p-ISSN: 2477-3328
e-ISSN: 2615-1588
International Summit on Science Technology and Humanity (ISETH 2018)
*Integrating Knowledge for Future Sustainable Development*

# Design Development Work Sheet Transformation Geometry Based on Van Hiele Geogebra Assisted to Improve The Understanding of The Student Concept

Dewi Susanti,[1] Master of Mathematics Education, Ahmad Dahlan University, Indonesia
Suparman, Masters in Mathematics Education, Ahmad Dahlan University, Indonesia

**Abstract** : *Understanding concepts is an important element in learning mathematics since the first until now the 21st century all-student math scores low in terms of five aspects of mathematical ability is the ability of mathematical problem solving, mathematical communication, mathematical reasoning, understanding of mathematical concepts and connections. Students who has no understanding of the concept will be difficulties in taking the matter further, it is difficult to apply the concept in everyday life and not be able to develop the potential within themselves. This research has two objectives. First, this study is to analyze the needs of student worksheets on transformation geometry courses that need to be developed. Second, this study was designed to design student worksheets based on Van Hiele geometry transformation GeoGebra assisted which can improve understanding of concepts. This research is a model using a 4D model consists of four phases: define, design, develope, and dessiminate. The subjects of this study were lecturers and students of mathematics education. The collection instrument uses the validation , questionnaire and test sheets. Validation sheets are given to experts to get criticisms and suggestions related to worksheets. Questionnaires given to professors and great students to obtain comments and suggestions related to the response to the worksheet. Concept understanding tests are given to students to find out the effectiveness of worksheets. Data analyzed is using descriptive analysis. This study provides the results of the need for the development of technology-assisted student worksheets in the 21st century. This study concludes that the development of Van Hiele-based transformation geometry worksheets assisted by GeoGebra to improve students' understanding of concepts needs to be developed.*

***Keywords*** : *Development of worksheets , concept understanding , Van Hiele, GeoGebra, transformation geometry*

## INTRODUCTION

In the Qur'an many verses encourage us to think, use reason, and understand something. The word sense comes in Arabic, al-'aql. Word al-'aql is the word mashdar ‹ aqola - ya'qilu -' aqlan means «understand (know / understand) and think (weigh)». One of the verses related to reason is QS. Al-Baqarah: 164. "Verily in the creation of the heavens and the earth, the change of night and day, the ships that sail in the sea with (charge) which are beneficial to man, what Allah sends down from the heavens in the form of water, then he revives the earth after death ( dry), and He spreads in it various kinds of animals, and the range of winds and clouds that are controlled between heaven and earth, (all of that) really, are signs (of God's greatness) for people who understand. " From ‹Atha ‹ra said, that when it came down to the Prophet Muhammad □ in Quran. 2: 163 in Medina, the unbelievers of Qurais Makkah said, "How could a God be able to provide for all mankind?" Then this verse came down (Quran Tajwid Maghfirah: 25). The verse conveyed the importance of understanding, understanding a lesson related to the greatness of God that is close to daily life and the importance of understanding the knowledge learned.

Understanding concepts is an important element in learning mathematics. This is in accordance with NCTM (2000), namely the low mathematics scores of students in terms of five aspects of mathematical ability, namely the ability of mathematical problem solving, mathematical communication, mathematical reasoning, understanding concepts and mathematical connections. Learning mathematics with a deep and meaningful understanding will bring students to feel the benefits of mathematics in everyday life (Agustina, 2016). According to Puspitasari's (2016) research results, geometry teaching materials developed with

1 Dewi Susanti, Master of Mathematics Education, University of Ahmad Dahlan, Indonesia. Email: geometri379@gmail.com

p-ISSN: 2477-3328
e-ISSN: 2615-1588

Van Hiele's learning theory approach are effective to improve understanding of geometrical concepts. In line with other studies, Ariawan (2014) GeoGebra assisted worksheets on geometry material effectively improve students' critical thinking skills. Then according to Prasetyo, et al (2018) states that the use of concept-based student worksheets in lectures on Vector Analysis is very useful. According to Pederson in Ariawan (2014) states that geometry is a skill that involves the eyes, hands and mind, there are more visual and dynamic aspects of geometry compared to other fields. The above opinion gives a signal that in geometry learning requires a medium that is able to provide visual and dynamic facilities well. The right media to answer this problem is technology-based media without leaving the manual process that is the basis for understanding the concept.

Many educational supporting media, one of them is geometry software. There are several software that can be accessed including GeoGebra, GeoNext, Archimedes Geo3D, Geometria, Sketchpad, Cabri Geometry and others. GeoGebra is one of the most innovative technologies (Andraphanova; 2015, Dikovic; 2009), a dynamic geometry learning aimed at visualizing concepts (Syahputra & Fauzi; 2017, Andraphanova; 2015, Chun-Yen & Kaushal; 2015, Noorbaizura & Eu Leog; 2013 Adulyasas & Rahman; 2013). GeoGebra can be used from elementary to university (Horenwarter in Noorbaizura & Eu Leog; 2013, Zaleha & Rahman; 2017). GeoGebra plays an important role for the development of e-learning in the future, many studies have found that GeoGebra is an effective tool for learning and teaching geometry (Noorbaizura & Eu Leog; 2013, Chun-Yen & Kaushal; 2015; Nguyen & Phoung Le; 2015, Kutluca; 2013) GeoGebra can be obtained freely and free on www.GeoGebra.org so that people and students can use this GeoGebra software to maximize learning. According to Hohenwarter & Fuchs (2004), GeoGebra is very useful as a media for learning mathematics with various activities as follows.

a. As a media demonstration and visualization In this case, in traditional learning, teachers use GeoGebra to demonstrate and visualize certain mathematical concepts.
b. As a construction aid In this case GeoGebra is used to visualize the construction of certain mathematical concepts, for example constructing an inner circle or an outer circle of a triangle, or tangents.
c. As an aid to the discovery process In this case GeoGebra is used as a tool for students to find a mathematical concept, such as the position of points or characteristics of parabolic graphics.

The following is the main view of GeoGebra software version 6.0.503.0 which will be used in this study.

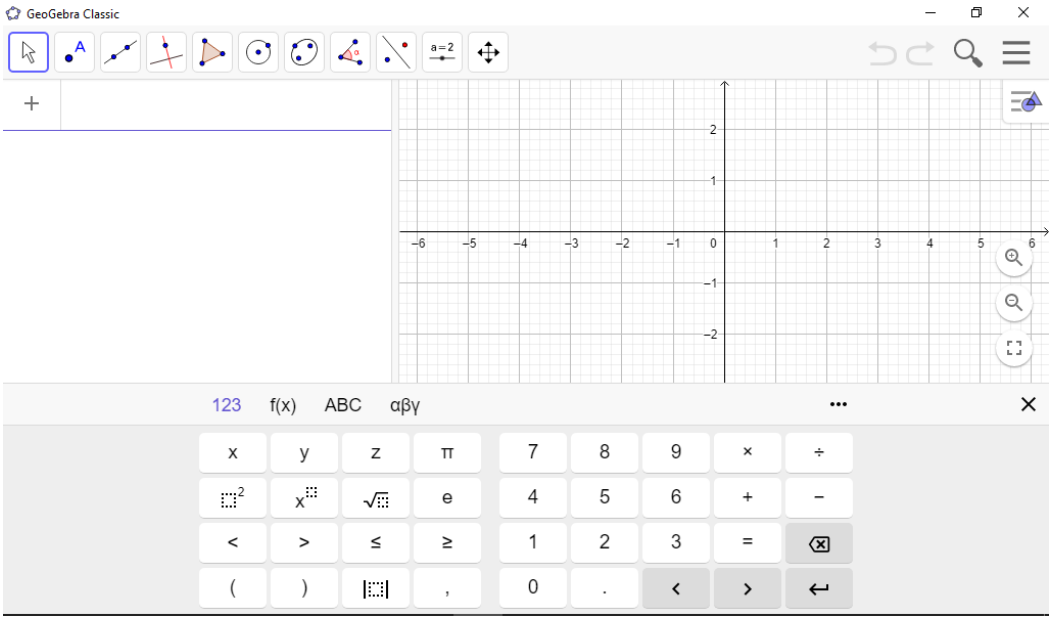



Figure 1. GeoGebra main view

Based on the class survey in mathematics education in the geometry subject, a presentation was presented using the GeoGebra demo on the triangular material giving a very good response. Students with detailed stages of presenting GeoGebra assisted material using LCDs so that they reach the audience in the classroom. This method is quite effective for learning geometry that is identical to the building and complex building elements. In line with the results of Asngari's research (2015) said that the GeoGebra program can be used as a mathematics learning medium to demonstrate or visualize mathematical concepts and as a tool to construct mathematical concepts. So far the research on media needs in media colleges is still limited compared to elementary school to high school. Therefore, from the description above, it is necessary to have a media in the form of worksheets as a learning source that is integrated with GeoGebra software that needs to be applied in transformational geometry courses in mathematics education students. This research is expected to help in understanding the concept of transformation geomatics with manual and technological approaches.

## RESEARCH METHODS

The research design used in this study was the design of a 4-D (Four D Models) development model according to Thiagarajani. It includes four phases: define, design, development and dissemination. The research will be carried out on the mathematics learning odd semester of 2018/2019 academic year. The researchstage is shown in Figure 2 as follows:

p-ISSN: 2477-3328
e-ISSN: 2615-1588

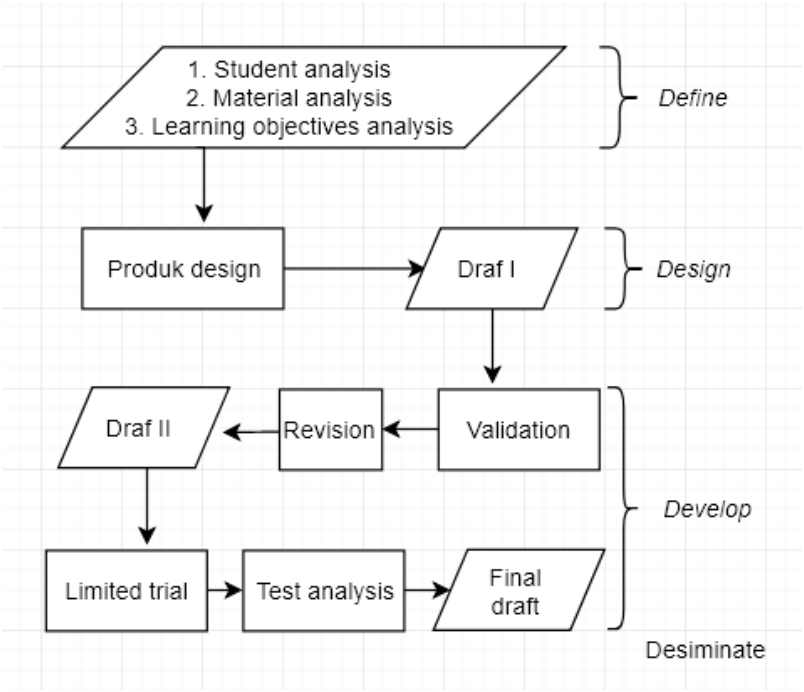



Figure 2. Design research development model 4-D addapted by Thiagarajan; 1974

The limited class trial subjects were 5-10 students of mathematics education study program who took geometry transformation courses at Ahmad Dahlan University in 2018/2019 academic year. Data collection instruments by meeting expert material experts, the media to validate the worksheets that will be created. In addition, instruments in the form of questionnaires response lecturers and students related worksheets to explore their opinions on the worksheets developed. Then the students' concept understanding test is used to see the potential effects of worksheets that have been made on concept understanding, carried out by giving questions and working individually. The data have been obtained through a questionnaire from experts and all-out students will be converted into a qualitative value of the cumulative value Likert scale. Furthermore, hypothesis testing is carried out using post-test data which is to see whether or not the worksheet developed is effective, namely the concept understanding test, then draw conclusions.

## RESULTS AND DISCUSSION

The development of this worksheet uses research methods 4D (Four D). This model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. The 4D development model consists of 4 stages: Define , Design , Develop and Disseminate. This model was chosen because it aims to produce products in the form of GeoGebra-assisted transformation geometry worksheets.

First, the defining stage is useful for determining and defining needs in the learning process and gathering various information related to the product to be developed. In this stage is divided into several steps, namely student analysis, material analysis and analysis of learning needs. Student analysis includes academic characteristics or analysis of student needs related to courses. In this study, the author refers to previous research, namely the importance of understanding concepts in learning and the results of surveillance. Material analysis aims to identify what material needs to be done research, identify methods and or supporting media

in accordance with the research, and when the material was studied in lectures based on the semester learning design of mathematics education. Analysis of learning objectives is carried out to determine indicators of learning achievement. The following is a relationship table of Van Hiele's thinking stage with an understanding of concept indicators that will be applied to learning in the development of worksheets that will guide the next stage.

Table 1. Relationship between Van Hiele's thinking stage and concept understanding indicators

| Stage Thinking | Concept Understanding Indicator |
|---|---|
| Visualization | |
| Analysis | Re-state a concept<br>Classify objects according to certain properties according to the concept<br>Give examples and not examples of a concept |
| Informal deduction | Presenting concepts in various forms of mathematical presentations |
| Deduction | Developing necessary conditions and sufficient requirements from a concept |
| Rigor | Use and utilize and choose certain procedures or operations<br>Applying concepts or algorithms to problem solving |

Second, the design stage. This design phase aims to design worksheets that can be used in transformation geometry courses. This design phase includes media selection, format selection, and initial design. The selection of media selected in this study is in the form of modules as initial material and transformation geometry worksheets that are integrated with GeoGebra. The modules that will be adopted from Stillwell (2000; 58) are as follows.

**Translasi**

Sebuah translasi memindahkan setiap titik pada bidang dengan jarak dan arah yang sama. Setiap translasi tergantung pada dua konstanta yaitu $a$ dan $b$. Sehingga kita dapat menotasikannya dengan $t_{a,b}$. Translasi tersebut mengirimkan setiap titik $(x, y)$ ke titik $(x + a, y + b)$, sehingga jelas bahwa translasi mempertahankan jarak antara dua titik, tetapi layak dicek secara formal sehingga mengetahui apa yang harus dalam kasus – kasus yang kurang jelas.

Untuk $P_1 = (x_1, y_1)$ dan $P_2 = (x_2, y_2)$. Jarak kedua titik adalah

$|P_1P_2| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ .

Untuk $t_{a,b}(P_1) = (x_1 + a, y_1 + b), t_{a,b}(P_2) = (x_2 + a, y_2 + b)$, Jarak kedua titik adalah

$$\left|t_{a,b}(P_1)t_{a,b}(P_2)\right| = \sqrt{(x_2 + a - x_1 - a)^2 + (y_2 + b - y_1 - b)^2}$$
$$= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$
$$= |P_1P_2| \text{ , Terbukti jarak ketua titik sama.}$$

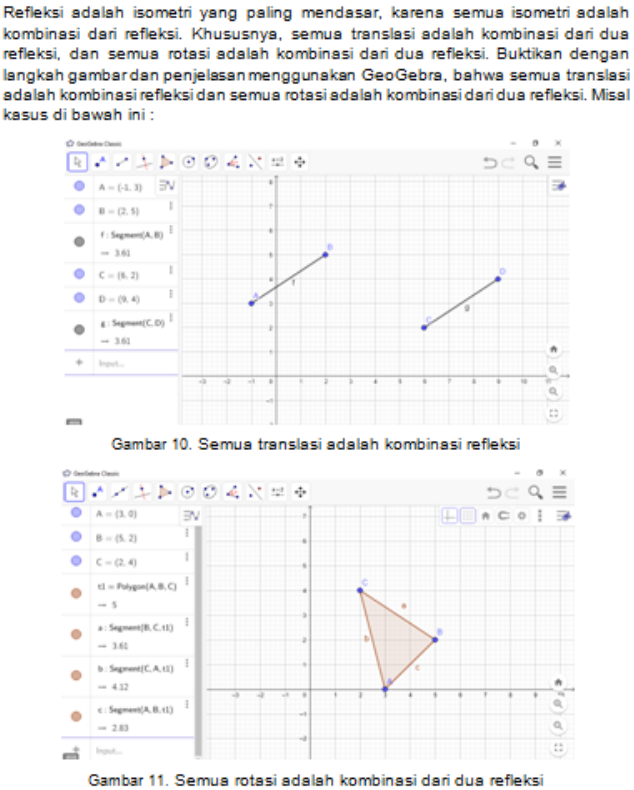
Figure 3. Translation material in the module

Modules as material and stimulus before students use worksheets that are presented in a simple format such as lecture books. The test on the module contains transformation geometry concepts that need to be understood as the initial capital of students. Then proceed with the design of worksheets, starting from a simple but still attractive cover. Cover and content on worksheets are intentionally designed simply so that students tend to be light in learning.

p-ISSN: 2477-3328
e-ISSN: 2615-1588


Figure 4. Worksheet cover design

The choice of format in development is meant by designing learning content, selecting learning methods, and learning resources, organizing and designing the contents of worksheets, creating worksheet designs. which includes layout, drawing, writing and integration design with GeoGebra.


Refleksi adalah isometri yang paling mendasar, karena semua isometri adalah kombinasi dari refleksi. Khususnya, semua translasi adalah kombinasi dari dua refleksi, dan semua rotasi adalah kombinasi dari dua refleksi. Buktikan dengan langkah gambar dan penjelasan menggunakan GeoGebra, bahwa semua translasi adalah kombinasi refleksi dan semua rotasi adalah kombinasi dari dua refleksi. Misal kasus di bawah ini :

Gambar 10. Semua translasi adalah kombinasi refleksi

Gambar 11. Semua rotasi adalah kombinasi dari dua refleksi

Figure 5. Content content on worksheets

The initial design is the worksheet design that has been made by the researcher and then given input by the supervisor, the input from the supervisor will be used to improve the worksheet before production. Then make a revision, which then will be validated by material experts and media experts. This design is in the form of a draft I worksheet.

## CONCLUSION

The development of GeoGebra -assisted transformation geometry worksheets was developed using a 4D type development research model. The steps are in the form of Define, Design, Develop and Disseminate. Define stages that have been done are up to the stage of student analysis, material analysis and analysis of learning needs. Then the design phase has arrived at the media selection stage, the selection of the initial format and design, so that it has become a draft worksheet 1. For the next stage, develop and dessiminate to find out the potential effects of the worksheets compiled, so that they can see the achievements understanding of concepts.

This initial draft was the first draft draft which was still in the form of a prototype which would later be validated by experts. The purpose of selecting the format for developing a worksheet is to produce a transformation geometry worksheet that is suitable for use by students in the lecture process. This research can be further developed at the validation stage so that the resulting Van Hiele-based transformation geometry worksheet is assisted by GeoGebra which can improve students' understanding of concepts.

## REFERENCES

Asngari. (2015). Using Geogebra in Geometry Learning. UNY National Mathematics Education Seminar, 299-302.

Dwi Indra Puspitasari. (2016). Development of Learning Materials Based on Van Hiele Thinking Phase to Improve Understanding of Geometry Concepts. Thesis, University of Lampung.

Hohenwarter, M. & Fuchs, K. (2004). Combination Of Dynamic Geometry, Algebra, And Calculus In The Geogebra Software System.

I Putu Wisna Ariawan. (2014) Development of Geogebra-Assisted Multi-Representation Locations to Improve Students' Critical Thinking Ability. *Indonesian Education Journal* , 3 (1), 359-371.

Kaushal Kumar Bhagat & Chun-Yen Chang. (2015). Incorporating Geogebra Into Geometry Learning-A Lesson From India. *Eurasia Journal Of Mathematics, Science & Technology Education* , 11 (1), 77-86.

Lilla Adulyasas, Shafia Abdul Rahman. (2014) Lesson Study Incorporating Phase-Based Instruction Using Geometer's Sketchpad and Its Effects on Thai Students' Geometric Thinking,*IJLLS* . 3 (3), 252-271.

Lisna Agustina. (2016). Efforts to Improve the Understanding Ability of Mathematical Concepts and Problem Solving of Sipirok 4 Junior High School Students in Vii Class Through Realistic Mathematics Approach (Pmr). *Exact Volume Journal* , 1 (1), 1-12.

Ljubica Dikovic. (2009) Applications Geogebra Into Teaching Some Topics Of Mathematics At The College Level. Comsis, 6 (2), 191-203.

Natalia V. Andraphanova. (2015). Geometrical Similarity Transformations In Dynamic Geometry Environment Geogebra. *European Journal Of Contemporary Education* , 12 (2), 116-128.

p-ISSN: 2477-3328
e-ISSN: 2615-1588

NCTM. (2000). Principles And Standards For School Mathematics. United States of America: National Council of Teachers of Mathematics, Inc.

Nguyen Phu Loc, Le Trong Phuong (2015) Parabola Teaching With Dynamic Software "Geogebra": A Pedagogical Experiment In Vietnam, *International Journal Of Education And Research* . 3 (4), 427-436.

Noorbaizura Thambi, Leong Kwan Eu. (2013). Effect of Students' Achievement In Fractions Using Geogebra. *SAINSAB* , 16, 97-106.

Norscia, Ivan & Palagi, Elisabetta , (2011). *Yawn Contagion And Empathy In Homo Sapiens* . 6 (12), P1-5. 5p.

Prasetyo, PW, Setyawan, F., & Sumargiyani. (2018). The Influence of the Use of Concept-Based Student Worksheets in the Lecture of Vector Analysis, Academic Discourse, 2 (1), 1-14.

Quran Tajwid Maghfirah. (2006). Ministry of Religion, Maghfirah Library.

Tamer Kutluca. (2013). The Effect Of Geometry Instruction With Dynamic Geometry Software; Geogebra On Van Hiele Geometry Understanding Levels Of Students. *Academic Journals* , 8 (17), 1509-1518.

Thiagarajan, Sivasailam, Dkk. (1974). Instructional Development For Training Teachers Of Exceptional Children. Washington DC: National Center for Improvement Educational System.

Zaleha Ismail, Syairatul Nadiah Abd Rahman. (2017) 2-Dimensional Learning and 3-Dimensional Geometry with Geogebra: Which Would Students Do Better *?, International Journal on Emerging Mathematics Education (IJEME)* , 1 (2), 121-134.

Zulfahmi, Edi Syahputra, Kms. M. Amin Fauzi. (2017). Development Of Mathematics Learning Tools Based On Van Hiele Models To Improving Spatial Ability And Self-Concept Student's Of Mts. Ulumuddin. *American Journal Of Educational Research* , 5 (10), 1080-1086.

Hohenwarter, M. & Fuchs, K. (2004). Combination Of Dynamic Geometry, Algebra, And Calculus In The Geogebra Software System.

## ABOUT THE AUTHORS

***Dewi Susanti :*** Master of Mathematics Education Student , Masters in Mathematics Education, Ahmad Dahlan University, Indonesia

***Suparman :*** Masters in Mathematics Education, Master of Mathematics Education, Ahmad Dahlan University, Indonesia