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Process of overcoming disequilibrium in solving geometry problems

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Abstract
Disequilibrium occurs when a person obtains the information that does not match what he knows. Disequilibrium needs to be overcome so that a person's knowledge is increasing. This research is qualitative research with a case study approach that aims to uncover the processes carried out by students to overcome the condition of disequilibrium in problem solving. Participants in this study were students who experienced disequilibrium in solving geometry problems. Data collection is done through geometry tests and in-depth interviews. Then the data is analyzed through data condensation, data display, and conclusion drawing stages. The results showed that the process undertaken by students to overcome the condition of disequilibrium is to check all the information contained in the problem then integrate the information into the scheme that is owned through assimilation or accommodation.

Keywords: disequilibrium, scheme, assimilation, accommodation

1. Introduction
As individuals who continue to learn, allowing students to obtain information that is different from the knowledge or schemes that have been formed. This situation will disrupt the balance of the existing schemes, this is because when obtaining information then the information is entered into the brain, then the brain looks for schemes that match the information to then respond based on the appropriate scheme. Schemes have an important role in helping someone understand the information or situation they are facing (Mubarik, Budiarto, & Sulaiman, 2018) [7].

The new information obtained can be classified into 3 types, 1) new information that is in accordance with the existing scheme, 2) new information that is not in accordance with the scheme that we have, 3) information that we have never gotten so that we absolutely do not have schema about that information. New information in accordance with the existing scheme will be immediately understood, so it is not a problem. However, when the information obtained is not in accordance with the existing scheme or there is no scheme about the information, the information cannot be understood so that it will cause problems. This causes the existing cognitive structure to be disrupted. The condition when a person obtains information that is not in accordance with the knowledge he has that causes an imbalance in cognitive structure is called disequilibrium (Ormrod, 2008; Slavin, 2017) [8, 10].

Geometry is a branch of mathematics which contains many concepts. Concepts are abstract ideas that can be used in classifying an object, event, or event that has something in common (Erdogan & Dur, 2014) [4]. Until now there are still many students who have difficulty in understanding geometry, as a result they also have difficulty in solving geometry problems. Students who experience disequilibrium cannot understand the information they get, so disequilibrium needs to be addressed. However, the process undertaken by a student in dealing with disequilibrium that occurs has not been explored through research. By revealing the process by students in overcoming disequilibrium conditions in solving geometry problems, it can give an idea to the teacher or lecturer in helping students or students to overcome difficulties or disequilibrium that occurs in the learning process. The benefits that can be obtained by describing the process carried out by students in dealing with disequilibrium that occurs shows that this research is important to do.

2. Materials and methods
2.1 Methods
This research is qualitative research with a case study approach that aims to uncover the process by students to overcome the disequilibrium conditions in the process of solving geometry problems.

2.2 Data collection
Data collection is done by the test method. The test given is a test that contains a geometry problem, in this study called the geometry test (Figure 1). Furthermore, in-depth interviews are conducted based on answers obtained to achieve the research objectives.

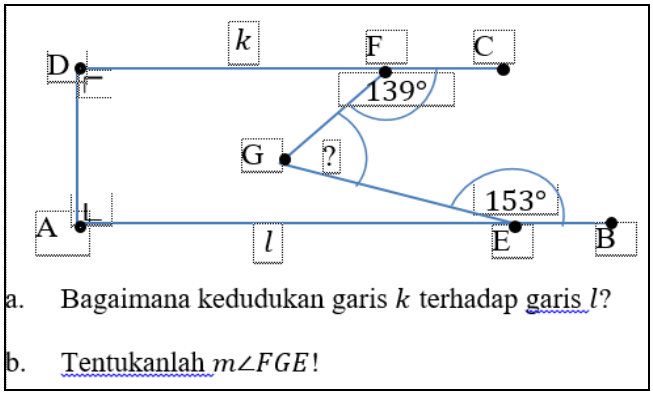

Fig 1: Geometry Test

2.3 Participant

Based on the research objectives to be achieved, participants in this study were students who experienced disequilibrium when solving problems. The process of selecting participants begins by giving a geometry test to students to find out students who experience disequilibrium in problem solving. Next, a student who was disequilibrium was selected as a participant and interviewed to explore the process carried out in dealing with disequilibrium.

2.4 Data analysis

In this study, the data analysis process starts from the time the researcher collects the data until when the research is complete. The data obtained in this study were analyzed using a data analysis model consisting of data condensation, data display, and conclusion drawing (Milles, Huberman, & Saldana, 2014) [6].

3. Results & Discussion

Based on the results of the interview it was revealed that in part (a) the participant already had a scheme about two parallel lines, when two lines were cut by another line and formed an equal angular side then the lines were parallel. In part (a), participants know that m∠FDA and m∠DAE are the pairs of interior angles on the same side and are equal. So participants concluded that lines k and l are parallel lines (Figure 2).

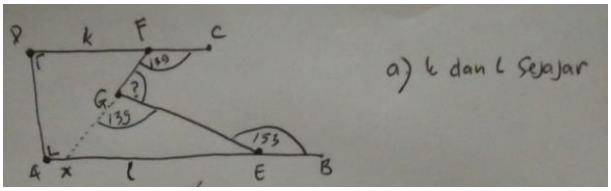

Fig 2: Participant answers part a.

The process by the participant is an assimilation process. This is because participants integrate information obtained into their schemes without changing the scheme.

In the question of part (b) Participants do not have a scheme about the geometry problems faced so that the disequilibrium conditions occur. Disequilibrium occurs because participants incorrectly understand the concept of the pairs of interior angles on the same side. According to participants ∠CFG and ∠XGE are the pairs of interior angles on the same side. Another error that occurred was that participants understood that the pairs of interior angles on the same side were always congruent. Disequilibrium that occurs causes participants to make mistakes in problem solving (Figure 3).

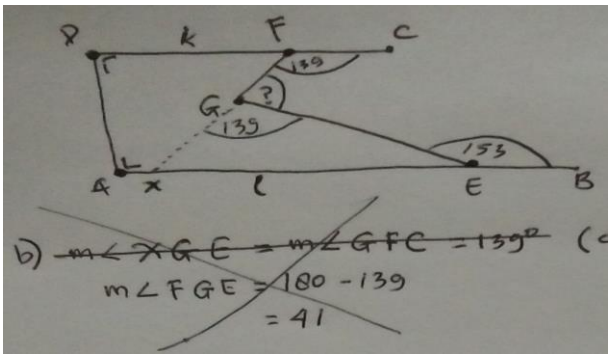

Fig 3: Participants answers when disequilibrium

To overcome the disequilibrium that occurs, participants try to analyze the schemes needed in solving existing problems. Participants re-examine the information available on the geometry test. After checking the answers and information available, participants suspected that the scheme used was incorrect. Then participants try to solve the problem using other schemes they have (Figure 4).

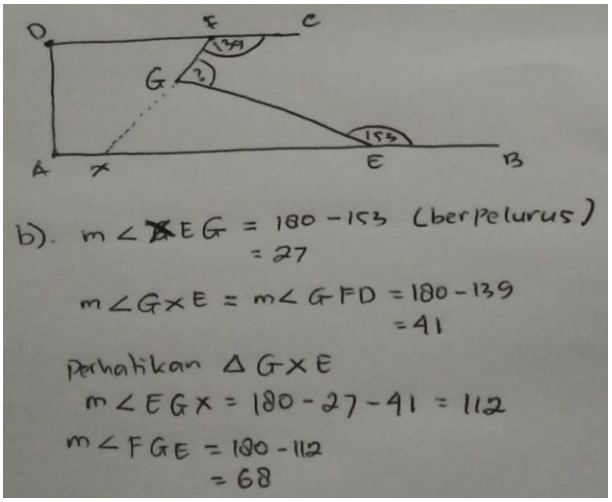

Fig 4: Participants answers after overcoming disequilibrium

Participants used a scheme about supplementary angles. Participants have a scheme that the size of supplementary angles is 180. Based on this scheme, participants integrate information obtained, namely ∠GEB and ∠GEX are supplementary, so m∠GEX = 180 - m∠GEB = 27. This process is an assimilation process because participants integrate information obtained into their schemes without changing their schemes. In Piaget's theory, assimilation is explained as the process of integrating information obtained into an appropriate scheme (Di Paolo, Barandiaran, Beaton, & Buhrmann, 2014; Piske *et al*., 2017; Zhiqing, 2015) [2, 9], [12]. In addition, (Veg-sala, 2017) [11] asserts assimilation is the mechanism by which the subject applies its existing schemas of reality in an effort to appropriate and incorporate new elements of its environment. The information received will be internalized into the existing scheme, then someone will respond to the information received using the existing scheme. (Slavin, 2017) [10] asserts assimilation is the process of understanding a new object or event in terms of an existing scheme. Assimilation is the process of understanding new objects or events within the framework of an existing scheme. Owned schemes are used as a basis for understanding the information received. Then participants used a scheme about the pairs of interior angles on the same side that had been changed. The scheme that is owned is the pairs of interior angles on the same side were always congruent changed to the pairs of interior angles on the same side are supplementary. This scheme is then used in determining m∠GXE. The relationship between ∠GXE and ∠CFG is the pairs of interior angles on the same side, so m∠GXE + m∠CFG is 180. Based on the scheme obtained m∠GXE = 41.

The process undertaken to overcome the disequilibrium that occurs is the accommodation process because participants integrate information obtained into the existing scheme by changing the existing scheme. Accommodation is the process of creating new schemes or adjusting old ones when

they can no longer explain new experiences (Eggen & Kauchak, 2013) [3]. In addition, it was explained that in order to be integrated information needed to change existing schemes or the formation of new schemes in accordance with the information obtained called accommodation (Castillo, Heredia, & Gallardo, 2017; Kaasila, Pehkonen, & Hellinen, 2010) [1, 5]. Then participants pay attention to the triangle GXE. Participants have a scheme about the sum of the angles of triangles is 180. This scheme is used because according to participants, m∠FGE can be obtained using the supplementary angles scheme. Because ∠FGE and ∠XGE are supplementary, m∠XGE needs to be known. To find out m∠XGE participants use a scheme about the sum of the angles of triangles. In the triangle GXE, m∠GXE is 41 and m∠XEG is 27. So, m∠XGE = 180 - 41-27 = 112. Because ∠XGE and ∠FGE are supplementary, then m∠FGE = 180-112 = 68. The process carried out by the participant is an assimilation process.

After overcoming the condition of disequilibrium through the process of assimilation and accommodation, participants can find the right solution of the problem at hand. The process of assimilation and accommodation is complementary in problem solving. Information that is in accordance with the existing scheme will be integrated through the assimilation process, whereas when the information obtained is not in accordance with the existing scheme, the existing scheme will be adjusted through the accommodation process. This shows that the process of assimilation and accommodation is an important process in overcoming disequilibrium conditions and in determining the success of problem solving.

4. Conclusions

The process undertaken by students to overcome the disequilibrium conditions that occur in the process of problem solving begins with double checking all the information contained in existing problems and adapted to the schemes that are owned, then integrating information in accordance with the existing schemes without changing existing schemes or called processes assimilation. Furthermore, when the information obtained is not appropriate, participants change the existing scheme so that it is in accordance with the information obtained and then integrates the information obtained or called the accommodation process. The process of assimilation and accommodation complement each other in helping students overcome disequilibrium in solving geometry problems.

The results of this study are expected to help students in overcoming the disequilibrium conditions that occur so that the problem solving is done successfully. In the next research, it is expected to be able to uncover other processes undertaken by students or students in overcoming difficulties in solving problems, so that it is expected to be applied in learning activities.

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