Berajah Journal
Jurnal Pembelajaran dan Pengembangan Diri
ISSN (p): **2797-1805** | ISSN (e): **2797-1082**

ANALYSIS OF STUDENTS UNDERSTANDING OF GEOMETRY CONCEPTS THROUGH LEARNING BY GIVING SCAFFOLDING

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ABSTRACT

This study aims to determine: (1) the effect of learning by giving scaffolding on students' understanding of geometric concepts, (2) the improvement of students' understanding of geometry concepts taught through learning by giving scaffolding, (3) the advantages of learning by giving scaffolding, and (4) the disadvantages of learning by giving scaffolding. This type of research includes descriptive qualitative research using library research methods.The data in this study were obtained from a collection of literature such as theses and journalsthat are relevant to the topic of discussion, namely understanding students' geometric concepts through learning by providing scaffolding. The results show that, 1) Learning by giving scaffolding has a great effect on students' understanding of geometric concepts based on the overall effect size calculation which produces an average effect size of 0.994 where this number is included in the high category. 2) There is an increase in the students' understanding of geometric concepts that are taught through learning by giving scaffolding. This can be seen from the achievement of indicators in the experimental class in the literaturewhich is generally better than the control class. 3) Based on the analysis, it was found that theadvantages of learning by providing scaffolding are (a) Can encourage students to find the concepts independently, (b) A great motivational tool to increase students' confidence in learning geometry concepts, (c) Make students more engaged in the learning process, (d) Make students more creative to reason, (e) Potential to optimize a quality learning environment. 4) The weakness of learning by providing scaffolding is that students need to adapt to the types of scaffolding used, especially technology-based and if the teacher does notunderstand the scaffolding, students will experience difficulties and scaffolding also takes a relatively long time.

Keywords: *Library Research, Understanding of Geometry Concepts, Scaffolding*

INTRODUCTION

Geometry is one of the mathematics subjects taught in elementary schools. According to Adjie & Rostika (2006: 267), geometry is a mathematical system. Learning geometry starts from a root concept that is not clearly defined, but we believe and can be illustrated. The root of the concept is point, line, intersect, lie at, between, and congruent. A point can be described as a point on an object. Geometry describes two-dimensional (square, trapezoidal, circle, etc.) and three-dimensional (cube, cylinder, etc.) shapes. Geometry, both in the group of flat shapes and spatial forms, is an abstract concept. This means that these forms are not concrete objects that can be seen or held. Geometric shape is a property, whereas what is concrete, which is usually seen or held, and is objects that have properties such as geometric shapes. For example, rectangle, the concept of a rectangle is an abstract concept identified through a characteristic. From the description above, it can be concluded that geometry is an abstract concept that can be described with concrete objects that have the same properties as geometric shapes.

Research on teaching geometry in schools has been widely carried out. Clements and Battista (Teguh, 2002) conducted a study of students in 7th grade junior high school and declare their findings that: (1) only 64% of 52 students knew that a rectangle was a parallelogram;

(2) 50% of students do not like the question of proof; (3) students were better at solving geometric problems presented visually than verbally. Therefore, learning geometry in schools should be aimed at investigating and exploiting ideas and

relationships between geometric properties. In geometric learning, students expected to be able to visualizing, describing and comparing geometric shapes in various positions so that students can understand them.

In addition, as stated by Saragih (2002) in his research on seventh grade junior high school students, it was found that they did not have good abilities regarding the characteristics possessed by each type of triangle in students. So that students can not classify it. The classified triangles are isosceles triangles, equilateral triangles, and right triangles. Overall, students' knowledge of examples and non- examples in learning about the concept of triangles is only limited to what is taught by the teacher during learning. Students do not know that the concept of triangles can be modeled in various forms. Based on this, it is very necessary for students to pay attention to understanding the concept of triangles and other supporting skills in understanding geometric concepts such as visual, verbal and logical.

Based on the result of studies that the researcher has described, it can be concluded that students' geometric abilities are still relatively low. The low ability of geometry is made possible by the weak understanding of concepts and geometry skills of students in solving geometry problems. Another reason is that the treatment given by the teacher (models, methods, and learning approaches used by the teacher) tends to be the same for each student, even though students have different ways of learning and thinking. According to Endang (2003) good geometry teaching must be in accordance with the child's abilities. Children's abilities can be seen from the thinking process and the application of skills in solving geometric problems.

The results of the researchers' observations show that most of the learning implemented in schools is still traditional. One of the traditional learning indicators is that geometry is still taught through paper and pencil. One of the difficulties of this method is that it does not present an accurate representation of geometric objects (Sariyasa, 2017: 1). This has an impact on students' difficulties in understanding geometric concepts.

Learning difficulties experienced by students, need an appropriate assistance (scaffolding) so that they can overcometheir difficulties. According to Chairani (2015) scaffolding is prepared by the teacher and it does not meant to change thenature or level of difficulties of the assignment, but with the scaffolding provided to enable students to completethe task successfully. Scaffolding or the provision of assistance provided to students can be in the form of pictures, instructions, motivations, and warnings, outlining problems into solving steps, providing examples, and other actions that allow students to learn independently (Hasan, 2015). Scaffolding is a form of gradual assistance given by teachers to students to solve mathematical problems so that students can solve them independently. Scaffolding is closely related to the Zone of Proximal Development (ZPD). ZPD is the range between the actual developmental level and the higher potential developmental level. Students are able to reach themaximum area if assisted sufficiently. If not assisted, students remain in their actual area without being able to develop to their potential level of development.

According to Ahktar (2014: 77), the use of scaffolding has proven to be helpful in building concrete concepts in mathematics and higher order thinking skills and will be very helpful in increasing a good level of confidence in mathematics.This is supported by the existence of a significant influence between the control class and the experimental class using a learning model by providing scaffolding.

Based on the problems above, researchers are interested in studying more deeply about the learning by giving scaffolding. So the purpose of this study was to determine the effect of learning by providing scaffolding on students' understanding of geometry concepts. Its specific purpose is to find out (1) The effect

of learning by giving scaffolding on students understanding of geometric concepts; (2) The improvement of students understanding of geometry concepts taughtthrough learning by giving scaffolding; (3) The advantages of learning by giving scaffolding; (4) The disadvantages of learning by giving scaffolding.

LITERATURE REVIEW

Mathematics as a collection of systems consists of 5 parts, namely the fields of arithmetic, geometry, algebra, analysis and the basics of mathematics or logic. Each field has sub-sections called branches of mathematics. As a science, mathematics is a structured, deductive, systematic and consistent science. Mathematical objects are abstract things. Mathematics is formed as a result of human thinking related to ideas, processes and reasoning (Hamzah, 2011: 11).

One of the purposes of mathematics learning is to understand the concept. Understanding has different levels of depth of meaning. Comprehension can be defined as the ability to explain something in different words from those found in textbooks. Concepts or understandings are the main conditions needed to master discrimination skills and previous fundamental cognitive processes based on the similarity of characteristics and a set of stimuli and their objects (Trianto, 2007:158). The indicators for understanding mathematical concepts according to Heruman (Noviyana, 2017), are: 1) Restate a concept that has been studied; 2) Classify objects based on whether or not the requirements that make up the concept are met; 3) Apply the concept algorithmically; 4) Provide examples and not examples of concepts that have been studied; 5) Present concepts in various forms of mathematical representation; 6) Link various mathematical concepts; 7) Develop the necessary conditions of a concept.

Geometry is a very important component of mathematics. Geometry is a study of form and space. It allows people to understand the world by comparing shapes, objects, and the connections between them. Geometric objects can be observed in everyday life. Children can learn geometry or gain information by observing the world in the form of concrete objects. The world of geometry in general can be represented through pictures, diagrams, and graphs. The representation is a process of conceptualizing geometric ideas.

NCTM (2000: 197) notes that learning mathematics with understanding is essential so that students are able to solve problems. In this case, students are expected to be able to understand representation as a process of conceptualizing geometric ideas. Therefore, in order for students to be able to master the world of geometry, students must have an understanding of geometric concepts both abstract and concrete to get adequate geometry skills.

The scaffolding that is meant in this research is the provision of sufficient assistance to students based on the form of difficulties experienced by students. Scaffolding was first initiated by Vygotsky, a psychologist from Russia, which was further popularized by Bruner, an expert in mathematics education.

There are two important concepts in Vygotsky's theory, namely the Zone of Proximal Development (ZPD) and scaffolding. Zone of Proximal Development (ZPD) is the range between actual developmental levels which is defined as the ability to solve problems independently under adult guidance or through collaboration with more capable friends. Scaffolding is the provision of some support to students during the early stages of learning then reducing support and providing opportunities to take on greater responsibilities after they are able to do so (Cahyono, 2010: 443).

Assistance provided to students in the learning process is carried out by gradually reducing the assistance until the student is released to solve his own problems. So that students can develop their own knowledge

according to their personal development. This is done because Scaffolding means giving a large amount of help to a child during the early stages of learning then the child takes over increasingly bigger responsibilities as soon as he can do it. This assistance can be in the form of instructions, warnings, encouragement, describing the problem into solving steps, giving examples, or others so that it allows students to grow independently (Trianto, 2013: 76).

METHOD

Researcher uses library research as research method. Library research is activities related to the methods of collecting, reading and taking notes and processing research materials. It is research that uses and utilizes resources to obtain research data (Zed, 2004). Library research is research that conducts a criticaland in-depth study of relevant library materials as the basis for solving a problem. In this type of research, knowledge, ideas, or findings contained in the literature are examined so as to provide theoretical and scientific information related to the effect of learning by giving scaffolding on students' understanding of geometric concepts. The research methods used include data sources, data collection, and data analysis.

The steps for analyzing the analysisin this literature review are starting with searching for data by inputting search keywords on the Google Scholar platform, grouping based on research questions, observing the information, analyzing data from the overall data, then based on the scaffolding used, describing the results of the analysis, and then draw conclusions. This is based on the research model according to (Sugiyono, 2017) which ispresented in the following figure.

In this study used data analysis techniques by Miles and Huberman (Sugiyono, 2017) describes the process of analyzing qualitative research data which consists of three stages that occur at the same time, namely data reduction, data presentation, and conclusion drawing/verification. Data reduction activities, data presentation, and drawing conclusions are a series of analyticalactivities that follow each other or are interactive cycle processes. Meanwhile, to find the magnitude of the effect of learning by providing scaffolding on students' understanding of geometry concepts, an effect size is used. Effect size is a measure of the magnitude of an influence exerted by a variable on another variable, the magnitude of the difference or relationship, which is independent of the influence of sample size. (Olejnik & Algina, 2003). The related variables areusually the dependent variable and the independent variable. It can also be considered as a measure of the meaningfulness of research results at a practical level (Huck, 2008). To calculate the effect size value, the equation used:

1. Mean and standard deviation of pretest-posttest
$$ES = \frac{\bar{x}_{post} - \bar{x}_{pre}}{SD_{pre}}$$
2. Mean and standard deviation of two group posttest only
$$ES = \frac{\bar{x}_E - \bar{x}_C}{SD_C}$$
3. Mean and standard deviation of two group pre-post test
$$ES = \frac{\left(\bar{x}_{post} - \bar{x}_{pre}\right)_E - \left(\bar{x}_{post} - \bar{x}_{pre}\right)_C}{\frac{SD_{preC} + SD_{preE} + SD_{postC}}{3}}$$
4. If the standard deviation is not known then it can be done by t-test
$$ES = t \cdot \sqrt{\frac{1}{N_E} + \frac{1}{N_C}}$$
5. If the standard deviation is not known then it can be done with the F test
$$ES = F \cdot \sqrt{\frac{1}{n}}$$

The results of the effect size calculation are interpreted using the classification suggested by Cohen's and expanded by Sawilowsky (2009), namely:

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Table 1. Classification of Effect Size

Effect Size	Category
$0.01 \leq ES \leq 0.20$	Very Low
$0.20 < ES \leq 0.50$	Low
$0.50 < ES \leq 0.80$	Medium
$0.80 < ES \leq 1.20$	High
$1.20 < ES$	Very High

RESULT AND DISCUSSION

1. Description of Learning by Giving Scaffolding

The following are the results of research on Learning by giving Scaffolding, which researchers will start to collect data before analyzing the data. Therefore, the steps needed incollecting data according to research procedures are; first the researcher willcollect data related to learning by giving scaffolding. Then reduce the data in order to obtain the main things or important things related to the research; second researchers will present the data so that the data presented will be in the form of a description based on the aspects studied according to the formulation of the research problem; third step is that the researcher will calculate and find the overall mean of effect size to answer the formulation of problem one and make conclusions based on the data presentation that has been described to answer the formulation of problems two, three and four.

The results of the study along with the main description of the data related to Learning by giving Scaffolding are as follows:

Table 2. Research Results Analysis of Learning by Giving Scaffolding

Code	Researcher Name and Year	Title	Scaffolding used	Results of Analysis
1	Irma Rachmawati and Alan Purnama, 2019	*Penggunaan Teknik Scaffolding Pada Pembelajaran Matematika Untuk Meningkatkan Kemampuan Pemahaman Matematik Pada Siswa SMP*	LKS	(1) By giving scaffolding there is a positive effect on students' understanding of geometry concepts. Thisis in accordance with research (Jelatu *et al.*, 2018) which states that there is a positive effect of assisted learning GeoGebra software in improving understanding of students' mathematical concepts in particular geometry as well as to increase morale on student learning. (2) There is an improvement in geometry learning outcomes through learning by giving scaffolding, this is in accordance with research
2	Fakhriatul Masnia, Zubaidah Amir, MZ, 2019	*Pengaruh Penerapan Model Scaffolding terhadap Kemampuan Pemahaman Konsep Matematis Berdasarkan Self Efficacy Siswa SMP*	-	
3	Praveen SHADAAN and LEONG Kwan Eu, 2013	Effectiveness of Using Geogebra on Students' Understanding in Learning Circles	GeoGebra Software	
4	Silfanus Jelatu, Sariyasa & I Made Ardana, 2018	Effect of GeoGebra-Aided REACT Strategy on Understanding of Geometry Concepts	GeoGebra with aided-REACT Strategy	

5	Novita Sari and Edy Surya, 2017	*Efektivitas Penggunaan Teknik Scaffolding dalam Meningkatkan Hasil Belajar Matematika pada Siswa SMP Swasta Al-Washliyah Medan*	five steps in learning with scaffolding techniques by Applebee and Langer	(Sari & Surya, 2017) which states that there is an increase in student learning outcomes from Cycle I and Cycle II after learning using scaffolding techniques is applied.
6	Hani Noviyantia, Angela Dewi Ika Christanti, Rosaria Crisma Serinac,2020	*Efektivitas Pembelajaran Visual scaffolding Berbasis GeoGebra untuk Membantu Siswa dalam Menemukan Konsep Fungsi Kuadrat dan Sifat-Sifatnya*	GeoGebra Software	(3) The role of scaffolding in influencing students' understanding of geometric concepts can be described using scaffolding's type Level 2: explaining (showing and telling), reviewing (looking, touching and verbalizing; parallel modeling; probing and prompting questions; students explaining and justifying) and Level 3: developing conceptual thinking (making connection), this is in accordance with research
7	Silfanus Jelatu, Sariyasa & I Made Ardana, 2018	*Pengaruh Penggunaan Media Geogebra terhadap Pemahaman Konsep Geometri ditinjau dari Kemampuan Spasial Siswa*	Geogebra Software	
8	Widya Rizky Fadhilla, Muh Fajar Safaatullah& Walida, 2019	*Kemampuan Koneksi Matematis dan Kemampuan Berpikir Geometri melalui Modifikasi*	LKPD	

2. Descriptionof Students Understanding of Geometry Concepts

The following are the results of research on students' understanding of geometriy concepts, which researchers will start to collect data before analyzing the data. Therefore, the stepsneeded in collecting data according to research procedures are; first the researcher will collect data related to the ability to understand geometric concepts. Then reduce the data in orderto obtain the main or important things related to the research. Second, the researcher will present the data so that the data presented will be in the form of a description based on the aspects studied according to the formulation ofthe research problem. The third step is the researcher will make conclusions based on the data presentation that has been described.

The results of the study along with the main description of the data related to students' understanding ofgeometry concepts are as follows:

Table 3. Research Results Analysis of Students Understanding of Geometry

No.	Researcher Name and Year	Title	Result of Analysis
1	Fakhriatul Masnia, Zubaidah Amir, MZ, 2019	*Pengaruh Penerapan Model Scaffolding terhadap Kemampuan Pemahaman Konsep Matematis Berdasarkan Self*	(1) Students' understanding of geometry concepts through learning by giving scaffolding is better than conventional learning models. This is in accordance with research (Jelatu *et al*., 2018) which states that Students' understanding of geometric concepts taught through GeoGebra

		Efficacy Siswa SMP	media-assisted learning is better than students' understanding of mathematical concepts taught using conventional learning. (2) There is an improvement in geometry learning outcomes through learning by giving scaffolding, this is in accordance with research (Sari & Surya, 2017) which states that there is an increase in student learning outcomes from Cycle I and Cycle II after learning using scaffolding techniques, which are intentionality, appropriateness, structure, collaboration, and internalization is applied. (3) The indicators used in the research conducted using indicators by Heruman, namely restating a concept, providing examples or counter-examples of the concepts that have been studied, classifying objects based on mathematical concepts, presenting concepts in various representations, applying concepts algorithmically. (4) There is 1 journal, J2 which sees an increase in students' understanding of geometry concepts in terms of indicators. From these journals, the indicator that students mastered the most was providing examples or counter-examples of the concepts that had been studied, while the lowest was applying the concepts in an algorithmic way.
2	Silfanus Jelatu, Sariyasa & I Made Ardana, 2018	Effect of GeoGebra-Aided REACT Strategy on Understanding of Geometry Concepts	
3	Novita Sari and Edy Surya, 2017	*Efektivitas Penggunaan Teknik Scaffolding dalam Meningkatkan Hasil Belajar Matematika pada Siswa SMP Swasta Al-Washliyah Medan*	
4	Silfanus Jelatu, Sariyasa & I Made Ardana, 2018	*Pengaruh Penggunaan Media Geogebra terhadap Pemahaman Konsep Geometri ditinjau dari Kemampuan Spasia Siswa*	
5	Ari Annisa Rakhim, Kartono, Supriyadi , 2020	Concept Understanding Skill of 8th Grade Junior High School Students in Missouri Mathematics Project Learning Based Curiosity With Scaffolding	

3. The Effect of Learning by Giving Scaffolding on Students Understanding of Geometry Concepts Based on Effect Size

To find out the size of the meaningfulness of the results of thisstudy, the researchers conducted an analysis of the sources of the journal. The journals that can be analyzed to determine the effect size of this study are journals that contain learning variables with scaffolding and students' ability to understand geometric concepts, F-test results, average results, standard deviations, and number of samples, both from the experimental class and the controlclass. The number of journals that meet these requirements to calculate the effect size is 4 journals. In this study, the authors calculated the effect size manually. The following is the calculation of the effect size of the 4 journals.

Table 4. The Effect Size Result

No.	Journal Code	Effect Size	Criteria
1	J3	1.665	Very High
2	J7	0.718	Medium
3	J8	0.688	Medium
4	J9	0.904	High
Mean of effect size		0.994	High

Based on the calculation ofeffect size, learning by giving scaffolding has a positive influence on students' ability to understand geometry concepts by calculating the average effect size value of 0.994 which if interpreted into Cohen's classification then the results are in the high category.

Tabel 5. Effect Size Distribution by Scaffolding Type

No.	Type of Scaffolding	Effect Size	Criteria
1	Software Geogebra	1.192	High
2	LKPD	0.688	Medium
3	Teaching Technique	0.904	High

4. The Improvement of GeometryLearning Outcomes Based on N- Gain Values

Based on the 5 journals that researchers analyzed aboutunderstanding the concept of geometry through learning by providing scaffolding, there was only 1 journal that presented the N-Gain value. The increase in the N-Gain value on J6 wasreviewed based on the test results on the Cube and Block material which was divided into two cycles, namely cycle I and cycle II. The improvement of student geometry learning outcomesbased on the N-Gain value in the journal is presented in the following table.

Table 6. The Improvement of Geometry Learning Outcomes Based on N-Gain Values

No	Journal Code	Journal Title	N-Gain Index		Criteria	
			Cycle I	Cycle II	Cycle I	Cycle II
1	J5	*Efektivitas Penggunaan Teknik Scaffolding dalam Meningkatkan Hasil Belajar Matematika pada Siswa SMP Swasta Al-Washliyah Medan*	0.4	0.7	Medium	High

5. The Improvement of Students Understanding of Geometry Concepts Based on Indicators

Based on the data sources, there is 1 journal that sees an increase in the ability to understand concepts in terms of indicators, namely journal J2, while other journals discuss increasing the ability to understand mathematical concepts as a whole without explainingthe increase in each indicator used. In J2, a concept understanding ability test was carried out at the end of the Cube and Block material meeting which resulted in student scores that would be reviewed from each indicator and the level of Self Efficacy (high, medium, or low).

Table 7. Description of Conceptual Understanding in Self Efficacy

No	Indicator of Conceptual Understanding	Self Efficacy					
		Experiment Class			Control Class		
		H	M	L	H	M	L
1	Restate the concept	Well	Well	Well	Enaugh	Enaugh	Less
2	Classify objects based on mathematical concepts	Enaugh	Well	Well	Enaugh	Less	Less
3	Apply the concept algorithmically	Well	Well	Well	Enaugh	Enaugh	Enaugh
4	Give examples or counter examples of the concepts that have been studied	Well	Well	Well	Well	Enaugh	Less

5	Present the concepts in various mathematical representations	Well	Well	Well	Enaugh	Enaugh	Enaugh

From the table, it can be seen that the students' understanding concepts in terms of self-efficacy in experimental class through learning by giving scaffolding has better results compared to control class through conventional learning. In the journal it was explained that of these five indicators the lowest average score was indicator of applying the concept in an algorithmic way. In this case, students still have difficulty in applying concepts logically with regard to problem solving. Students are still difficult in determining what to do first in applying the concept. In applying the concept in an algorithmic way, students must first pay attention to what is known in the problem, what will be asked and what steps must be taken. However, most of the students only saw what was asked in the problem so theyonly used the formula without knowing what to explain beforehand. The indicator that gets the highest average scores out of all the existing indicators is to provide examples or counter-examples of the concepts that have been studied. For this indicator, almost all students are able to write their answers properly and correctly.

CONCLUSION

Based on the results and discussions that have been described, the following conclusions are obtained:

1. Learning by giving scaffolding has a great effect on students' understanding of geometry concepts based on the overall effect size calculation which produces an average effect size of 0.994 where this number is included inthe high category. The role of scaffolding in influencing students' understanding of geometric concepts can be described using scaffolding's type Level 2: explaining (showing and telling), reviewing (looking, touching and verbalizing; parallel modeling; probing and prompting questions; students explaining and justifying) and Level 3: developing conceptual thinking (making connection).
2. There is an increase in the students' understanding of geometry concepts that are taught through learning by giving scaffolding. This can be seen from the achievement of indicators in the experimental class in the literature which is generally better than the control class and also the increase based on the N-Gain value by using five steps in learning with scaffolding techniques by Applebee and Langer, namely intentionality, appropriateness, structure, collaboration, andinternalization.
3. Some of the advantages of learning by providing scaffolding that have been analyzed are as follows:
   a. Can encourage students to find the concepts independently.
   b. A great motivational tool toincrease students' confidence in learning geometry concepts.
   c. Make students more engaged in the learning process.
   d. Make students more creative to reason.
   e. Potential to optimize a quality learning environment.
4. Some of the disadvantages of learning by providing scaffolding that have been analyzed are as follows:
   a. Students need to adapt to the types of scaffolding used, especially technology-based ones.
   b. If the teacher does not understand the scaffolding, students will experience difficulties andscaffolding also takes a relatively long time.

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