validators, and media and language expert validators. In the validation process, continuous improvements are made to the e-module according to suggestions and comments from the validator until the e-module is declared valid. The validation results in terms of material and evaluation are presented in Graph 1.



Graph 1. Assessment of Material and Evaluation Aspect

Based on Graph 1, average in the curriculum aspect was 4.15 and the numeracy aspect was 4, both of which was "suitable" for validity criteria. Meanwhile, the average in the material presentation was 4.42, for language use was 4.92, both of which into was "very suitable" for validity criteria. Overall, the average of the material assessment and evaluation analysis was 4.37 with "very suitable" for validity criteria. Meanwhile, the validation results in terms of media and language are presented in Graph 2.



Graph 2. Assessment of Media and Language Aspects of Each Aspect

Based on Graph 2, the average of colour combinations aspects was 4.25, the usefulness of media for learning average was 5, while the other aspects average was 4.5. That's mean, all of these aspects were "very suitable" for validity criteria. Overall, the average of the media and language assessment analysis was 4.53 with the "very suitable" for validity criteria.

At this stage, a readability test was also carried out on four class VIII students at SMPN 2 Banda Aceh to measure whether the e-module had been read by the students or not. The results of the readability test analysis by four students are presented in Table 5.

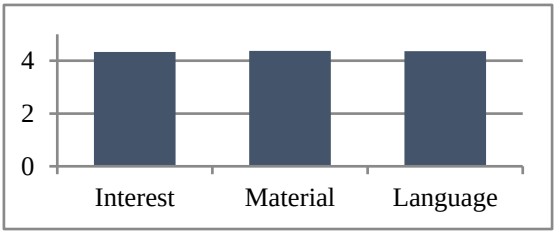
Table 5. Readability Test Analysis Results

Aspect \ Analysis	$\sum_{i=1}^{n} x_i$	n	$\bar{x}$	Criteria
Appearance	155	9	4,3	Very suitable
Presentation of Material	64	4	4	suitable
Language	55	3	4,58	Very suitable

Overall, the average of the analysis of students readability assessment sheets was 4.29 with "very suitable" criteria. So, development stops at this stage because it has met the validity criteria.

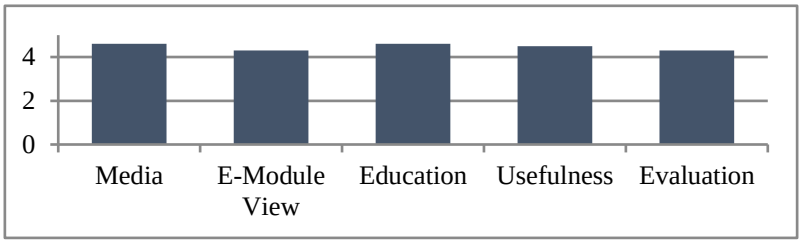
Implementation Stage

Implementation is the actual step of delivering the developed learning materials to students (Chiang & Lee, 2016). At this stage, product results that are valid and legible are used in learning to determine the practical results of their use. The data in this trial was obtained using a practicality questionnaire instrument which was filled in by 25 class VIII students and a mathematics teacher at SMPN 2 Banda Aceh who taught in class VIII. The results of the practicality questionnaire completed by students can be seen in Graph 3.



Graph 3. Student Practicality Test Assessment

Based on Graph 3, the interest aspect obtained an average of 4.33, the average of material aspect was 4.37 and the language aspect was 4.36. These three aspects were "very practical" criteria. Overall, the average of the student practicality test assessment analysis was 4.35 with the "very practical" criteria. Meanwhile, the practicality questionnaire assessment completed by the teacher can be seen in Graph 4.



Graph 4. Teacher Practicality Test Assessment

Based on Graph 4, the average of media and education aspects was 4.6, the usability aspect was 4.5 and the e-module display and evaluation aspects was 4.3. These five aspects was "very practical" criteria. Overall, the average result of the teacher practicality test assessment analysis obtained was 4.46 with the criteria "very practical".

Evaluation Stage

The evaluation stage in this research was only carried out through formative evaluation. From the validation results, the e-module was revised based on suggestions obtained from the validator on the validation sheet.

After undergoing a formative evaluation process, an advanced version of the e-module has been developed for users. The improvements include a more appropriate title that aligns with the learning objectives and reflects the content of the e-module. The material presented is more comprehensive, as it includes prerequisite topics and essential materials. Additionally, readings aligned with numeracy indicators have been incorporated into the content, examples, and practice questions. In terms of design, the resulting e-module is more visually appealing and

easier to read. Explanations regarding the features used are provided, making it easier for readers to follow the learning activities in the e-module. Furthermore, the language used has been refined to align with mathematical concepts.

Discussion

The development of this e-module has been carried out through a series of development activities starting from the analysis, design, development, implementation and evaluation stages. This series of activities was carried out with the aim of developing and producing new products in the form of mathematics learning materials. The learning material developed is a numeracy e-module on the relationship between lines and angles and the congruence properties of triangles for junior high school students.

The first stage carried out is the analysis stage. The main activity carried out at this stage is that the researcher analyzes information related to the reasons for the need to develop learning materials to achieve learning objectives (Cahyadi, 2019). At the analysis stage carried out at SMPN 2 Banda Aceh, it was found that: 1) The numeracy abilities of class VIII students were still very low, 2) there were no learning books on the relationship of lines and angles and the congruence properties of triangles specifically for strengthening numeracy.

Furthermore, applying technology to learning is a demand for the current curriculum that is suitable for the 21st century. The use of technology in learning materials will create a pleasant atmosphere and attract students' attention. One of the creative solutions for teachers is the use of electronic modules (e-modules). This is in accordance with research by Rismaini & Devita (2022) who found that e-modules have the potential to present mathematics learning in an interesting and non-repetitive way so that it can increase students' interest in learning. The use of the e-module is very suitable to be implemented at SMPN 2 Banda Aceh, because the school has adequate facilities such as computers that students can use.

The development of the e-module in this research focuses on the relationship between lines and angles and the congruence properties of triangles, because geometry is one of the materials that is considered difficult in mathematics. Understanding geometric material requires spatial abilities, so it is difficult to explain without using media. Moreover, high numeracy skills are needed to be able to answer geometry questions. This is reinforced by the results of Rezky et al. (2022) research which states that junior high school students with low numeracy skills experience difficulties in interpreting geometry problems, they do not know how to choose strategies and calculations optimally, and are unable to associate mathematical symbols and draw wrong conclusions. The results of this research prove that currently there is a great need for learning materials that can facilitate students in improving their numeracy skills in geometry material, one of which is using e-module.

The next stage is designing the e-module. The designed e-module meets the standards for good e-module components. The e-module components developed include: 1) front cover page, 2) explanation of e-module features, 3) foreword, 4) table of contents and list of images, 5) introduction which includes e-module description, study guide, activity description learning, learning outcomes, learning objectives, and criteria for achieving learning objectives, 6) prerequisite material, 7) essential material, namely material on the relationship of lines and angles and the nature of congruence of triangles which is associated with numeracy, student

activities, example questions and exercises, 8) summary , 9) quiz grid, 10) final quiz, and 11) bibliography.

Material is taken from various reference sources, from books, modules, to YouTube. The material has been adjusted to the expected learning outcomes and objectives. The material in the e-module uses a language style that is not too formal and suits the character of middle school students. To make it easier for students to understand the concept of abstract geometric material, the e-module also adds several pictures and illustrations for each sub-material. Moreover, several videos have also been included to clarify the material. The e-module is also equipped with example questions in each sub-material accompanied by alternative solutions, and multiple choice exercises are also provided in each sub-material. Some questions in the e-module are presented in the form of contextual reading or narrative. At the end of the lesson, a final numeracy quiz was also added which was designed via the quizizz website as a final student evaluation.

In the design stage, the instrument that will be used in the validation process is also prepared, namely in the form of an assessment questionnaire. This assessment questionnaire serves as an assessment guide for experts/validators in validating the feasibility of the learning module being developed. An assessment questionnaire can be said to be valid if the statements presented in the questionnaire can reveal something that can be measured (Sanaky, 2021).

At the development stage, validation was carried out by six validators. Four people are material and evaluation experts, while the other two people are media and language experts. According to Akker, validity can be seen from two aspects, namely (1) content validity, namely validating the truth of the theory underlying a media, (2) construct validity, often known as internal coherence between various components of a device. If the intervention (development) meets these requirements, the intervention is considered valid (Akker et al., 2007). If the development process of a product does not meet these criteria, the development process will continue until the stated criteria are met, the aim being that the product produced is of the desired quality.

The e-module development process was carried out twice. In the material aspect, the title of the material was revised, because the previous title was not appropriate to the selected learning outcomes and did not represent the content of the material. Furthermore, there are also suggestions for adding some prerequisite material as an introduction before entering the essential material. So in the e-module, explanations are added starting from the meaning of points and lines, the relationship between two lines, to the meaning and size of angles before explaining the material on angles formed due to the connection of two lines, also added congruence material before explaining the material on the congruence of triangles according to the validator's suggestions. Then in the evaluation questions section, there is a suggestion to add reading related to daily life before being given abstract questions.

Meanwhile, in the media aspect, the font section has been revised, with the same font type except for the activity title and cover title. Due to the use of various font types, readers are confused and have difficulty reading the material. The validator also suggests to adding white space in the form of padding and margins on each page so that the e-module display does not appear piled up and narrow. So in the e-module, white space is added at the same distance on each page to maintain layout consistency. Then, in the language aspect there were several revisions to words or language that were not correct and did not comply with mathematical

concepts, so these words had to be replaced by editors. After going through the revision process, the final score is obtained by the validator. Based on the results of e-module validation by material and evaluation expert validators, a final average score of 4.37 was obtained, while media and language experts obtained an average score of 4.53, both of which fall into very valid criteria.

At the implementation stage, the learning materials that have been developed are applied to learning. After learning using the numeracy e-module, a limited trial (small group trial) was carried out by distributing practicality questionnaires to 25 class VIII students at SMPN 2 Banda Aceh and a mathematics teacher. According to Akker et al. (2007), practicality of a learning product can be measured by seeing whether teachers or other experts feel the material is easy to convey and easy for students to understand and whether it is in accordance with development objectives or not. The practical results of the numeracy e-module obtained in the field showed a positive response from teachers and students. Based on the teacher response questionnaire, an average score of 4.46 was obtained and the student average was 4.35, both of which met the very practical criteria.

Evaluation stage, this stage is carried out to provide feedback to product users. The evaluation stage has two subcomponents, namely formative and summative evaluation. Formative evaluation is carried out to collect data at each stage which is used for improvement (Afgani et al., 2024) and summative evaluation is carried out at the end of the program to determine its effect on student learning outcomes and the quality of learning at large (Puspasari & Suryaningsih, 2019). In this research, only a formative evaluation was carried out by making improvements or revisions to the e-module to produce a better e-module that met valid and practical criteria.

Conclusion

The process of developing a numeracy e-module for geometry material for junior high school students, using the ADDIE development model. The results of the e-module development, on average, obtained a very valid category based on assessments from validators. Analysis of the results of material expert validation and evaluation obtained an average value of 4.37, in terms of media and language an average value of 4.53 was obtained, both of which fall into very valid criteria. The results of implementing e-module in learning obtained practical score data from a mathematics teacher and 25 students. Based on the results of a mathematics teacher's response, an assessment of 4.46 was obtained, while the students' practicality score obtained an average value of 4.35, both of which were in the very practical category. It can be concluded that the numeracy e-module on geometry material for junior high school students is very valid and very practical to use as numeracy learning material.

The researchers hope that the e-module developed in this study can be utilized for experimental activities with a broader implementation, allowing for a more comprehensive evaluation of its efficacy.

Declarations

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