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Differentiated Module to Improve Students Geometric Skill on Quadrilateral

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Abstract

Geometric skills was one of the essential competencies in mathematics learning**.** However, instruction that did not consider differences in students' abilities could hinder the achievement of this competency. This study aimed to produce a differentiated learning module on quadrilateral material that was valid, practical, and effective in improving students' geometric skills. The study used the 4-D model, which included the stages of define, design, develop, and disseminate. The research subjects were 24 eighth-grade students at SMP Negeri 1 Rambipuji. Data collection techniques were questionnaire techniques and test techniques, with the included instruments being on validation sheets, teacher and student response questionnaires, pre-test, and post-test. The research results showed that the developed learning module had a validity score average of 3,84, practicality ratings of 97,50% from teachers and 83,02% from students, and an effectiveness score with an average N-Gain of 0,76 (high category). The module included learning objectives, diagnostic assessments, differentiated activities, summative assessments, and reflection. Each student group received scaffolding tailored to their ability level. This learning module could be used to support differentiated instruction aligned with the Merdeka Curriculum.

Keywords: differentiated learning; geometric skills; learning module; quadrilateral

INTRODUCTION

Meaningful mathematics learning needed to adapt to students' characteristics and needs. Geometry, as one of the branches of mathematics, did not only focus on shapes and measurements but also on spatial relations. In the context of junior high school learning, the topic of quadrilaterals became one of the important subjects as it trained students to develop shape visualization, recognize the properties of plane figures, and build connections between geometric concepts (Shidqiya & Suyitno, 2022). Geometry instruction should foster spatial thinking and the understanding of relationships between objects (Triyono et al., 2024). Futhermore, the development of students geometric thinking can be explained through Van Hiele's model, which outlines five sequential levels visualization, analysis, informal deduction, deduction, and rigor each representing progressively more sophisticated ways of understanding geometric concepts. Integrating this theoretical framework into instruction helps teacher design learning activities that match students current thinking level while facilitating advancement to higher levels (Unaenah et al., 2020). Van Hiele based theoretical frameworks and instructional approaches can effectively characterize and support students' progression in geometric reasoning and understanding (Fitriza et al., 2022). In addition to mastering the concepts, students are also required to master the geometry skills used (Susanto & Mahmudi, 2021). The geometry skills referred to students' skills in learning geometry, which according to Hoffer (1981) consist of five skills: (1) visual skills, (2) descriptive skills, (3) drawing skills, (4) logical skills, and (5) applied skills. To solve problems, students are required to possess these geometry skills (Muhassanah et al., 2014).

In practice, classroom instruction was still dominated by conventional methods that tended to be uniform and did not consider students' varying abilities. Many students experienced difficulties in understanding the properties of geometric figures and the relationships among them, and that diagnostic assessments were rarely used to identify students initial understanding (Marfuah et al., 2023). This resulted in a low level of conceptual understanding and weak geometric skills. (Rahmah & Susanah, 2020) emphasised the importance of approaches that accommodate diverse learning needs in order to improve the quality of mathematics education. The Merdeka Curriculum recommended differentiated instruction as one solution to this challenge. Teachers can implement differentiated learning in content, process, and product (Hidayat & Patras, 2024).

This approach adapts processes, content, and products based on students' readiness, interests, and learning profiles. It required teachers to design learning activities appropriate to students' skill using diagnostic assessments. This enables more personalised and meaningful learning experiences. Studies by (Basri et al., 2024) and (Haryanti, 2024) have shown that differentiated learning modules improve learning outcomes and higher-order thinking skills.

Consequently, students received a more tailor-dressed. and meaningful learning. Scaffolding was a facilitator that underpinned-active student engagement yet another inroad to helping students be actively engaged. Scaffolding was also another teaching method that motivated the active learning of students via active participation in the learning experience (Sari & Surya, 2017). Diagnostic assessments are rarely carried out efficiently in mathematics lessons, restricting the degree to which teachers can differentiate their teachings to suit the needs of students' needs (Marfuah et al., 2023). But there's still never been one fully differentiated learning unit designed for quadrilaterals which organically incorporates students' diagnostic data based on assessment Indonesian geometrical mindset. This emphasizes the need for a module that can focus both on the content needs in geometry and on ailments of students. This support suggested that adoption of response to intervention approaches could have a positive impact on student learning.

However, the practice of differentiated instruction was still similar to reality various challenges appeared. Teachers often lacked appropriate teaching materials and did not fully understand how to develop and apply diagnostic assessments systematically. Teachers at SMP Negeri 1 Rambipuji were already familiar with differentiated instruction, but had not used cognitive diagnostic tools to identify students' geometric skills. As a result, learning activities were not yet fully responsive to students' needs.

Based on this background, there was a need to provide appropriate teaching materials in the form of differentiated learning modules designed based on the results of diagnostic assessments. The learning modules were designed to deliver learning experiences aligned with students' ability levels and to facilitate attainment of geometric skills. The module is developed using a systemic learning development model and expert validation and field trials, the resulting learning modules were expected to become feasible solutions to improve the quality of mathematics learning in the Merdeka Curriculum era.

In addition, the integration of differentiated approaches with content suited to students' developmental phases also needed to be considered in learning planning. Learning modules designed contextually not only helped students understand geometric concepts but also improve connections between material and real-life situations. Learning materials aligned with students' readiness and learning styles could enhance learning effectiveness and support the creation of inclusive and participatory learning environments (Marantika et al., 2023). Several research related to preparing learning modules for differentiated learning is taken, but development is required. Several packages for differentiated instruction exist, but they do not include embedded diagnostic assessments. In contrast, a class geometry module without scaffolding. While successful in mathematics education, this approach has not yet been able to overcome the levels of readiness and misunderstandings among students. In this study, a designed module about quadrilaterals in the aspect of differentiated teaching is proposed to employ diagnostic assessment and scaffolding. This orchestra of features are designed to enhance learning efficiency. Thus, this research is required to produce a module of differentiated learning stage about quadrilateral.

METHOD

The researchers used Development (R&D) approach utilizing the 4-D development model. They employed Research and Development (R&D) method utilizing the 4-D development model. It was made up of four phases: definition, design, development and dissemination (Thiagarajan et al., 1974).

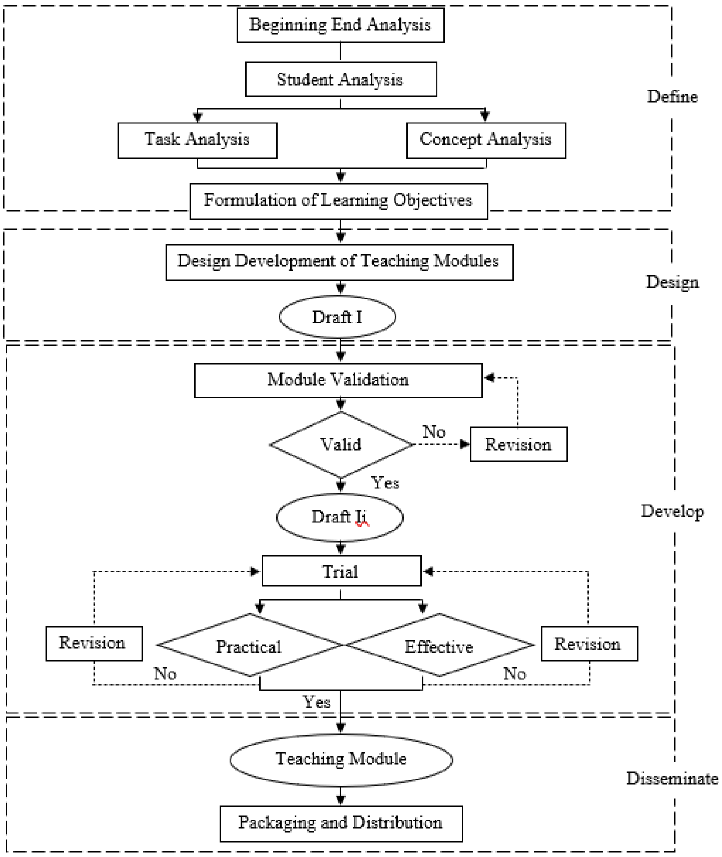

Figure 1. Flowchart of the Development Stages Based on the 4-D Model

The purpose of the identification of learning needs and curricula, as well as student, descriptive analysis was defined in the developing stage. Regarding the designing stage, the researchers hypothesized the structure of learning module. The package of learning consisted of elements such as the objectives, diagnostic tests, activities were differentiated and formative plus summative assessments. During the development phase, experts' validation and trials were conducted by researches. After validation, corrections were implemented according to the feedback collected from validators. This was regarding the tryout of productivity module in terms of practical and effectiveness on 24 students grade VIII at SMP Negeri 1 Rambipuji. The disseminating stage obtained the distribution phase of the learning module, which was conducted both directly to mathematics teachers at the school and through digital media such as learning platforms and social media. The following chart shows the stages of developing the 4-D model used in this study.

The research utilized various instruments, including validation forms, questionnaires for students and teachers, as well as pre-tests and post-tests. The validity of the developed learning module and research instruments was assessed to determine their appropriateness. Validators carried out the validation process using the validation forms. The average mean score (Va) was then compared to the predefined validity level range for the learning module (Zahro et al., 2021).

Table 1. Validity Criteria of the Learning module

$\boldsymbol{V_a}$ (Score Range)	Validity Level
$\boldsymbol{V_a} = 4$	Very valid
$3 \le \boldsymbol{V_a} < 4$	Valid
$2 \le \boldsymbol{V_a} < 3$	Less valid
$1 \le \boldsymbol{V_a} < 2$	Not valid

According to Table 1, the learning module and instruments were considered valid if the V_a score fell within a range of 3 to 4. If the V_a score was below the established validity criteria, the module or research instrument needed to be revised to meet the expected validity standards.

The practicality of the learning module was evaluated based on student and teacher response questionnaires, as well as observation sheets detailing the implementation of the learning process using the developed module. The steps used to analyze the module's practicality, adapted from Yunus et al. (2024), are outlined below.

$$P = \frac{\sum S}{SM} \times 100\% \text{ .... (1)}$$

Description:
P : percentage score
S : score obtained
SM : maximum score
The percentage results were categorized based on the practicality criteria of the learning module as follows.

Table 2. Practicality Criteria of the Learning module

Percentage (%)	Level of Practicality
$\mathbf{75} \le \boldsymbol{P} \le \mathbf{100}\%$	Practical
$\mathbf{50}\% \le \boldsymbol{P} < \mathbf{75}\%$	Quite practical
$\mathbf{25}\% \le \boldsymbol{P} < \mathbf{50}\%$	Less practical
$\mathbf{0}\% \le \boldsymbol{P} < \mathbf{20}\%$	Not practical

According to Table 2, the learning module was deemed practical if the P score fell between 75% and 100%. If the P score was lower than the established practical criteria, the module needed to be revised to meet the specific needs of classroom learning.

The effectiveness of the learning module was assessed to measure the improvement in students' geometric skills, based on the comparison of pre-test and post-test scores, which were analyzed using the normalized gain (N-Gain) test. The following steps, were followed to analyze the module's effectiveness using the N-Gain test:

a. The N-Gain score was calculated by comparing the students' pre-test and post-test scores. The formula used was presented below:

$$Normalized\ Gain\ (G) = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2)$$

b. The N-Gain (G) calculation results were then classified into three categories. The classification criteria were presented in the following description:

Table 3. N-Gain Category Levels

***N-Gain* Score**	**Category**
$\mathbf{0,7 < G \leq 1}$	High
$\mathbf{0,3 \leq G \leq 0,7}$	Medium
$\mathbf{G < 0,3}$	Low

c. The average N-Gain score that had been calculated was then converted into a specific effectiveness category. The classification guidelines were presented in the following description.

Table 4. Effectiveness Criteria of the Learning module

Persentage (%)	**Level of Effectiveness**
$\mathbf{75\% < P \leq 100\%}$	Effective
$\mathbf{55\% < P \leq 75\%}$	Quite Effective
$\mathbf{40\% < P \leq 55\%}$	Less Effective
$\mathbf{0\% \leq P \leq 40\%}$	Ineffective

Based on Table 4, the learning module was considered effective if the P score was greater than 75%. If the P score fell below the effective category, the learning module had to be revised to become more effective in improving students' geometric skills.

RESULTS

The development of the differentiated learning module was carried out by following the stages of the 4-D model, which included define, design, develop, and disseminate. The define stage aimed to identify learning needs, particularly in improving students' geometric skills. This stage covered several types of analysis, namely initial-final condition analysis, student analysis, concept analysis, task analysis, and the specification of learning objectives. Based on observations and interviews with the mathematics teacher at SMP Negeri 1 Rambipuji, it was found that the differentiated approach had been previously applied, but not evenly and was not yet supported by diagnostic assessment tools to map students' geometric skills. The research subjects, namely the students of class VIII G, demonstrated varied learning abilities, which were then analysed as the basis for developing the differentiated assessments and student worksheets.

The geometry material analysed covered various types of quadrilaterals, such as parallelograms, rectangles, squares, rhombuses, kites, and trapezoids, with emphasis on their properties, relationships among shapes, and classification based on similar characteristics. The task analysis was conducted to adjust the cognitive load for each student group: developing, intermediate, and advanced, by designing student worksheets with different levels of scaffolding. The learning objectives were derived from the analysis and allow students to recognize properties and relations of quadrilaterals as well as improve their geometric abilities using tasks adopted to individual learner's profiles.

The project concentrated during design on development of the learning module and students' activity sheets that incorporated geometry skills and research tools. The module was systematically developed and included learning objectives, cognitive diagnostic tests or assessments, differential instruction (process skills based), formative, summative test (pre-test and post-test) as well as a reflection for students and teachers. The students' worksheets were modified for varying abilities. They were intended to scaffold the emergent group heavily throughout the station, support the bridging group minimally during a station, and extend the learning for advancing group. The first version of the learning module was designed to take advantage of learning in line with students' ability, for their best geometric competence advancement. The design of the developed learning module is presented in Figure 2.

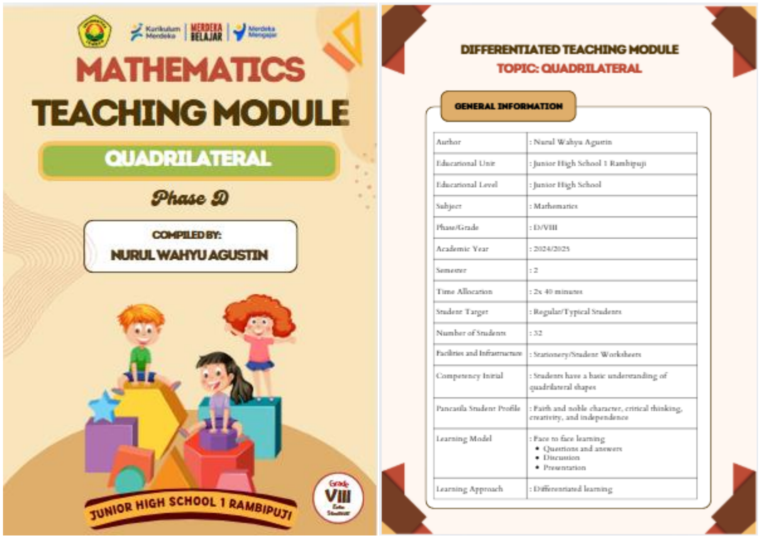

Figure 2. Display of the Learning module

Figures 2 shows a first layout of the learning module and the differentiation according to process to become started according students their student profile. The module comprises important information such as background, objectives and steps of learning activities along with student worksheets for various experiences levels and assessments for assessing students' ability to achieve indicators to geometric thinking; a reflection section is also available for self-assessment among students and teachers. This format is designed to make the learning process more focused and effective, and to support the achievement of predetermined learning objectives. This module is equipped with several key elements, including a general identity, a cognitive diagnostic assessment to identify students' level of understanding, ability-based learning activities, differentiated student worksheets, summative assessments (pre-test and post-test), teacher and student reflections, and observation sheets for the learning process. The student worksheet activities are grouped into developing, moderate, and advanced categories. Figures 3 through 5 illustrated the initial student worksheets layout for the developing, intermediate, and advanced groups.

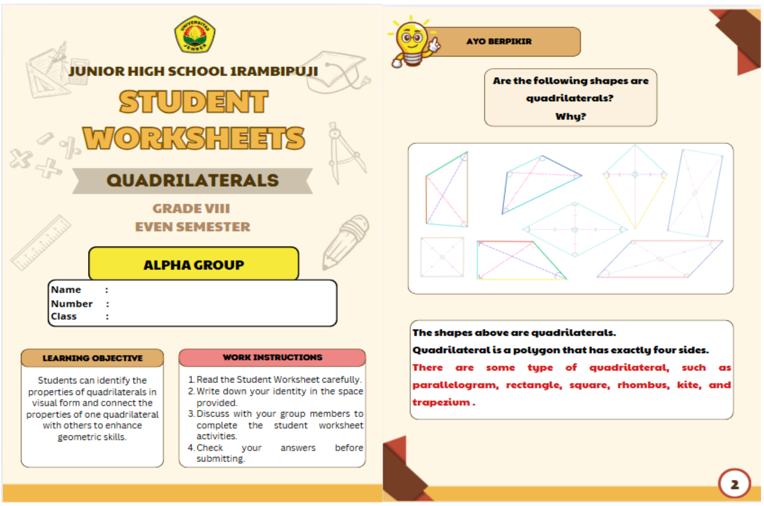

Figure 3. Display of the Student Worksheet for Developing Level

The developing group is given student worksheet with extensive scaffolding in the form of simple explanations and step-by-step assistance to guide students in understanding basic concepts. Teachers provide step-by-step assistance, such as reading the instructions for the questions, using visual aids in the form of pictures of quadrilaterals available in the worksheet, and filling in tables with structured verbal guidance. The goal is for students to gradually grasp the basic concepts of plane geometry with optimal results. The activities in student worksheet different with the student worksheet for moderate level which shown in Figure 4 below.

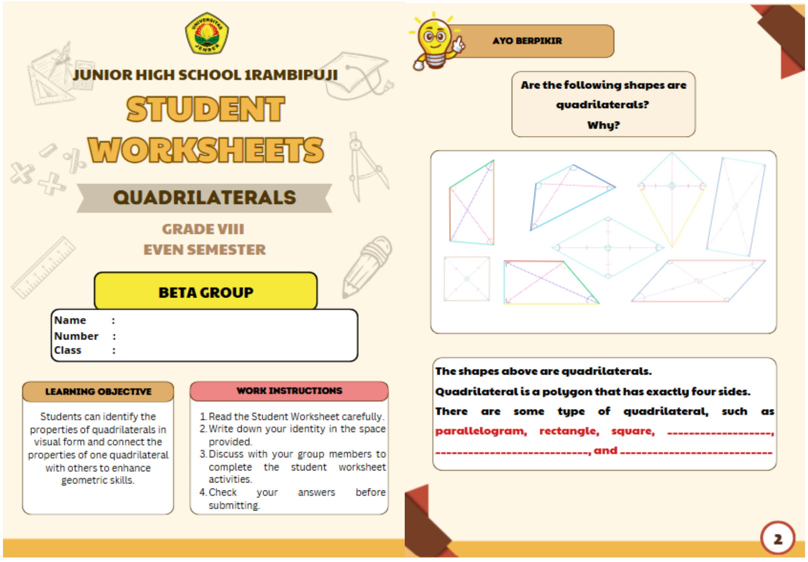

Figure 4. Display of the Student Worksheet for Developing Level

The moderate group is given student worksheet with sufficient guidance, encouraged to engage in active discussion, and remains under teacher supervision. The teacher acts as a facilitator, walking around, monitoring the discussion, and asking prompting questions such as "What is the difference between a rhombus and a square?" to help reinforce their understanding. The goal of this scaffolding is to train students to think independently and actively participate in discussions, while still providing guidance when needed. The activities in student worksheet different with the student worksheet for advance level which shown in Figure 5 below.

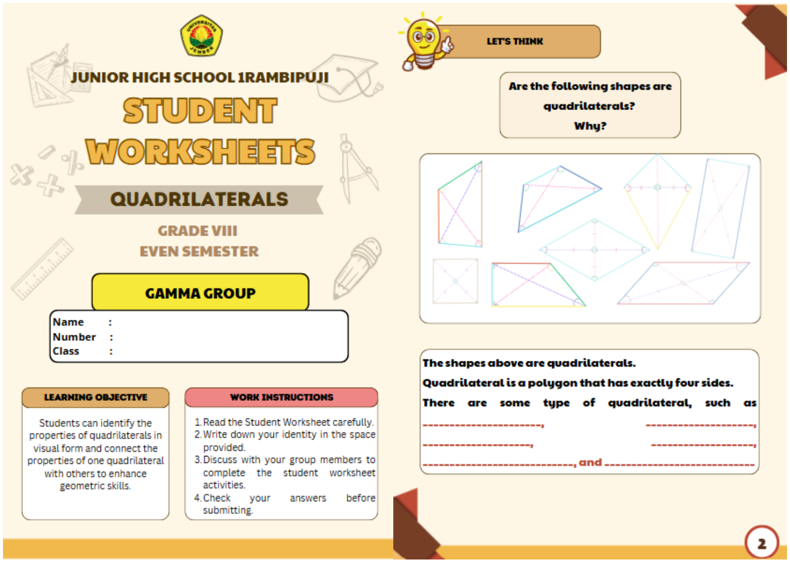

Figure 5. Display of the Student Worksheet for Advanced Level

Meanwhile, the advanced group is given challenging student worksheet with minimal assistance, encouraging independent exploration, and the teacher only monitors their discussion process. The teacher provides minimal scaffolding, only occasionally offering clarification or feedback when requested. The goal is to encourage students to think critically and independently, then make generalizations from concepts they have mastered.

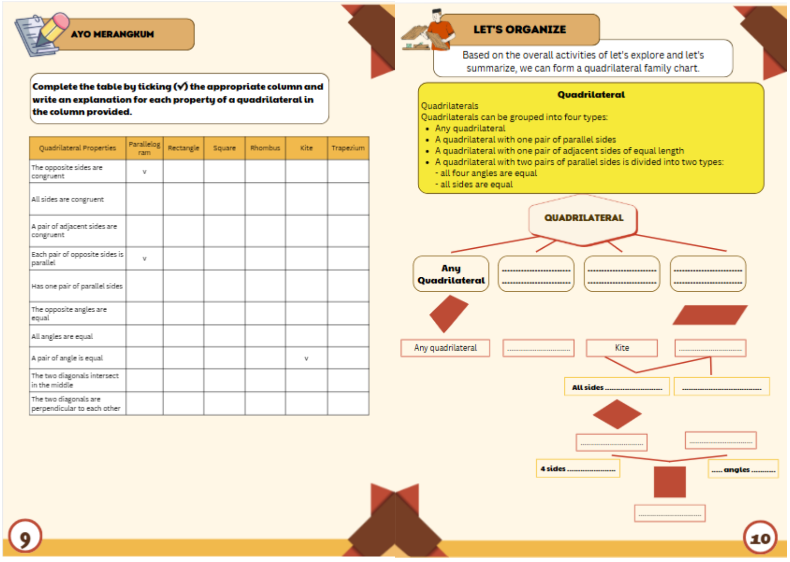

Figure 6. Geometric Skills Activities Presented in the Student Worksheet

Figure 6 presented an example of an activity that developed geometric skills in the student worksheet. The image on the left illustrates an activity in which students are asked to identify the characteristics of each quadrilateral by checking the corresponding statements in the provided table. This activity is expected to train students' verbal and reasoning skills. The image on the right illustrates an activity where students are asked to conclude the relationship between each quadrilateral shape, which is presented in the form of a diagram. This is expected to train students' reasoning skills. In addition, images 3-5 also illustrate activities that can train visual skills when presented with several images of flat shapes.

In the develop stage, the learning module was validated by two mathematics education lecturers from the University of Jember and one junior high school mathematics teacher. The validation results showed that the average validity score of the learning module was 3.84, which fell into the valid category. After that, the learning module was tested on 24 eighth-grade students from class VIII G. Before the learning activities began, a cognitive diagnostic assessment was conducted to classify students into three categories: developing, intermediate, and advanced groups. The recapitulation of diagnostic assessment results shows in Table 5 below.

Table 5. Recapitulation of Diagnostic Assessment Results

Score	Category	Number of Students
71-100	Advance	2
41-70	Intermediate	21
0-40	Develop	1

Based on Table 5, to support a more effective learning process, students in the moderate category are then regrouped into small units of 5 to 6 students so that differentiated learning can be optimally implemented. The learning was conducted over two class periods, starting with a pre-test, followed by differentiated learning activities based on students' ability groups, and ending with a post-test and the completion of response questionnaires by both students and the teacher. An observer also completed a lesson implementation observation sheet.

In the final stage, disseminate, the learning module was distributed to mathematics teachers at SMP Negeri 1 Rambipuji and through digital platforms such as Ruang Pendidikan (https://guru.kemendikdasmen.go.id/bukti-karya/pdf/900169) and YouTube (https://www.youtube.com/shorts/28C0WToVeDw). This dissemination aimed to allow the learning module to be more widely used by teachers in implementing differentiated learning in accordance with the principles of the Merdeka Curriculum.

Development Analysis Results

The validity analysis was conducted by three validators, consisting of two Mathematics Education lecturers from the Faculty of Teacher Training and Education, University of Jember, and one mathematics teacher from SMP Negeri 1 Rambipuji, based on the aspects of format feasibility, content, and language. The following table presents the validity results of the learning module.

Table 6. Results of the Learning module Validity Analysis

No.	Component	Average Validity Score (V_a)	Validity Category
1.	Learning module	3,84	Valid
2.	Student Worksheets	3,87	Valid
3.	Cognitive Diagnostic Assessment	3,94	Valid
4.	Learning Implementation Observation Sheet	3,91	Valid

The validity analysis was conducted on the learning module and its components, namely the Student Worksheet, cognitive diagnostic assessment, and the learning implementation observation sheet. The assessment was carried out by three validators using a scale of 1 to 4, covering aspects such as format, content, and language. Based on the recap results, the average validity score was 3,84 for the learning module, 3,87 for the student worksheet, 3,94 for the cognitive diagnostic assessment, and 3.91 for the learning implementation observation sheet. All scores fell within the range of $3 \leq V_a < 4$, thus categorized as valid. This indicated that the differentiated learning module and its components were considered suitable for use in the learning process.

Table 7. Average Scores of Student Response Questionnaire

Indicator	Score	Percentage
The learning activities made it easier for me to understand quadrilateral material.	3,54	88,54%
My geometric thinking skills improved after the learning activities.	3,33	83,33%
The learning activities suited my learning needs.	3,38	84,38%
The materials presented in the learning activities were relevant to everyday life.	3,46	86,46%
The learning activities made me more confident in solving geometry problems.	3,38	84,38%
The learning activities helped me visualize quadrilaterals and their properties.	3,50	87,5%
The learning activities made me more interested in studying geometry.	3,04	76,04%
The learning activities made it easier for me to understand and apply quadrilateral concepts.	3,17	79,17%
I understood geometry concepts better because of the learning activities.	3,25	81,25%
After the learning activities, my ability to solve geometry problems improved.	3,17	79,17%
Student Response Questionnaire Percentage	**3,32**	**83,02%**

The practicality analysis of the differentiated learning module was obtained from student and teacher response questionnaires after the trial implementation in class VIII G at SMP Negeri 1 Rambipuji. This practicality analysis was used to determine students' and teachers' responses to the differentiated learning module on the topic of quadrilaterals. The following table was the result of the student response questionnaire calculation.

The module's practicality was assessed using student response questionnaire, teacher response questionnaire, and observations on lesson implementation. The mean student score for the module was 83.02%, and that of the teacher was 97.50%. These were both rated as very useful. These results suggest that the module was clear, useful, and contained material of relevance to students. The application observation also demonstrated that the learning process with the module was conducted as designed. Figure 7 shows the pre- and post-test scores. For the pre- test, the student score analysis results range from a minimum of 24 to a maximum of 76, and for the post-test, the lowest score is 64 to 96 at its highest. With all of the indicators individually, we found that the one with the largest effect was making use of the plane figures' properties. These students at first would only provide the name of a shape and no reasoning for choosing the misshapen polygon, but went on to use correct properties successfully after the lesson, such as “having two pairs of opposite sides that are parallel and equal in length”, “opposite angles being equal”, and “All angles being right angles”. This suggested that the learning activities featured in teacher worksheets, particularly those which focused on manipulation of shape attributes, categorization of quadrilateral families, and using visual scaffoldings, enabled pupils to learn and to apply such knowledge more deeply. The results showed a very significant difference, which means learning with the module of differentiated learning had a good influence on achievement in science.

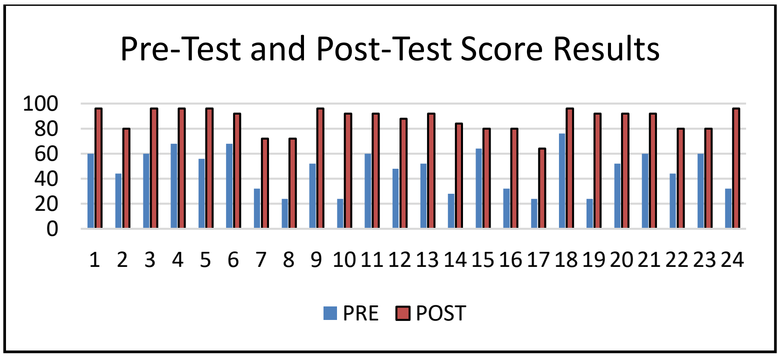

Figure 7. Pre-Test and Post-Test Score Results

Figure 7 shows the differences between the pre-test and post-test scores for students across all 24 participants. The pre-test scores are shown as blue bars, and the post-test scores are red. It is clear that each student's post-test was always a better performance when compared to their pre-test, indicating a consistent direction of improvement. The lowest pre- test score was 24 and reached 64 in the post-test, while the highest pre-test score was 76 to 96 after the post-test. This increase in mean grades for all students means the personalized learning module had a positive effect on student geometry skills. The most outstanding improvement was on the part of their use of properties of plane figures, which advanced from merely naming shapes to giving correct statements about their properties, such as “having two pairs of opposite sides that are parallel and equal in length,” “equal opposite angles,” or “that all the angles are right.” Such a regular trend of improvement throughout the dataset visually demonstrates the efficacy of the module in improving students’ understanding and application of quadrilaterals.

The recapitulation of pre-test and post-test results was presented in Table 8, which showed that the average pre-test score was 47,67 and increased to 87,33 in the post-test.

Table 8. Recapitulation of Pre-Test and Post-Test Results

	Pre-test	***Post-test***
Number of students	24	24
Highest score	76	96
Lowest score	24	64
Average	47,67	87,33

The step taken to determine the effectiveness of using the differentiated learning module in improving students' geometric skills was to analyze the pre-test and post-test data using the N-Gain calculation. This calculation aimed to measure the extent of improvement in students' abilities after the learning process compared to their initial condition. The N-Gain results were categorized into three criteria: high, medium, or low.

Table 5. Percentage of N-Gain Categories

N-Gain Score (G)	**Category**	**Number of Students**
$\mathbf{0,7 < G \leq 1}$	High	17
$\mathbf{0,3 \leq G \leq 0,7}$	Medium	7
$\mathbf{G < 0,3}$	Low	0

Based on Table 8, out of 24 eighth-grade students who took the pre-test and post-test, 17 students showed improvement that fell into the high category. Meanwhile, the remaining 7 students were categorized as medium, and no students were classified as low. This meant that all students experienced an improvement in ability, either in the medium or high category. Furthermore, the overall N-Gain results were summed, and the average was calculated.

Table 6. Effectiveness Analysis Results Based on N-Gain

Data	**Total**	**Average**	
	N-Gain (G)	***N-Gain***	**% Effectiveness (P)**
Pre-test and post-test scores of 24 students	18,31	0,76	76,29%

Based on Table 9, the total N-Gain score was 18.31, with an average N-Gain of 0.76 and an effectiveness percentage of 76.29%. This improvement showed that the differentiated learning module was effective in helping students understand the concept of quadrilaterals and in improving their geometric skills. The module provided challenges suited to the ability levels of each group (developing, intermediate, and advanced) and allowed students to participate in the learning process actively.

According to the analysis, it can be concluded that the product of a differentiated learning module development was categorized as valid, practical, and effective. Thus, the developed module was considered appropriate as a learning tool to facilitate the practice of differentiated instruction on quadrilateral issues in supporting the improvement of students' geometric skills.

DISCUSSION

The objective of this research was to design a product in the form of a quadrilateral module which could be used to teach each student according to their individual ability, because learning generally does not take the differences into account. Differentiation is a fundamental approach to matching the learning process with the student's varying cognitive abilities (Tomlinson, 2017). Teachers do not always have systematic instruments to help them to diagnose students' preparedness, particularly in geometry (Basri et al., 2024; Haryanti, 2024). There is also no module in Indonesia that includes a diagnostic assessment to measure students' geometric ability (Rahayu et al., 2023).

Results from phase 1 of this study confirmed these findings, thus emphasizing the need for a module to be modifiable with respect to content, processes, and assessment to accommodate individual students. (Aini et al., 2023; Madrazo & Dio, 2020; Nizar et al., 2018). The differentiated learning module that was developed in the present research, therefore, meets the three main criteria, namely validity, practicality, and effectiveness (Murtafiah et al., 2018; Vásquez et al., 2023). The content validity of the module was supported through expert reviews involving format, relevance, and clarity (Alwast & Vorhölter, 2021; Hoover et al., 2023; Sánchez, 2019). It featured geometry indicators, followed the Indonesian spelling law (PUEBI), and organized learning activities in a logical and orderly fashion (Çevikbaş & Kaiser, 2022; Prasojo et al., 2020; Rezat et al., 2021). The learning resources included diagnostic tests, pre-tests, post-tests, and student worksheets to suit the various abilities: lower (developing), middle (intermediate), and higher (advanced) (Denizli & Erdoğan, 2018; Fardian et al., 2024; Li et al., 2011). There were reflection sections for the students as well as the teachers (Huang, 2024). The quality of the learning tools are based on the degree of content, learning objectives, student characteristics, and experts who were involved as well as integrated during the validity checking process (Weigand et al., 2024; Zahro et al., 2021; Żammit & Camilleri, 2024). Modules created with an expert validation process may be more implementation feasible (Trenholm, 2023; Yunus et al., 2023). There were also components of structured diagnostic activities, tailored worksheets for different levels of readiness, and scaffolding in modules to cater to the various levels of geometric thinking as proposed by Van Hiele (Arnal-Bailera & Manero, 2023; Awaji et al., 2024; Helsa et al., 2023; Johar, 2025).

This study began by grouping students based on cognitive diagnostic assessment results, following Tomlinson's (2017) recommendation that initial assessments are crucial for designing responsive learning strategies. The diagnostic assessment, which was administered to 24 students, revealed that the majority of students, specifically 21 students, were classified as intermediate (Cabilan & Peteros, 2024; Nursalam et al., 2025; Torres-Peña et al., 2024). In contrast, two students were designated as advanced, and one student was placed in the developing category (Taufiqulloh et al., 2024). The developing group was assembled according to the student level to whom the instruction was delivered through the teacher's intensive scaffolding using his textbook. However, the instructional strategy became a disadvantage when it came to the imbalances in the people. Having only one student not allowed for people in the developing group to have the discussion with the partners and without one because of one, so the effectiveness evaluation about this group was more descriptive. It was not possible to compare it with other people. The differentiated instruction principle asserts the necessity to assess readiness regardless of the number of people in the group (Haryanti, 2024). Results were in accordance with this view, given that the module was designed according to individual students' varied competences.

In the practicality analysis, it was indicated that both teachers and students reported that they found the differentiated learning module user-friendly. This ease of use was confirmed by responses to the student questionnaire, as the most highly rated item was that learning activities helped me learn quadrilaterals. It indicates that the module also strengthened visual representation, a necessary element of geometrical skills. But "the learning activities made me more interested in studying geometry" was the lowest-rated item, indicating that we need to work on how to make the content fit into students' lives, according to Basri et al. (2024)In practice, a learning module is determined by the suitability of the material and teaching strategies for students' learning needs (Çevikbaş & Kaiser, 2020; Kullberg & Runesson, 2013; Malihi, 2015).

The effectiveness analysis revealed that all measures of geometric skills significantly increased following a period of using the differentiated learning module. The largest gain was shown in the factor "using the properties of plane figures." These findings indicate that the module was successful at providing support for students to explore properties through exploration work and visual scaffolding. In contrast, the "solving contextual problems" indicator saw the smallest gain. The students know these are not because of the students; it is due to the limitations in the tool used for evaluation. This limitation in instrument design shows an area for further research by which all indicators can be measured more fully. This is not due to a lack of understanding by the students but rather due to limitations in the evaluation tool used. This limitation in the instrument design highlights an area for future research, aiming to ensure that all indicators can be measured more comprehensively. The achievement of the module also proved that differentiated instruction narrows the learning gap among students with different levels. This is consistent with the results of Rahayu et al. (2023), who explicitly discussed that teaching with the use of Van Hiele levels of geometric thinking improves students' capabilities upon adjusting to their needs at each level (Fitri et al., 2017; Nuryadi, 2014; Silaen et al., 2025).

The module development process generated a good product that meets the criteria of effective, practical, and valid. The success of the module in enhancing students' abilities supports its efficacy. There have been a number of studies on the adaptation of teaching to students' differentiated levels of geometric development (Rahayu et al., 2023). Various studies have examined the effectiveness of differentiated instruction in increasing students' participation and learning achievement (Basri et al., 2024; Haryanti, 2024; Tomlinson, 2017).

This module on differentiated learning provides a process differentiation in addition to content, product, and environmental differentiation. Moreover, the exclusive utilisation of process differentiation guided by cognitive diagnostics constitutes a notable limitation, which may result in diminished learning responsiveness. Incorporating non-cognitive appraisals has viability and worth, as (Romlah et al., 2025) show throughout contemporary literature, to ease differentiation. It is indicated that for the future, efforts should focus on expanding diagnostic frameworks, diversifying forms for differentiation, and rigorously testing their impact on learning outcomes.

CONCLUSION

The development process of the differentiated learning module on quadrilateral material was carried out using the 4-D model. A curriculum as well as learning needs analysis was conducted in the define stage, showing that the teacher lacked cognitive diagnostic instruments or differentiated teaching materials with which to map initial student abilities. These findings led to a module draft. During design, module design depended on geometric skills indicators. It included learning objectives, diagnostic assessments, differentiated learning activities adjusted to each group's needs in the student worksheets activities, summative assessments, and reflections. The development stage involved expert validation and trials to assess content feasibility, practicality, and effectiveness in improving geometric thinking skills. The final product was disseminated to mathematics teachers at SMP Negeri 1 Rambipuji through the Ruang Pendidikan platform, YouTube, and TikTok in the dissemination stage.

The results of the developed learning module demonstrated achievement in the three main aspects: validity, practicality, and effectiveness. Validity was shown through the assessment of three validators on format, content, and language, with an average score of 3,84. Practicality was indicated by teacher response scores of 3,90 (97.50%) and student scores of 3,32 (83,02%), both categorized as practical. In terms of effectiveness, learning outcomes improved, with the average pre-test score rising from 47,67 to 87,33 in the post-test. The average N-Gain score was 0,76 (76,29%), indicating a high level of effectiveness. A total of 17 students showed improvement in the high category, 7 in the medium category, and none in the low category. These results proved that the differentiated learning module developed was suitable to be used as a learning tool capable of improving the geometric skills of eighth-grade students on quadrilateral material in accordance with the Merdeka Curriculum.

For future researchers, it is recommended to conduct trials with a broader range of subjects and timeframes. The researchers have to consider the use of non-cognitive diagnostic assessments to ensure student grouping encompasses aspects of interest, motivation, and learning style, enriching the student grouping process in differentiated learning. Furthermore, the development of learning modules can be directed toward the integration of interactive digital media to be more adaptive to technological developments and current student needs.

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