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Development of Module Based on Higher Order Thinking Skills on Cylinder and Cone Matter

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Abstract

This study aims to develop a valid, practical, and effective Higher Order Thinking Skills-based learning module on Cylinders and Cones for SMP NU Sumenep seventh-grade students. This type of research is research and development with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). Data were collected using tests and questionnaires. Material and media experts validated the results. The results of the study show: 1) the validity aspect obtained an average of 87.5% with the criteria of "very good", 2) The practicality aspect seen from student assessments after using the learning module, obtained an average of 84.5% with the criteria of "good", 3) The effectiveness aspect seen from the results of students' mathematical problem-solving abilities, obtained an average of 76% with the criteria of "good". Based on the study results, we can conclude that the learning module related to cylinders and cones is suitable for use in learning because it has met three criteria: valid, practical, and effective. The HOTS-based learning module, especially about cylinders and cones, is expected to increase students' curiosity about the material, which can indirectly also improve students' understanding.

Keywords: Cylinder and Cone Material; Development of Learning Modules; High Order Thinking Skill; Research and Development

1. Introduction

Education plays an important role in improving the quality of human resources to compete in the era of the Industrial Revolution 4.0. In Indonesian education, the government often changes curricula to improve the quality of education. The curriculum is one of the determinants of educational success because it is a guideline for educators in implementing learning (Rahayu et al., 2023). Therefore, the curriculum needs to be developed dynamically according to the demands of the times (Ananda & Hudaidah, 2021).

Fulfilling the needs of the education system in the Industrial Revolution 4.0 era, the Ministry of Education and Culture has launched Merdeka Belajar. Merdeka Belajar is a step towards educational transformation that is presented as the policy and strategic direction of the Ministry of Kemendikbud RI, which is stated in the 2020-2024 strategic plan. Merdeka Belajar is expected to be a transformative educational step towards realizing superior Indonesian Human Resources (HR) with a Pancasila profile.

Implementing the Merdeka curriculum changes the learning system from teacher-centered to student-centered. Student-centered learning will train students to think critically in learning and problem-solving (Suatini, 2019). In addition, the Merdeka curriculum also emphasizes students' ability to observe their surroundings in the learning process, which requires students to be accustomed to solving problems and making the best solutions based on their knowledge (Tuerah & Tuerah, 2023). This concept is very suitable for the Higher Order Thinking Skill (HOTS) pattern because the Merdeka curriculum includes many things, including differentiated learning, focus on problem solving, flexibility in learning, HOTS-oriented assessment, and character development, so that the Merdeka Curriculum and HOTS complement each other and support educational goals. The Independent Curriculum, initiated by the Minister of Education, Nadim Makarim, allows educators to manage classes and allows students to explore and develop their critical thinking skills (Majidah et al., 2024). Students who are accustomed to exploring and practicing critical thinking skills will gradually become accustomed to high-level thinking.

According to Resnick (In Zebua, 2024), higher-order thinking skills involve basic mental activities such as describing, building representations, analyzing, making conclusions, and making relationships between two or more quantities. Integrating HOTS in learning is the key to preparing students who can think critically and creatively and solve problems (Zebua, 2024). The main goal of HOTS is to improve students' ability to think critically and creatively in processing the information obtained and applying it in problem solving using the knowledge they have and making decisions in complex situations so that they can face various challenges that occur in an increasingly sophisticated and modern era (Tasrif, 2022). We can say that HOTS refers to more complex thinking skills, which go beyond simply memorizing facts or understanding basic information. HOTS involves the ability to analyze, evaluate, create, or organize.

Supporting factors are needed to achieve high-level thinking skills, such as learning devices or media that support the implementation of HOTS-based learning, one of which is a learning module. The mathematics learning module strongly supports students' higher-order thinking by encouraging them to think critically and creatively, facilitating independent and reflective learning, and providing problem-based activities and real projects. A module is a unit of teaching material containing materials, methods, and evaluations systematically designed to achieve the expected competencies (Chuseri et al., 2021). The modules are arranged systematically and adjusted to the characteristics of students, which contain learning materials, student activity sheets, and practice questions. The existence of modules allows students to explore knowledge, learn independently, and minimize teacher assistance so that they can indirectly control and assess their abilities in learning (Andryani & Kurniawati, 2023). The module in this study is HOTS-based and related to the material on cylinders and cones.

One of the reasons why HOTS-based learning has not been implemented is that in the school, learning is still teacher-centered, and students only listen and work on questions. This causes students to be passive, and their high-level thinking skills are not honed. In addition, there are no tools or media to support HOTS-based learning, such as teaching modules. Some teachers still do not fully understand higher-order thinking and how to assess it, which indirectly hinders teachers in implementing HOTS-based learning (Rampean et al., 2022). During learning, teachers and students still refer to textbooks from publishers as the only source of learning (Shalikhah & Nugroho, 2023). To train and develop students' abilities in high-level thinking, there needs to be a teaching module that contains student activities in concept discovery to understand better the material being taught and practice questions to measure their ability to solve problems.

When faced with practice questions taken from textbooks, students still experience difficulties encountering geometry questions on geometric shapes, especially curved sides, which require analytical skills at the application level (C3), meaning that students are still not trained to work on HOTS-based questions. Level C3 or Applying is the ability to use knowledge, concepts, principles, or procedures learned to solve problems or carry out tasks in real or new situations. This means that students not only remember or understand information, but can also apply formulas, methods, or rules, use concepts in practical situations, and carry out procedural steps. It is common for students to find it challenging to solve problems with curved-sided geometric shapes because they have not been able to identify and analyze the problems given (Sitorus et al., 2023). In their research, Agustini & Fitriani (2021) stated that students have difficulty calculating the volume of curved-sided geometric shapes because they have only memorized the formula without knowing how it came from.

If students only memorize formulas, they may forget them later. In addition, when faced with the same concept but the form of the problem is modified, they will find it difficult (Agustini & Fitriani, 2021). This shows that students' understanding is still limited to memorization skills, and they cannot solve problems when faced with questions requiring high-level thinking skills. Thus, mathematics learning about curved-sided geometric shapes must be well-designed to understand the material successfully.

Several studies related to the development of learning modules have been conducted, including the development of realistic mathematics modules integrated with higher-order thinking skills (HOTS) on spatial geometry material (Chuseri et al., 2021), the development of learning modules with a scientific approach to improve students' problem-solving abilities (Sidik & Rumbia, 2021), and the development of problem-based learning modules that can improve students' mathematical literacy (Alayubi et al., 2024). However, this research differs from previous research because it emphasizes developing HOTS-based learning modules on cylinders and cones to train students' critical thinking skills.

The novelty of this research compared to previous research is: (1) Focusing on critical thinking, this module is made based on problem-based learning in which students are trained to think critically and the practice questions are specifically designed to include HOTS; (2) Integration of the PBL model about students' critical thinking focuses on the material of cylinders and cones; (3) The creation of questions is specifically designed to see the extent to which students' critical thinking refers to the indicators of critical thinking according to Facione, namely interpretation, analysis, evaluation, conclusions, explanations, and self-regulation.

Based on the problems above, researchers are interested in developing learning modules that can help teachers develop HOTS-based learning while helping students improve problem-solving skills and understand teaching materials better. Thus, the purpose of this study is to produce HOTS-based learning modules-based mathematics learning module product to improve the problem-solving skills of grade VII students on the material of cylinders and cones in stimulating critical thinking that is oriented towards problem solving and is expected to be a valid, practical and effective learning media in Junior High School NU Sumenep.

2. Method

The research location was NU Sumenep Middle School, Batuan District, Sumenep Regency. The research was conducted from April 15 to May 27, 2023, and involved 8 class VIII students, as many as 25 students at NU Sumenep Middle School, as research subjects. This study uses a research and development (R&D) method that aims to produce new products through the development process. The development model in this study uses the learning module development model according to the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) (Rayanto, 2020). The ADDIE model is suitable for developing various products, one of which is learning modules (Safitri & Aziz, 2022).

The development procedure in this study is adjusted to the module preparation procedure and the ADDIE model design development procedure. An explanation of the development procedure in this study can be seen in the Table1.

Table 1. ADDIE Model Development Procedure

ADDIE Stage	Activity
Analysis	The analysis stage aims to examine module problems, namely regarding needs analysis, curriculum and student characteristics analysis.
Design	The design stage aims to create a design for the learning module to be developed.
Development	The development stage is the stage of producing learning modules, which includes aspects of product creation and analyzing product trials.
Implementation	The implementation stage is the implementation of the mathematics learning module on curved-sided spatial geometry material to class VII students of SMP NU Sumenep.
Evaluation	The evaluation stage aims to evaluate the activities carried out by researchers. Analyze the practicality and effectiveness of the mathematics learning module that have been validated by a team of experts and has been field-tested.

Data collection methods used in this research were tests and questionnaires. The questionnaire method in this research is a validation questionnaire for mathematics learning modules and student responses. The test was in the form of questions on students' problem-solving abilities. The data collection instruments used in this study were classified into three types to meet the validity, practicality, and effectiveness criteria: a) validation sheet, used to measure the validity of the math learning module. Furthermore, the validation sheet was a questionnaire submitted to expert lecturers and mathematics subject teachers; b) student response questionnaire, used to measure practical aspects. This questionnaire aims to obtain data about students' opinions regarding the use of the module; c) problem-solving ability tests were carried out at the end of learning, using questions to measure the effectiveness aspect. The data analysis technique in this study was validity, practicality, and effectiveness analysis.

3. Results and Discussion

3.1 Results

This research uses the type of *Research and Development (R&D) with products developed in the form of HOTS-based learning modules (Higher Order Thinking Skills*) on the BCSS material, which researchers at SMP NU Sumenep have carried out. The development model used in this study is ADDIE, with the stages *of Analysis*, *Design*, *Development*, *Implementation*, and *Evaluation*. Based on the research and development carried out, the following research results were obtained:

3.1.1 Analysis stage

a. Needs Analysis

The needs analysis aims to identify the fundamental problems in mathematics learning at SMP NU Sumenep. After conducting a needs analysis, it is known that Merdeka Belajar creates a student-centered learning system so that students are expected to be able to think critically. Of course, in its implementation, teaching materials are needed to make students more active in the learning process and support them in the critical thinking process. However, in its implementation, this has not been implemented optimally in the learning process.

Based on what was found in the field, it is necessary to develop teaching materials in the form of learning modules that can facilitate students to be more active in mastering concepts and solving problems in the critical thinking process, following the independent curriculum that refers to the application of the HOTS concept. Based on this, the researcher developed an HOTS-based learning module for the material on curved side space for class VII at SMP NU Sumenep.

b. Curriculum Analysis

The curriculum analysis stage aims to determine the curriculum that applies in schools. In addition, it is known that the material in mathematics lessons can be used as learning modules. At the design stage, the curriculum defines the product design and components in the mathematics module.

c. Analysis of student characteristics

The analysis of student characteristics aims to determine the characteristics of students that are the basis for researchers to compile the modules to be developed. In general, students follow learning activities quite well. Learning using the lecture method makes students less active. Researchers see that students become active only when the teacher gives assignments or questions to be worked on in front of the class. Responding to these conditions, grade VII students of SMP NU Sumenep need teaching materials that can motivate and foster students' enthusiasm for learning independently or with teachers. Based on this analysis, HOTS-based learning modules can be applied to students and are expected to improve students' problem-solving abilities.

3.1.2 Design Stage

a. Preparation of Module Framework

The preparation of the module framework is based on the grade VII mathematics syllabus. The module is arranged into three main parts: the beginning, the contents, and the end. The first section contains the cover, foreword, table of contents, Learning Outcomes and Competencies, learning objectives, study instructions, and a concept map. The second section contains the learning module. The final section contains evaluation questions, a glossary, and a bibliography.

b. Collection and Selection of References

Collecting and selecting references to be used in module development. References are adjusted to the curriculum currently used in class VII of SMP NU Sumenep.

c. Design and Features of Learning Modules

The design and features of learning modules include the beginning, content, and end. The beginning contains 1) Cover, 2) Foreword, 3) Table of Contents, 4) Learning Outcomes and Competencies, 5) Learning Objectives, 6) Learning Instructions, and 7) Concept Map. The content section contains learning modules in the form of activities so that students can find concepts. The content section consists of learning activities, containing learning activities: analysis space, evaluation space, and creation space; examples, exercises, and evaluations, while the end section contains 1) Evaluation questions, 2) Glossary, and 3) Bibliography. The following is a screenshot of each section of the module.

d. Preparation of Learning Module Assessment Instruments

Preparation of learning module assessment instruments includes learning module assessments, student response questionnaires, and problem-solving ability test questions. The preparation of the learning module assessment sheet is made into three types: the suitability of the material content, the suitability of the presentation, and HOTS by the validator. The preparation of test questions is used to determine the effectiveness of the learning module in improving students' mathematical problem-solving abilities. The student response questionnaire was designed to determine students' responses after using the learning module. One type of question used in the student response questionnaire is positive statements.

3.1.3 Development Stage

The development stage aims to produce and assess the extent of the feasibility of the learning module that has been designed. The criteria for a good module that can be used in learning are modules that are systematic, communicative, facilitate independent learning, contextual, train HOTS, and are equipped with evaluation. To find out which learning modules are suitable for use, an assessment is carried out by the validator. After obtaining the feasibility assessment, the learning module is revised according to criticism and suggestions from the validator.

In the research on the development of this learning module, two validators were used, namely the Lecturer of STKIP PGRI Sumenep, Mrs. Kurratul Aini, M.Pd, and the Mathematics Teacher of SMP NU Sumenep, Mrs. Khalishaturrusyd, S.Pd.

a. Creating Learning Modules

b. Product trial analysis.

The trial process of the developed module involved an expert validation stage to assess its quality in terms of content, presentation, and integration of Higher Order Thinking Skills (HOTS). Table 2 presents the results of the module validation based on the average percentage scores for each research aspect, along with their respective categories.

Table 2. Module Validation Results

Research Aspects	Average Percentage	Category
Content Eligibility	88,9%	Very Good
Presentation Eligibility	85,625%	Very Good
HOTS	90%	Very Good
Average	**87,5%**	**Very Good**

Table 2 shows that the quality of the learning modules based on the validator's assessment shows a total average percentage of 87.5%; thus, the module shows Very Good. However, validators' responses, criticisms, and suggestions are also noted.

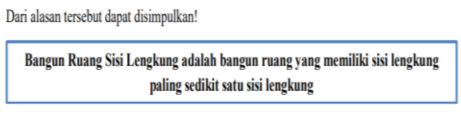
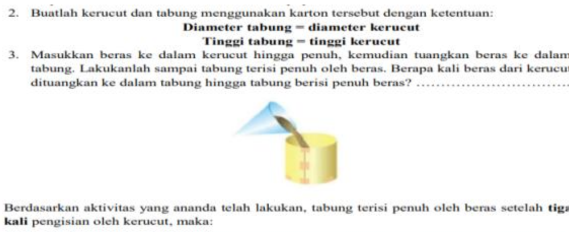
After the quantitative validation process, qualitative feedback was also obtained from the validators to provide more detailed insights into the aspects that needed improvement. This feedback was given in the form of responses, criticisms, and suggestions regarding the HOTS-based BCSS material learning module for mathematics lessons at SMP NU Sumenep. Table 3 presents the complete list of validator comments.

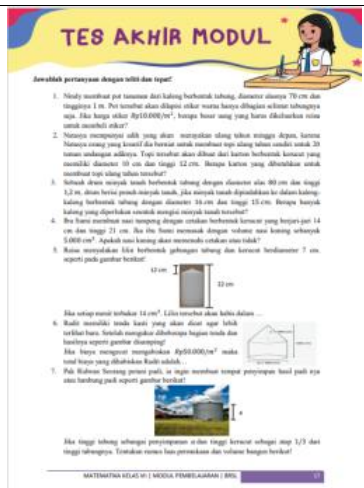
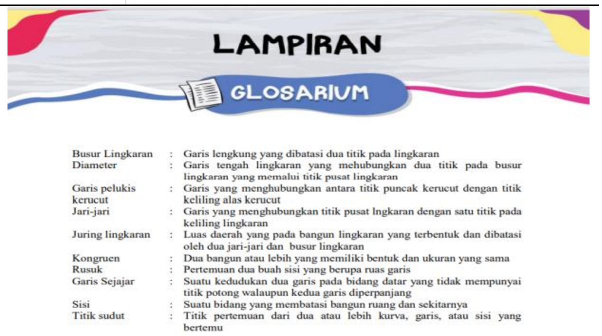
Table 3. Validators' Responses, Suggestions, and Criticisms

No	Responses, Criticisms, and Suggestions
1	Use a brighter font for the title of the module and avoid white color.
2	In the summary box for the definition of Curved Surface Shapes, replace the word "seminimalnya" with another word.
3	There are typos in the words "Diamterer" and "kerucur" in the text
4	In the point "Problem: Let's Read the Text", add an icon as a marker for independent student activities.
5	In the final text of the module, several questions need to be replaced with HOTS questions.
6	It would be better to include a glossary in the learning module to aid students in understanding the terms used in the module.
7	Also, provide the learning module as an e-module so it can easily carry anywhere and anytime.

Based on the feedback presented in Table 3, the researcher made several revisions to improve the quality and usability of the learning module. These revisions aimed to enhance visual clarity, linguistic accuracy, and the inclusion of features that promote independent learning and HOTS-oriented tasks. The detailed changes are presented in Table 4.

Table 4. Revised Results

Revised Results	Module Images
The title cover on the module has been changed to a lighter color font, and some icons on the cover have been fixed to make it look neater and more attractive	
The word "at least" is replaced with "at least"	
The words "Diamterer" and "Kercur" have been corrected to "Diameter" and "Kercut"	

<table>
<tr><th>Revised Results</th><th>Module Images</th></tr>
<tr><td>In the point "Problem: Let us read the text," an icon image has been given as a marker of students' independent activities</td><td>
</td></tr>
<tr><td>The final text of the question module has been replaced with HOTS questions in the form of description questions.</td><td>
</td></tr>
<tr><td>A glossary has been included in the module to make it easier for students to use the word terms in the module.</td><td>
</td></tr>
<tr><td>The modules have been made into e-modules to carry them anywhere and anytime easily. Students can use it by scanning the QR code listed in the module.</td><td>
</td></tr>
</table>

3.1.4 Implementation Stage

The implementation or application stage aims to implement the learning module in the classroom after it has been declared feasible by the validator. Eight students participated in implementing this stage, and three meetings were held in class (6 x 45 minutes). In the first meeting, the researcher explained how the research would be conducted and its intended objectives. Next, the researcher went directly into the lesson. First, the researcher distributed the learning modules she had created to the students and began with the Curved-Sided Solid Geometry topic. In the second meeting, the material was reviewed at the beginning. In the second meeting, the researcher discussed the shape of a cone. Students were guided to find the definition of a cylinder, the elements contained in a cylinder, and the concepts of surface area and volume of a cylinder, as well as solve problems related to cylinders in everyday life. In the third meeting, students were asked to work on test questions and fill out a student response questionnaire prepared by the researcher. First, students filled out the student response questionnaire for approximately 10 minutes. After that, students worked on the test questions. They were given 90 minutes to complete the work. The researcher had prepared the answer sheets. After completion, students were asked to collect their answer sheets. From the first meeting until the last meeting, there were no significant obstacles; learning proceeded well and according to plan.

3.1.5 Evaluation Stage

The evaluation stage aims to evaluate the activities carried out by researchers. At this stage, the module assessment that is seen is the practicality and effectiveness of the learning module. The practicality aspect can be seen from the students' response questionnaires. Meanwhile, the effectiveness aspect is seen from the students' math problem-solving ability test results.

The data on the results of student responses after using the HOTS-based on BCSS material learning module at SMP NU Sumenep in mathematics lessons, which was then summed up to scores, the assessment results were used to see the practicality of the developed product, as presented in the Table 5.

Table 5. Data on the Assessment Results of the Student Response Questionnaire

Assessment Aspects	Indicator	No. Questionnaire	Average Score	%	Category
Module Features	*Self-instructional*	3 dan 5	3	75	Good
	Personal Abilities	7	3,625	90,6	Very Good
	Purpose	1 dan 6	3,3125	82,8	Very Good
	Associations of structure and sequence	10	3,25	81,25	Very Good
	Media	8	3,5	87,5	Very Good
	Active participation of students	4 dan 9	3,5	87,5	Very Good
	There is an evaluation	2 dan 15	3,6875	92,1	Very Good
Material	Benefits of modules in developing HOTS capabilities	11, 13 dan 16	3,5	87,5	Very Good
	Benefits of modules in assisting students on BCSS material	12, 14, 17 dan 18	3,53125	92,1	Very Good
Language	Clarity of the language the module uses	19	3,5	87,5	Very Good
	Clarity of writing or image illustrations	20	3	75	Good

After the module was revised based on validator feedback, a limited trial was conducted involving students to gather their perceptions of the module’s quality and usability. The student response questionnaire covered three main aspects: module features, material, and language. The purpose of this stage was to evaluate the extent to which the developed module meets students’ needs and expectations in supporting the learning process. The results of the student response questionnaire are presented in Table 6.

Table 6. Results of Student Response Questionnaire

Aspect	Score Average	Percentage (%)	Category
Module Features	3,4	85	Good
Material	3,5	87,5	Very Good
Language	3,25	81,125	Good
Average	**3,38**	**84,5**	**Good**

Based on the data in Table 6, the results of student responses to the modules that have been used show a good category with an average percentage of 84.5%. To obtain a more structured picture of each indicator's effectiveness level, the scores obtained from the analysis results are converted into percentages. This conversion is intended to facilitate the process of interpretation and categorization of data. Furthermore, the percentage is classified into specific categories that describe the level of effectiveness based on a predetermined range of values. The classification of the percentage of effectiveness scores can be seen in the following Table 7.

Table 7. Percentage of Effectiveness Score Category Percentage

Percentage (%)	Category
85,01-100,00	Very good
70,01-85,00	Good
50,01-70,00	Less Good
01,00-50,00	Not Good

Based on the recapitulation of the data from the student Problem Solving Ability test results, which is then summed up to the scores, the assessment results are used to see the effectiveness of the developed product assessed on every aspect of the cognitive level. After an assessment of each cognitive aspect, the results are obtained in Table 8.

Table 8. Test Question Results

Cognitive Level	Average Percentage (%)	Category
C4	78,75	Good
C5	75	Good
C6	72,5	Good
Average	**76**	**Good**

Based on the results of the Table 8, the effectiveness aspect was assessed with an average of 76% with good criteria.

3.2 Discussion

This study aimed to develop and evaluate a HOTS-based learning module for Building Curved Side Space (BCSS) material that is aligned with the Independent Curriculum, integrates engaging visual design, and systematically embeds higher-order thinking tasks. The findings from validation, field testing, and learning outcome analysis confirm that the module achieved its primary objectives: (1) meeting expert standards of validity, (2) being perceived as practical and engaging by students, and (3) effectively improving higher-order cognitive skills, the achievement of the main objective of this research is in line with the results of the (Ma'rifat and Suraharta, 2024) research which was also achieved in the validator test, practical based on the practicality test by teacher and students and effectively improve student learning outcomes.

Compared to previous studies on HOTS-based learning tools, the novelty of this research lies in its specific integration of the HOTS framework (C4–C6) into the BCSS topic for junior high school mathematics, supported by visual design elements that were iteratively refined through validator feedback. While earlier works, such as (Rukmana et al., 2024) have demonstrated the validity and effectiveness of HOTS-based modules in general mathematics topics, few have focused on three-dimensional geometry particularly curved surfaces were abstractness and spatial reasoning often hinder student comprehension. The current study addresses this gap by designing activities and problem sets that require not only calculation but also multi-step analysis, evaluation, and creation within a geometric context.

The high validation scores (>80%) across all expert assessments directly answer the initial research question regarding feasibility (what). Scientifically, this can be attributed (why) to the module's alignment with cognitive development theory, where visual aids, context-based tasks, and scaffolding strategies help bridge abstract spatial concepts with concrete student experiences. The positive student responses (84.5% overall) further confirm the module's practicality and its capacity to sustain learner engagement, which is consistent with (Salsabila, 2025), who emphasizes that active and challenging learning materials foster curiosity and motivation.

The effectiveness results, showing significant pretest–posttest gains (from 45 to 78, $p < 0.01$), are consistent with earlier research by (Ma'rifat and Suraharta, 2024), which also reported high learning gains from HOTS-based modules. However, the present study adds a new dimension by detailing performance improvements at each cognitive level: C4 (analysis), C5 (evaluation), and C6 (creation). Notably, the relatively lower gains in C6 highlight a common challenge in HOTS instruction—students' difficulty in generating original solutions—which has been less explicitly addressed in prior studies. This suggests that while the HOTS framework is effective overall, targeted scaffolding for creative problem-solving remains an area for further refinement.

In terms of differences from earlier findings, the module's design incorporated iterative media and content improvements based on validator suggestions—such as adding independent activity icons, revising terminology, and providing an e-module format—which were not prominent features in previous works. These design elements may explain the high student motivation results (85% reported increased challenge and interest) and could serve as a model for future HOTS-based resource development, especially for abstract geometry topics, this is in line with research results (Harianja and Anwar, 2021) which state that there is an increase in student learning outcomes after using HOTS-learning modules. This study not only confirms the validity and effectiveness of HOTS-based learning modules in mathematics but also contributes a novel, context-specific approach to BCSS instruction that integrates visual design and iterative feedback. This positions the current work as both an extension and a refinement of earlier research, offering practical implications for enhancing spatial reasoning and problem-solving skills in middle school mathematics.

4. Conclusion

This study is based on a problem-based learning model, and students' higher-order thinking skills are developed based on the ADDIE model, which includes Analysis, Design, Development, Implementation, and Evaluation. There are three determining aspects of a teaching module suitable for use in learning: validity, practicality, and effectiveness. Based on the research results described, all three aspects have been fulfilled: very good for validity, practicality, and effectiveness. In addition, after the implementation of the learning module in class VII SMP NU Sumenep, there was an increase in the average score from pretest to posttest on each indicator of students' critical thinking. This implies that the teaching module based on higher-order thinking skills on the material of cylinders and cones is suitable for use in learning.

The results of this study show that the development of HOTS-based learning modules on the BCSS material can meet the aspects of validity, practicality, and effectiveness. Therefore, this module is highly recommended for use in learning activities at school, both for independent and group activities. Furthermore, it is suggested that intensive training and mentoring be provided to teachers who will implement this module so that they better understand the HOTS approach and can innovate teaching according to the needs of students. In addition, it is also necessary to develop other supporting media, such as animated videos, simulations, or computer-based applications, that can help students understand concepts visually and interactively.

For further research, it is recommended that larger-scale testing be conducted involving different schools in different regions to ensure sustainability and generalization of results. In addition, developing modules with other materials that suit the needs and characteristics of students at various levels of education is also important. In addition, there is a need for a long-term evaluation of the continuous improvement of students' higher-order thinking skills and a more comprehensive assessment involving affective and psychomotor aspects. Through this effort, it is hoped that mathematics learning in Indonesia can be more advanced and able to compete internationally.

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