

## DEVELOPING INSTRUMENT TO INCREASE STUDENTS' GEOMETRY ABILITY BASED ON VAN HIELE LEVEL INTEGRATED WITH RIAU MALAY CULTURE

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### ABSTRACT

The study aims to develop geometric instruments that can be used to improve geometry based on Van Hiele's cognitive level, which is integrated with Malay culture. This study's research design is the Research and Development (R & D) proposed by Carson, which consists of several stages, namely: potential and problems, material collection, product design, product validity, product testing, product revision, and mass products. The subjects of this study were 65 students majoring in math education in the first semester. The test instruments were analyzed using Aiken's validity and Cronbach Alpha reliability. The trial analysis was analyzed using descriptive statistics to test students' abilities during three meetings. The data analysis showed that the test instruments were developed in valid and reliable categories. The instruments developed were descriptions in the valid and reliable categories. The instruments in the form of valid and reliable test descriptions can be used to obtain relevant data and improve geometric skills based on the Van Hiele Level, which is integrated with Malay Culture.

**Keywords:** *geometry teaching material, Van Hiele cognitive level, Riau Malay culture*

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### INTRODUCTION

Geometry is one of the compulsory subjects that should be learned by math education student. In studying this subject, students must have good reason and ability. Students who study geometry only by reading quickly without getting quality teaching materials will have difficulty in understanding the material. The lack of teaching materials will make students hard to understand the Geometry (Zetriuslita et al., 2021). Therefore, students need to get complete the teaching materials that can provide a total understanding of geometry at various levels.

In geometry, we know the term Van Hiele cognitive level, which consists of five cognitive levels that are found by Van Hiele, namely: visualization, analysis, abstraction, deduction, and rigor (Musa, 2018). Van Hiele's cognitive level in learning geometry can be included at school or college (Risnawati et al., 2019). At the lowest level, students are required to be able to identify, give names, to the highest level where students are required to be able to explain the theorems of different postulate systems and analyze or compare these systems (Kharisma & Asman, 2018). To achieve an understanding of geometry up to the level of stiffness, it requires teaching materials that are designed optimally so that they can guide students in understanding Geometry material. Thus, lecturers must facilitate learning activities with Geometry teaching materials that help students understand concepts and mastery of the material to a high level.

Another important thing in an instrument is the integration of the existing test instruments in the learning device with local culture so that the culture is maintained through the learning process in the classroom. Andrian et al. (2018) explain that the development of educational products that are integrated or combined with culture can contribute to the maintenance of culture itself. Students who forget or are affected by the negative impact of technology development can be recalled with educational products that are integrated with culture. Educational products that are integrated with local culture provide opportunities for students to develop this culture in the teaching and learning process in the classroom (Gavareshki et al., 2012). Students can also be noticed that maintaining cultural uniqueness through any source because preserving culture is the responsibility of students as the younger generation (Bulut & Bars, 2013).

Educational products in the form of learning instruments and learning media that are integrated with culture can form the character of students who love their area (Shih et al., 2017). Educational products developed can be an effective means of achieving complete success in the learning process. Therefore, the development of educational products in the form of learning media, learning devices, instruments to detect mastery of learning materials must be the concern of all elements of education because the success of learning is depending on the developed educational products (Lee et al., 2012). Educational product development can also be a link between culture and learning activities (Greenhow & Lewin, 2016). The development of educational products and deep integration with culture is very important as an effort to preserve culture.

The development of educational products in the form of geometric instruments that are integrated with local culture can be a solution to the development of local culture because Geometry is closely related to human life and daily problems (Abdullah & Leow, 2017). Besides, geometry is very close to the environment of everyday human life (Kosaki et al., 2013). In fact, in the animal world, geometry is taught in which arena forms from the animal environment become objects of learning. The involvement of the animal world with geometry is because animals have a very complex scope or environment (Prados, 2011). The closeness of learning Geometry with everyday life for humans, animals and plants is due to the fact that geometry has a close relationship between structure and form. This is a very logical reason why geometry can solve problems in everyday life (Kutluca, 2013). Therefore, this study will integrate the instruments developed with the Riau Malay culture. The cultural object that will be developed in this study is weaving because it is a Malay cultural object that contains mathematical values. Rezeki, et al. (2020) explain that weaving is a cultural object that is appropriate to use in learning flat shapes because it has a characteristic pattern with flat shapes.

Based on observations made by researchers on students' class, it is known that the teaching and learning process in the Geometry course has not used teaching materials specifically designed to understand Geometry material. The test instrument developed to detect students' geometrical abilities is still at a low level. In certain subjects, students have difficulty understanding the material and tend to be lazy to ask the lecturers because students think Geometry is boring. Students' knowledge of geometry is still at the basic level and has never been taught on material according to Van Hiele's cognitive level, lecture material has never been linked to local culture.

After making observations in class, the researcher also interviewed the lecturer regarding the geometry subject and asked about the effectiveness of the learning that has been implemented so far. The lecturer stated that it was indeed difficult for students to understand Geometry material due to the absence of effective teaching materials and instruments to diagnose students' ability to learn Geometry. The learning conditions must be immediately addressed by the lecturers so that researchers will assist lecturers in solving problems in class by developing instruments in the form of tests on Van Hiele's Cognitive Level-Based Geometry learning which is integrated with Riau Malay Culture.

This research is important because this instrument will facilitate the needs of students and describe the students' abilities and difficulties in understanding the material. Understanding Geometry to a high level Van Hiele can hone the students' thinking skills at a high level (Risnawati et al., 2019). Students can solve difficult problems and students can compete for good jobs and answer global challenges. The selection of lecture materials from local culture is useful for providing understanding to students about Malay culture so that it is not lost by the influence of foreign cultures that enter student life. In addition, lecture material that is raised from local life (local culture) makes it easier for students to understand Geometry material (Zetriuslita et al., 2021).

Geometry is one of the branches of mathematics included in the school mathematics curriculum. In Indonesia, geometry is learning mathematics from elementary to intermediate levels (Risnawati et al., 2019). From the above opinion, it can be seen that geometry is one of the branches of mathematics covered by public school mathematics. Geometry is also studied at the college level. Al-ebous (2016) said that the purpose of learning geometry is to develop logical thinking skills, develop spatial intuition, impart knowledge in learning mathematics for the next level, and interpret arguments mathematically. Students who already have good geometric skills will make it easier for these students to master further learning because spatial and reasoning skills are enhanced through learning geometry that affect math skills on other topics (Ngirishi & Bansilal, 2019). Important abilities in mathematics learning are formed through learning Geometry because Geometry can improve students' spatial and reasoning abilities (Mukamba & Makamure, 2020). Developing mathematical formulas and developing mathematical concepts are abilities that can be formed through learning Geometry (Bhagat & Chang, 2015) from this opinion, it can be seen that there are many objectives of learning geometry, one of which is to improve students' spatial abilities.

According to Lestari (2018), teaching materials are prepared to meet the needs of readers in general and prospective mathematics education teachers, especially students. They understand and explore geometry better. Putri (2016) states that teaching materials are a set of learning tools or devices that contain learning materials, methods, limitations, and evaluation methods that are designed systematically and attractively to achieve the expected goal, namely achieving competence or sub competence with everything. Complexity. This understanding explains that a teaching material must be designed and written with instructional principles because it will be used by the lecturer to help and support the learning process.

The development of instructional media in the form of modules is important to improve the geometry of student teacher candidates up to level 5, namely visualization, analysis, abstraction, deduction, and rigidity (Vojkuvkova, 2012). Based on this opinion, it can be seen that the development of Geometry teaching materials is very important to improve students' understanding of geometry up to level 5, namely: visualization, analysis, abstraction, education, and rigidity. Each level has its own characteristics and stages in presentation, lecturers must be able to make teaching materials easier to understand.

In studying geometry, the stages that often make students difficult to learn are the visualization and spatial stages. This is because the students' spatial abilities are still low, as stated by Sugiarni et al. (2018) that the survey results prove that many students have difficulty imagining a spatial figure and therefore to complete spatial geometry exercises. As a future study, it is planned to create special interactive worksheets to develop spatial abilities. Therefore we need teaching materials that meet the learning needs of students. The teaching materials referred to in this study are Geometry teaching materials which are arranged based on Van Hiele's cognitive level which is integrated with Riau Malay culture.

According to Podayeva et al. (2019), culture is a system of values and ideas shared by a group of people in a certain environment at a certain time. Culture is defined as everything that is related to culture. In this context, cultural studies are viewed from three aspects; First, universal culture is related to universal values that apply everywhere that develop in line with

the development of social life and science and technology. Second, national culture, namely the values that apply in Indonesian society nationally. Third, the local culture that exists in the life of the local community. Furthermore Wahyuni, et al. (2013) stated that education and culture have a very important role in fostering and developing the noble values of our nation which have an impact on character building based on cultural values.

Mathematics learning integrated with local culture will be easier for students to understand because it is closer to the environment or student life. Thus students will prefer learning delivered by lecturers. This is where we need a medium that connects local culture with mathematics learning which we know as ethnomathematics. With ethnomathematics, learning and culture are interrelated so that learning is created that is close to student life and easy to understand (Risnawati et al., 2019). However, the difficulty of some educators is integrating Malay culture with learning media (Rezeki et al., 2020). One example of an element of Malay culture that can be integrated into mathematics learning is the variety of *siak* weaving Malay decorations in which there are flat motifs or patterns. The shape of the motif can be increased in learning Geometry on Flat Shape material. Thus, lecturers as teachers can introduce Malay culture and make learning easier for students to understand. Malay culture development can be done by bringing up positive attitudes towards community culture. Thus, this paper aims to develop an integrated instrument in a module developed by uniting Malay culture with reference to the Van Hiele level.

## RESEARCH METHOD

The type of the research carried out is research and development (R&D). According to Carson (2015), development research is a process used to develop and validate educational products. The product that is expected in this development research is an instrument that can improve geometric skills based on Van Hiele's level which is integrated with Malay culture. Development steps, namely; (1) Potential and Problems, (2) Collection of Materials/Sources, (3) Product Design, (4) Product Validity, (5) Product Testing, (6) Product Revision, (7) Mass Products. The subjects of the instrument trial were students of the Mathematics Education Study Program, Teaching and Education Faculty, Universitas Islam Riau. The data analysis used in this study is the Aiken and Cronbach Alpha validity and descriptive statistics.

## FINDINGS AND DISCUSSION

### Potential Problems

Basically, researchers carry out this development to produce an instrument that can help or facilitate students' needs in achieving learning goals and integrate them with Riau culture. The instrument was developed with the aim that students are able to think critically based on the cognitive level suggested by Van Hiele so that with these abilities students are accustomed to hone higher-order thinking skills, students can solve difficult questions, students can compete to get good jobs and able to answer global challenges.

Based on observations made by researchers on December 2, 2018, semester 1 students obtained information that the teaching materials used were teaching materials that were not the design of the lecturers used in the learning process so that in a certain chapter students still had difficulty understanding. Ingredient. In addition, the teaching materials used have never been taught based on Van Hiele's cognitive level. Lecture materials have never been linked to local culture. In addition, researchers also interviewed lecturers in geometry courses and asked about the effectiveness of learning that had been done so far. The lecturer stated that students had difficulty in understanding Geometry material due to the absence of effective teaching materials and the lack of Geometry learning media that could be used in classroom learning.

## Source or Material Collection

Based on the problems found, a solution is needed to solve these problems by developing a Van Hiele Cognitive Level-Based Geometry instrument that is integrated with Malay Culture. Therefore, researchers collect relevant materials or sources to develop these instruments. The materials or sources that researchers use in developing instruments are based on journals, books, and several other related sources.

## Product Design

In this process, the product is designed as efficiently as possible. Products are designed according to Van Hiele's Cognitive Level and integrated with the Riau Malay culture, Tenun. The product developed is an instrument in the form of a test description. The lattice of the instrument in this development research can be seen in Table 1.

Table 1. The Lattice of the Instrument

Basic Competencies	Indicator	Items
Students can find the angular size of the triangle	Students can determine the properties of the triangle by observing, measuring, experimenting, drawing, and making a triangle model.	1, 2, 3, 4
	Students can already know the relationship between triangles that are one and the other and do the sorting of the building.	5, 6, 7
	Students can compile evidence based on the triangle theorem, not only accepting understandable evidence but understanding the importance of the roles of undefined elements, in addition to defined elements.	8, 9, 10
Students can prove the nature of the parallelogram quadrilateral that arises because of the definition	Students are able to know the relationship between a parallelogram and other rectangles based on the shape of the building and the quadrilateral theorem.	1, 2, 3, 4
	Students can compile evidence based on the theorem Parallelograms by understanding the importance of the role of the defined quadrilateral elements.	5, 6, 7, 8
	Students have begun to realize how important the accuracy of the basic principles of the parallelogram data construct is the basis of proof.	9, 10, 11, 12
Students can prove the nature of the quadrilateral (Rhombus) that arises because of the definition	Students can already know the relationship between the Rhombic quadrilateral and other rectangles based on the shape of the building and the quadrilateral theorem.	1, 2, 3, 4
	Students can compile evidence based on the Quadrilateral theorem Ketupat by understanding the importance of the role of the defined quadrilateral elements n.	5, 6, 7, 8
	Students have begun to realize the importance of the accuracy of the basic principles of quadrilateral shapes that underlie a proof.	9, 10, 11, 12

## Product Validation

After the product is developed, the product is validated by experts for get information to what extent the product being developed is valid and reliable. Validation is carried out on the test instrument. The results of the expert validation of the Student Test Instruments are as follows.

### *Validity and Reliability*

The essay instrument was analyzed using Aiken's validity and inter-rater reliability in order to obtain information on whether the instrument that is developed was in the valid or reliable category. The results of the validity and reliability can be seen in Table 2, Table 3, and

Table 4. The instrument in the form of an essay which was analyzed using Aiken's validity and Inter-rater Reliability was carried out to obtain information on whether the instrument developed was in the valid or reliable category. There are three instruments developed in order to obtain information on whether students can understand the instruments that are developed based on Van Hiele's cognitive level which is integrated with Riau Malay Culture, namely weaving.

Table 2. Validity and Reliability Result for the First Meeting

Item	$\Sigma$	Aiken Index	Category	Inter-rater Reliability
<b>SWS I</b>				
1	9	1.00	High	0.721
2	9	1.00	High	
3	9	1.00	High	
4	8	0.89	High	
5	8	0.89	High	
6	9	1.00	High	
7	6	0.67	Middle	
8	8	0.89	High	
9	7	0.78	Middle	
10	6	0.67	Middle	

Based on Table 2, it can be concluded that there are seven items in the high category and three items in the medium category. In this case, the expert gives an assessment of the instrument with good and very good categories as many as ten items. Therefore, according to the expert, the instrument is declared valid or can be used to obtain relevant information about the research objectives. From the inter-rater reliability results, a reliability index of 0.721 is obtained so that the instrument that is developed has a good reliability index.

Table 3. Validity and Reliability Result for the Second Meeting

Item	$\Sigma$	Aiken Index	Category	Inter-rater Reliability
<b>SWS II</b>				
1	6	0.67	Middle	0.714
2	8	0.89	High	
3	9	1	High	
4	8	0.89	High	
5	7	0.78	Middle	
6	7	0.78	Middle	
7	7	0.78	Middle	
8	9	1	High	
9	9	1	High	
10	7	0.78	Middle	
11	9	1	High	
12	6	0.67	Middle	
13	9	1	High	
14	6	0.67	Middle	

Based on Table 3, it can be concluded that there are seven items included in the high category and seven items in the medium category. In the case of SWS II, the expert gave an assessment of the instruments with good and very good categories of fourteen items, so that according to the expert, the instrument was stated in the valid category or could be used to obtain relevant information about the research objectives. From the inter-rater reliability results, a reliability index of 0.714 is obtained so that the instrument developed has a good reliability index.

Table 4. Validity and Reliability Result for the Third Meeting

Item	$\Sigma$	Aiken Index	Category	Inter-rater Reliability
<b>SWS III</b>				
1	6	0.67	Middle	
2	7	0.78	Middle	
3	6	0.67	Middle	
4	7	0.78	Middle	
5	9	1:00	High	
6	7	0.78	Middle	0.78
7	9	1:00	High	
8	6	0.67	Middle	
9	8	0.89	High	
10	8	0.89	High	
11	9	1.00	High	

Based on Table 4, it can be concluded that there are five items in the high category and six items in the medium category. The expert gives an assessment of the instruments with good and excellent categories as many as eleven items so that according to the expert the instrument is stated in the valid category or can be used to obtain relevant information about the research objectives. From the inter-rater reliability results, a reliability index of 0.78 is obtained so that the instrument developed has a good reliability index.

## Product Trial

### *Wide Scale Trial*

During the product trial, the lecture process ran smoothly. This can be seen from the enthusiasm of the students in answering the developed instruments. The increase in students' geometry skills based on the Van Heile level can be seen in Figure 1. From Figure 1, it can be concluded that there is an increase in students' ability to work on essay instruments. From this increase, it can be concluded that there is a tendency for a good increase due to the instruments that have been developed.

The research was conducted online on semester 1 students of the Mathematics Education Study Program at the Islamic University of Riau. In this research, the product being tested is in the form of a geometry course instrument based on Van Hiele's cognitive level which is integrated with Malay Malay culture. Lectures are conducted online smoothly although there is a slight network disruption. Students answer the instruments that have been developed solemnly even though there is network disruption among students in the village.

The test instrument is in the form of an essay which is also developed in the valid and reliable category. The Aiken index of each test instrument at the first, second, and third meetings were in the medium and high categories with an index of 0.67 - 1.00. The reliability index of the essay instrument being developed was also greater than 0.7. An instrument reliability index greater than 0.7 can be used to collect relevant information in the field according to the research objectives designed by the researcher (Mardapi, 2008; Andrian et al., 2018, Andrian, 2019, Retnawati, 2015). Valid and reliable instruments can make all the information needed easy to obtain and it is easier to find out the weaknesses of a product, such as curriculum, learning media, and other educational products (Andrian et al., 2018). Accurate and reliable information will provides an accurate statistical analysis so that the conclusions from the hypothesis can be used to make policy (Andrian, 2019). Educational product development carried out carefully with proper procedures can provide an accurate description of an ongoing educational condition (Hadi et al., 2019).

The instrument developed can improve students' geometric skills based on Van Hiele's level. These results indicate an instrument that has been validated by experts to improve cer-

tain capabilities is effective. The same research was conducted by Risnawati et al. (2019) on junior high school students in Pekanbaru. The instrument developed by Risnawati et al. (2019) was able to improve Van Hiele's thinking level skills and students' knowledge of the local culture, namely Riau.

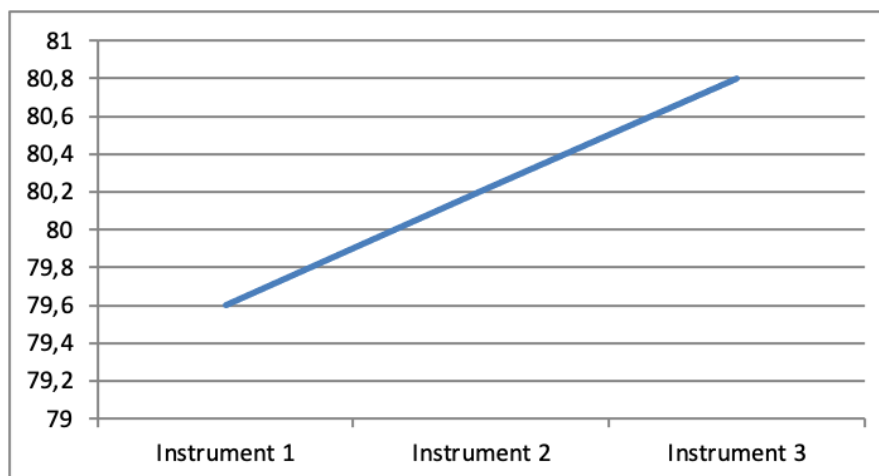


Figure 1. The increase of the Usage of Instruments 1 to 3

## CONCLUSION

From the research findings, it is concluded that the instrument developed is included in the valid and reliable categories. Instruments in the form of valid and reliable test descriptions can be used to obtain relevant and improve geometric skills based on the Van Hiele Level which is integrated with Malay Culture.

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