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Development of a Guided-Discovery Learning-Based Module to Improve Mathematical Problem-Solving Ability on Quadrangle Materials

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Abstract
This study creates a valid, practical, and effective discovery-based module to improve students' ability to solve mathematical problems on quadrilateral content. This study employs the definition, design, and development phases of the research and development process. Validation sheets, student response questionnaires, and test questions were the study tools utilized. Techniques for data analysis using percentages and N-gain. Based on the findings of a study using guided exploration modules to enhance students' ability to solve quadrilateral problems in class VII SMP, which was valid with 76.92%. Results from the practicality test with practical categories were 79.37%. Student ability to solve mathematical problems shows effectiveness. The increase in the mathematical problem-solving ability of each student is in the medium category with an average N-gain of 0.48139.

INTRODUCTION

According to Permendiknas No. 22 (2006) students must have some mathematical abilities while solving problems. One of them is the ability for problem-solving, which includes the ability for comprehending problems, create mathematical models, finish models, and interpret. In learning mathematics, students are expected to have good mathematical problem-solving abilities (Mahanani & Murtiyasa, 2016). Mathematical problem-solving ability is a skill in determining the parts that are known, asked, and the completeness of the points needed, and can determine the mathematical model used, can apply solving strategies, and can interpret and re-test the truth of the answers obtained (Chotima et al., 2019). The following are indications of a person's ability for solving mathematical problems: explaining the problem's description, including the knowledge to recognize the parts that are known, the questions being asked, and the sufficiency of the points needed; designing and determining mathematical models, including the knowledge to formulate mathematical problems; setting a problem-solving strategy; and interpreting and testing the accuracy of the answers obtained, including the knowledge to identify the correct answers (Chotima et al., 2019).

However, Indonesia still has poor levels of proficiency in solving mathematical problems (Mahanani & Murtiyasa, 2016). According to Aisyah, et al.(2018), students still have difficulty solving quadrilateral and triangle-related mathematics problems. Students still struggle to solve mathematical problems because they can't

deliver the answers they want, can't make models that relate to the concerns, and have trouble dealing with the effects of not having discussed the issue.

Similar findings were obtained during observations at SMPN 2 Kapur IX in class VII for the academic year 2021–2022. Students achieve only a few of the indicators of mathematical problem-solving abilities at this school. Kudsiyah, et al. (2017) state that some factors, such as difficulties with using learning resources, mastering the material in learning resources, the context of questions that are infrequently discussed, the studied material not being stored in long-term memory, remembering formulas, attitudes, motivation, attention, being lazy in learning, and student responses that are still being used, affect students' ability to solve mathematical problems. According to findings from observations made in classrooms, learning resources have a dominant impact on student's ability to solve mathematical problems. Students have trouble comprehending the information in the school's learning resources. Examples of questions and exercises in the learning resources could not home students' mathematical problem-solving abilities.

Teaching materials are an important factor to take into account during the learning process, suggests Nasution (2016). Educators struggle to enhance student learning outcomes in the absence of supportive teaching resources. Teaching materials as guided discovery-based modules are one of the learning resources that educators can create based on the characteristics of their students The guided discovery-based module guides students to learn directly from student experience and do investigations, find concepts and implement them in life (Saputri & Oktarin, 2019). By constructing their concepts, understanding them rather than just memorizing them, and learning from their experiences rather than expecting to operate into pre-existing patterns, students should be able to develop their mathematical problem-solving abilities. This is the hope behind the design of learning resources as guided discovery-based modules. Guided discovery-based modules have been developed on flat-sided building materials for PGSD students (Sintawati, 2017). In this study, researchers developed a guided discovery-based module to improve students' mathematical problem-solving abilities on quadrilateral material. Thus, this research produces a quadrilateral module based on the guided discovery that is valid, practical, and effective to improve students' problem-solving abilities.

METHOD

Research and development cover this area of study. The 4-D development model, which stands for define, design, develop, and disseminate, is used by researchers. The researcher did not finish the dissemination stage because of time restrictions. The researchers investigated learning resources, student characteristics, learning objectives, and guided discovery literature during the define stage. The researcher created a guided discovery-based mathematics module and research tool during the design stage. The researcher validates and evaluates the usefulness and efficacy of the created module during the development stage. At SMPN 2 Kapur IX, the research trial was carried out. Students from class VII.2 made up the study's 30 participants.

Researchers used validation sheets to obtain product validation data. Product practicality data obtained from student response questionnaires. Product effectiveness data obtained from mathematical problem-solving ability tests. Validation and practicality data analysis uses percentages, while effectiveness data analysis uses N-Gain.

RESULT AND DISCUSSION

The results of this study are described for each stage of development.

Define Stage

Although students at SMPN 2 Kapur IX have used teaching materials created by teachers and packaged books from the library, we have not fully met the expected learning objectives. This is because the library's collection of mathematical textbooks still does not make learning easier. There are fewer textbooks available than there are students.

Learning resources as teaching materials used by students at this school also do not facilitate the learning process because the teaching materials only contain material summaries and sample questions. Examples of

questions in the teaching materials do not describe the identification of things that are known, asked, or the adequacy of the information needed. The examples of questions in the teaching materials do not reveal complete problem-solving ability indicators, so students are not used to solving problems for mathematical problem-solving abilities. Even though the teaching materials used did not facilitate mathematical problem-solving skills, when students were given questions about mathematical problem-solving abilities, students could identify the problem correctly. However, students did not write the meaning of symbols and mathematical models correctly. In addition, solving student problems is still wrong. Thus, students at SMPN 2 Kapur IX had low mathematical problem-solving abilities.

Teachers hardly employ learning media, such as in-focus, teaching aids, and others. Teachers often use handbooks, teaching materials, and whiteboards as resources and media during the learning process. This results in a one-sided learning process, a lack of independent learning motivation on behalf of the students, and poor mathematics problem-solving abilities. According to Nabillah & Abadi (2019), both internal and external factors influence learning outcomes. Students themselves have contributed internal factors, such as ones related to their health, interests, abilities, and goals. External factors are those that originate from sources other than the students themselves, such as the family, the school, and the community

Students at SMPN 2 Kapur IX have a variety of learning styles and learning rates as intrinsic factors. Some students can learn simply by listening to the teacher explain the information. They can get it right away. Some students gain knowledge of the subject via the teacher's and peers' explanations. In other words, they study the content numerous times to comprehend it. Despite being silent throughout the learning process, students can understand the subject. Some students have listened to the teacher's explanations several times, but some of them are still confused. Therefore, teachers as elements that influence learning outcomes need to make open resources to improve students' knowledge so that problem-solving abilities are also better.

Nasution (2016) argues that instructional materials are crucial to the learning process. Educators fail to enhance student learning outcomes in the presence of supportive teaching resources. Teaching materials in the form of modules are one type of instructional material that educators might create based on the characteristics of their students. With the help of this module, we intend students will comprehend the content on quadrangles and solve associated problems easily.

This guided discovery-based quadrangles material module contains two basic competencies, seven indicators of competency achievement, subject descriptions, brief descriptions, and instructions for using the module so that students can learn independently with or without the help of educators. The content of the guided discovery-based module is taken from textbooks and mathematics support books for SMP/MTs Class VII Semester 2 and other sources about quadrangles.

Design Stage

According to research by Mufidati & Kholil (2021) regarding the design stage, the format is modified to basic competencies, indicators, learning objectives, assessments, learning activities, and reading sources. This module is designed based on the major strengths, basic competencies, and indicators discovered in the syllabus produced at SMPN 2 Kapur IX.

Computers are used to create the modules, which are based on the guided discovery method's learning processes. According to (Mawaddah & Maryanti, 2016), there are eight steps of guided discovery method. They are stimulation, formulation of issues, formulation of hypotheses, data collection, independent experiments, data processing, evidence, and conclusion. Using the instructions provided in the module, students can use the guided discovery approach to learn for themselves about the different rectangles, their characteristics, and the formulas for calculating their perimeter and area. Examples and practice questions include the mathematical problem-solving ability. Below, we summarize the design of the guided discovery-based rectangular material module.

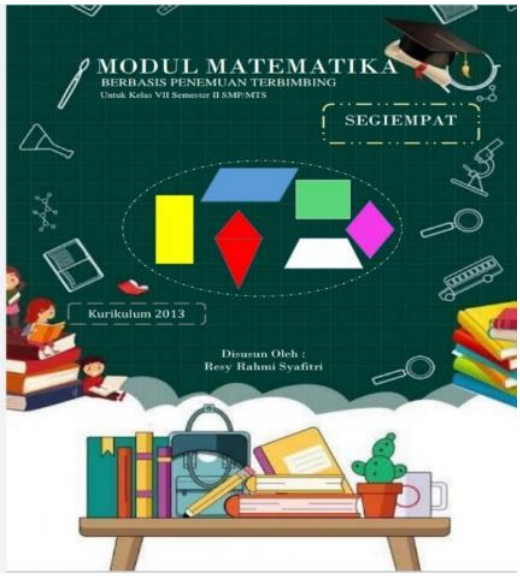

Figure 1. Cover of the Guided Discovery-Based Module

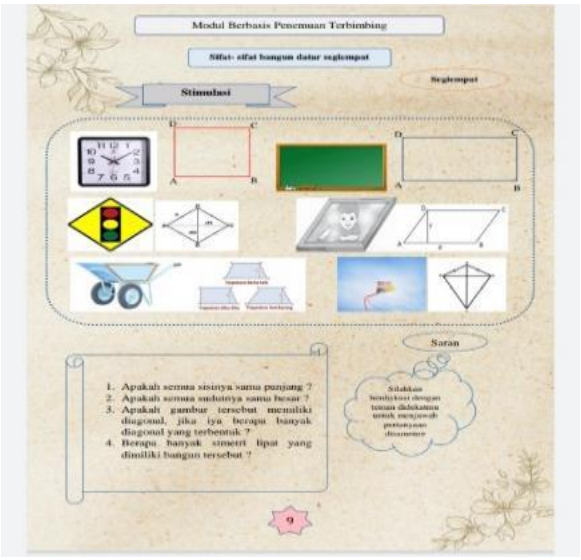

Figure 2. Material Description for the Stimulation Step

The cover of the guided discovery-based module contains the material to be studied, the educational unit, the author's name and the curriculum used in the school (Figure 1). Stimulation is the provision of stimulation to students in the form of questions, recommendations for reading books, or other activities (Mawaddah & Maryanti, 2016), so that students' desires to investigate themselves can arise. In the developed module, the researcher provides stimulus to students related to pictures and questions about the material to be studied (Figure 2). The activity of formulating problems can be interpreted as providing opportunities for students to identify as many problem agendas as possible that are relevant to the subject matter (Mawaddah & Maryanti, 2016). In the developed module, students are asked to formulate problems from pictures (objects around students) or illustrations as much as possible (Figure 3).

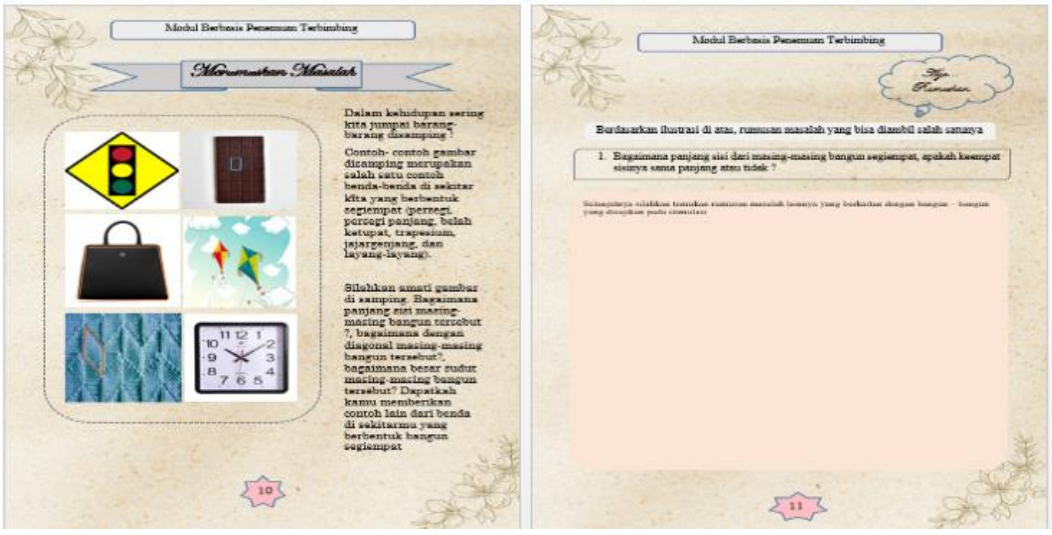

Figure 3. Material Description for Steps to Formulate Problems

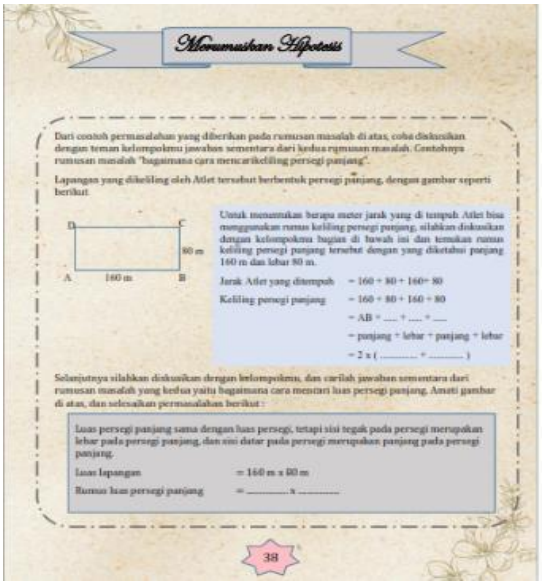

Figure 4. Description of Material for Steps to Formulate Hypotheses

Figure 5. Material Description for Data Collection

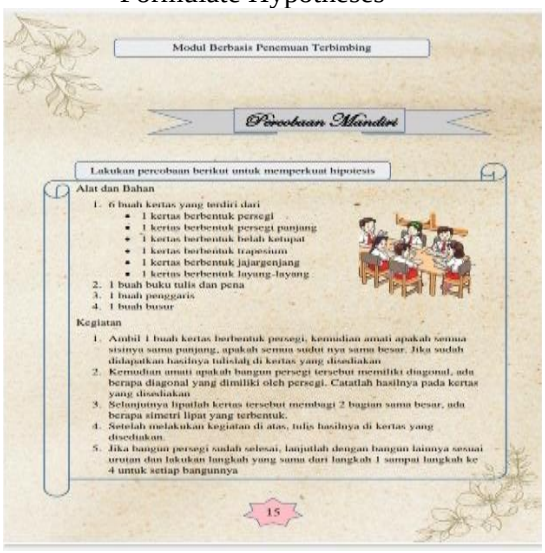

Figure 6. Description of Materials for Independent Experiments

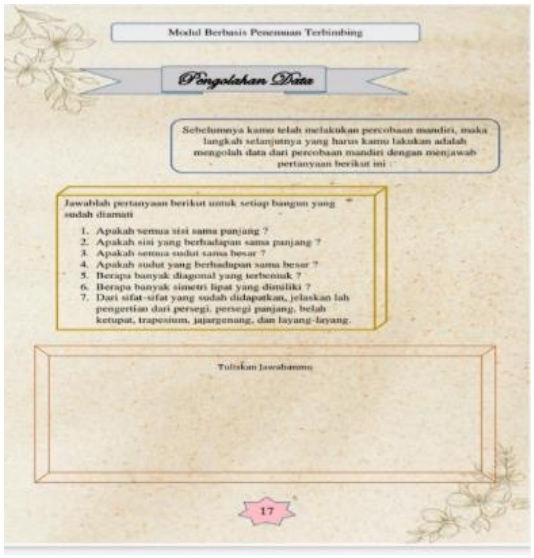

Figure 7. Description of Material for Data Processing

Students are required to come up with a temporary solution to the formulation of the current problem in developing a hypothesis. In the subject, students and their groups debate coming up with temporary solutions to the made illustrations and issue formulations (Figure 4). Data collection aims to collect as much relevant information as possible to prove the hypothesis (Mawaddah & Maryanti, 2016). Data collection in the module is in the form of presentation of hypotheses from each group, followed by a discussion on selecting hypotheses from each group (Figure 5).

Independent experiment aims to prove the truth of the hypothesis that has been owned by students. At this stage, students are asked to carry out the activities in the module, so that students can find out whether the hypothesis they already have is true or not (Figure 6). The data processing means processing data from the results of independent experiments (Mawaddah & Maryanti, 2016). Students are asked to answer the questions that have been presented (Figure 7).

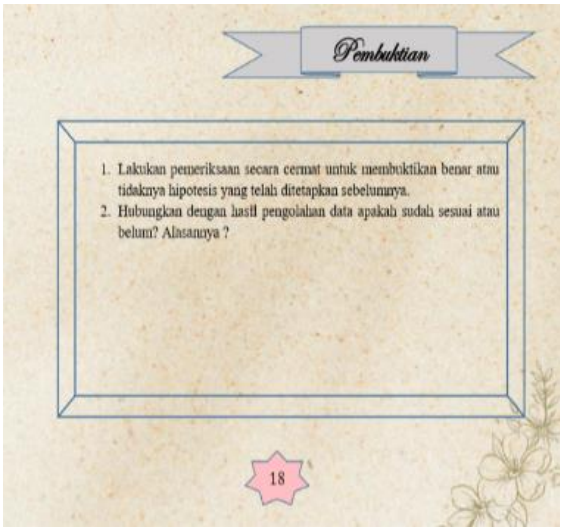

Figure 8. Description of Material for Proof

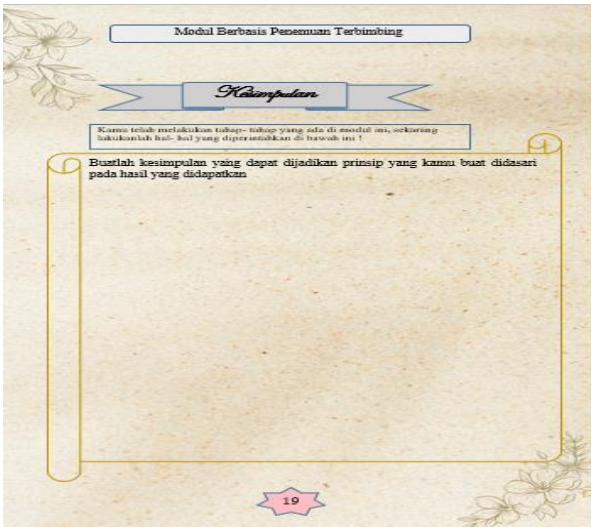

Figure 9. Description of Material for Conclusion

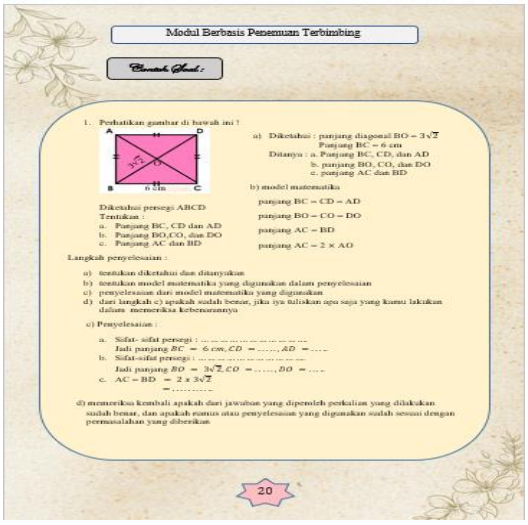

Figure 10. Display example questions

Proof is an activity of examining data that has been processed (Mawaddah & Maryanti, 2016). Evidence activities aim to prove whether the established hypothesis is true. In the module, we ask students to relate the results of the hypothesis with the results of independent experimental data processing (Figure 8). The activity of making conclusions means formulating general principles and applying them to all the same problems (Mawaddah & Maryanti, 2016). In the module, at this stage students make conclusions from the material they have learned (Figure 9). The module also contains examples. Solve the problems in the example section using the principle of guided discovery. The questions in the example section are questions that characterize mathematical problem solving abilities. The display of sample questions in the module is shown in Figure 10.

Develop Stage

1. The results of the validation of guided discovery-based modules to improve mathematical problem-solving ability on quadrangle material

Table 1. Results of Guided Discovery-Based Module Validation

No	Validated Aspect	Validator			Total	Max Score	%	Categori
		1	2	3				
1.	Content feasibility	32	33	37	102	132	77	Valid
2.	Presentation feasibility	44	54	64	162	201	79	Valid
3.	Language feasibility	10	12	13	35	49	73	Valid
4.	Graphic feasibility	19	26	30	75	96	78	Valid
	Total	105	125	144	374	478	77	Valid
	Mean	26	31	36	93	119	77	Valid

In the quadrilateral material for class VII SMP, the results of the validation of the guided discovery-based module to enhance mathematical problem-solving abilities range from 70% to 80% per each aspect, as shown in Table 1. A module is declared validated based on the standards stated by Muljono (2007), specifically the elements of content feasibility, presentation feasibility, language feasibility, and graphic feasibility.

Overall, the guided discovery-based module on the quadrangle material is valid because the guided discovery-based module is under the feasibility of a development product. According to the content feasibility criterion, the guided discovery-based module's content corresponds to the 2013 curriculum, based on the condition and includes concepts, definitions, and principles. The guided discovery steps are already present in the material description. In order to improve students' mathematical problem-solving abilities, the module already includes examples of questions relating to indicators of those abilities. The module's sentences are simple to comprehend and employ the EYD. The guided discovery-based modules are organized logically and clearly, and the text and graphics' colors match.

If the guided discovery-based module has given students the opportunity to enhance their own understanding of the subject, then it is valid. This is in sync with Harisman's (2014) opinion that a module can be valid if the data is given in a systematic order that enables students to learn independently. The validator offers ideas for improvement in the following areas: the cover, a space for students to complete each guided discovery step, the guided discovery steps, and typing errors.

2. The results of the practicality of guided discovery-based modules to improve mathematical problem-solving ability on quadrangle material

Table 2. Practical Results of Guided Discovery Based Modules According to Students

Practical Aspects	Total	Max Score	%	Category
Instruction				
Feeling happy	245	336	72,91	Practical
Motivating	236	336	70,23	Practical
Respond	184	252	73,01	Practical
Content Validation				
Modules help in learning and understanding concepts	229	336	68,15	Practical
Achievement of indicators of mathematical problem-solving ability	458	672	68,15	Practical
Advance Validation				
Image display	245	336	72,92	Practical
Ease of use	226	336	67,26	Practical
Mean	260,4285	372	70,37	Practical

According to Table 2, 70% of students responded well to guided discovery-based courses. The guided discovery-based module for class VII SMP's quadrangle material is useful for improving mathematical problem-solving abilities. The results are in line with Sintawati's research (2017), namely learning to use guided discovery-based modules is included in the practical criteria.

We gathered this information from the responses of SMPN 2 Kapur IX class VII.3 students who had previously used guided discovery-based modules. The findings of the survey given to the student's responses show the usefulness of this guided discovery-based program. Six of the thirty-one statements on the student response form fall into the very practical group, seventeen statements into the practical category, and the remaining sixteen statements into the somewhat practical category. Feeling happy, motivated, and responsive, assisting with learning and understanding concepts, achieving indicators for solving mathematical problems, image display, and usability are all practical elements that are measured.

The summary of student responses to the guided discovery-based module are:

a. Students agree that learning using guided discovery-based modules is very fun.
b. Students agree that learning material through guided discovery-based modules can enhance their ability for solving mathematical problems. Their ability to learn independently and actively during the learning process can also be developed by presenting issues in the module. The guided discovery-based module's problems are ones that individuals encounter daily.
c. The guided discovery-based mathematics module's design has attracted the interest of the students. This is determined by looking at the appearance, writing, letters, language, and layout style.
d. Using guided discovery-based modules on quadrangle content improves students' ability to solve mathematical problems.

3. The results of the effectiveness of guided discovery-based modules to improve mathematical problem-solving ability in quadrangle materials

The results showed that the mathematical problem-solving ability increased by 0.48139 in the medium category. The results are supported by the results of Nasution's (2016) research, namely that the module can improve students' mathematical problem-solving abilities. Nasution (2016) found classical completeness in the first trial of 81.25% and classical completeness in the second trial of 90.63%.

Of the twenty-one students who took the mathematical problem-solving ability test, there were five students at a low level of mathematical problem-solving ability, fourteen students in the category of moderate mathematical problem-solving ability, and two students at a high level of mathematical problem-solving ability. Based on these data, after learning to use guided discovery-based modules, there are still students who are in the low category for mathematical problem-solving abilities. Students' poor mathematical problem-solving abilities may result from a lack of learning motivation, as well as environmental, familial, and other variables. Both internal and external elements may impact students' learning outcomes (Nabillah & Abadi, 2019).

CONCLUSIONS

This study produced a guided discovery-based module to enhance student's ability to solve mathematical problems in the quadrilateral material of class VII SMP. This module was valid, practical, and effective. The guided discovery-based module validation's overall average score is 76.92%. The feasibility of the content/material, the feasibility of the presentation, the feasibility of the language, and the feasibility of the graphics are all measured validity factors. Guided discovery-based modules' practicality was evaluated in terms of their usability, time commitment, module appeal, and advantages. The student response survey's overall average score is 70.37%. The effectiveness of the guided discovery-based module is seen from the improvement of students' mathematical problem-solving ability tests. In the medium category, the average increase in the mathematical solving ability test is 0.48139.

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