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THE GIVING OF SCAFFOLDING TO OVERCOME JUNIOR HIGH SCHOOL STUDENTS' DIFFICULTIES IN SOLVING HIGHER ORDER THINKING PROBLEMS OF ALGEBRA

Luthfiyanti Putri Wulandari
Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
e-mail : luthfiyantiwulandari@mhs.unesa.ac.id

Rini Setianingsih
Mathematics Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya
e-mail : rinisetianingsih@unesa.ac.id

Abstract

In learning process, teacher have to pay attention to the level of students ability, because somestimes the students encounter difficulties in solving problem because they have not grasped correctly what is taught. In Junior High School Level, one of competences to be mastered is the ability to solve algebraic counting operations. To minimize the students' difficulties in solving problem of algebraic counting operations, it need guidance in the form of directives or instructions to guide students find the solution. Scaffolding is a help, whether in the form of guidance, direction, giving examples, or other actions provided by adults or peers who are more qualified in order to help students solving the assigned tasks. Scaffolding is applied to help students develop their thinking process. Students who were initially familiar with routine questions then develop their ability in solving problems through giving higher order thinking questions. Students need scaffolding to maximize their ability so that they can reach the potential level.

This study is descriptive in nature using qualitative approach. It was conducted at SMP Negeri 22 Surabaya. The purpose of this study is twofold, namely difficulties experienced by students in solving higher order thinking problem of algebra and the appropriate scaffolding given to overcome the students' difficulties. In this study there are three research subjects consist of students with high, medium, and low mathematics competence.

Based on the results of data analysis, it can be stated that students with high, medium, and low mathematics competence encounter difficulty in making mathematical models of sentences in the problem, completing the process, writing out the final results, and making solutions according to the given problem. The form of scaffolding given to overcome students difficulties is (1) explaining in the form of explaining the importance of making a supposition in turning sentences into mathematical sentence and giving a similar example in making the solution of the given problem. (2) reviewing in the form of asking students to read carefully and examine what is asked in the problem, question and answer to direct students to justify, and ask students to write the appropriate solution. (3) restructuring in the form of reading the problem by giving emphasis intonation on the important thing, and (4) developing conceptual hinking by asking students to connect what's asked in the problem with the results obtained.

Keywords*: scaffolding, difficulties, higher order thinking problem, algebra.*

PRELIMINARY

Nowadays, there are still many teachers who carry out teaching and learning activities by transferring knowledge to students directly without involving students actively in building such knowledge. The result, students only understand and fixated on the problem solving procedures without a true understanding of the concept of the material being taught. This is in line with Ashari's (2007) opinion that is still relevant for the current condition, that the characteristics of current mathematics learning refers more to short-term goals, that is, only to meet the standard of passing the exam, but not really understand about the material, and more focus on procedural ability . In addition, the classroom settings are monotonous, and students are more often trained to think low-level by working on the problems that exist in the package book that mostly in the form of routine questions. As a result, students find it difficult to resolve non-routine issues that require students to think at a high level and be able to argue about how to solve the problem.

The role of teachers is very important to improve the ability of students, by paying attention the level of ability of students in capturing the knowledge provided. In constructing knowledge, students actually able to construct individually without the help of others then the students indicate the existence of the actual zone. When the student is able to develop the maximum potential he has with the help of others indicate he reach his potential zone, then this zone that can still be developed is called Zone of Proximal Development (Ahda, 2017).

In Fernandez (2001), Vygotsky argues that ZPD (Zone of Proximal Development) is the distance between the actual development determined by the student's independence in solving the problem and the level of potential development determined through problem solving under adult guidance or collaboration with peers who more competent. Therefore, a partner who can help provide help while working, can be a teacher or a friend who is more qualified. This is called scaffolding.

Anghileri (2006) states three levels of scaffolding as a series of effective teaching strategies that might be seen in the classroom. The most basic level is environmental provisions, which is the arrangement of learning environments that allow to take place without direct intervention from the teacher. Further on the second level, teacher interactions are increasingly directed to support student learning, and at the third level teacher interaction is directed to the development of conceptual thinking.

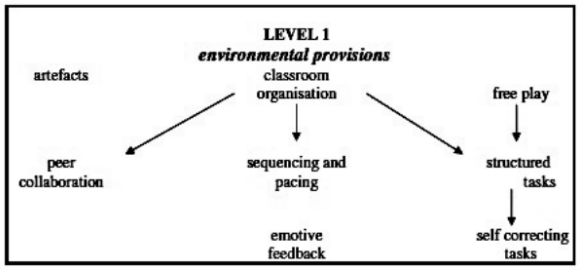


Figure 1. *Scaffolding* Level 1 (Anghileri, 2006)

In this level, before interacting with their students, teacher scaffold learning with environmental provisions including artefacts and classroom organisation also grouping. Here, scaffolding practices identified so far do not involve direct interaction between the teachers and students and does not directly relate to the mathematics to be learned.

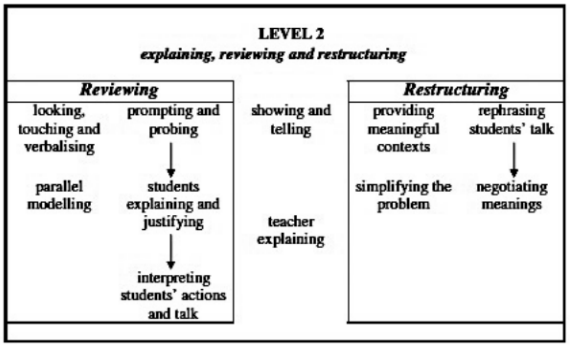


Figure 2. *Scaffolding* Level 2 (Anghileri, 2006)

On scaffolding level 2 direct interactions between teacher and students are showed to be related specifically to the mathematics being considered. The form of interaction are: (1) Explaining i.e. conveying the idea of concepts has been learned; (2) Reviewing i.e. refocusing students attention and give them a further opportunity to develop their own understanding; (3) Restructuring i.e. making idea more accessible, not only establishing contact with students' existing understanding but taking meaning forward.

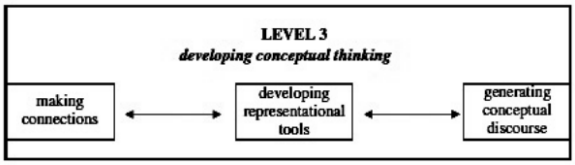


Figure 3. *Scaffolding* Level 3 (Anghileri, 2006)

This level consists of interaction by creating opportunities to reveal understanding to students and teacher together. Students are supported in making connection and developing a range of representational tools, transferable skills and understanding that can be communicated become established. Teacher in this classroom can engage their students in conceptual discourse that extends their thinking.

Vygotsky (in Bikmaz, 2010: 2) states that students need scaffolding as a bridge on student ZPD in completing a task in which students can not initially understand or complete the task but with the help of an adult or a more competent person, the student can complete the task given to him. Scaffolding is also applied to help students develop their thinking process. Students who were initially familiar with routine problems will develop their ability to solve problems through giving higher order thinking questions. Based on the thinking ability according to Bloom's Taxonomy revision by Krathwohl, the first three levels are the lower order thinking which are remembering, understanding, and applying, while the next three levels are the higher order thinking which are analyzing, evaluating, and creating. The cognitive process of analyzing is categorized in three forms: distinguishing, organizing, and attributing. The cognitive process of evaluating is related to making decisions based on criteria and standards including checking and criticizing. In creating students are formulating, planing, and producing. (Ahda, 2017).

In thhis study scaffolding is intended to help students to overcome difficultise when solving the problem of higher order thinking problems of algebra. The algebraic material used is about the algebraic counting operation. Mastery of students in this competency is very important because it can affect and will be the initial knowledge for students learning Algebra in the next stage. For example, when students learn about equations, inequalities, systems of equations, functions, equations of lines, and others. Students who lack in mastering the

algebraic counting operation resulted in low student achievement in the subject matter of the algebra. Therefore, assistance is needed in the form of direction or guidance to guide students to solve higher order thinking problem in algebraic counting operation. This study aims to describe students' difficulties in solving the problem of higher order thinking problems of algebraic before being given scaffolding and the form of scaffolding given to overcome the difficulties of students in solving the problem of higher order thinking problems of algebra.

METHOD

This research includes descriptive research with qualitative approach. This research was conducted at class VIII-G SMP Negeri 22 Surabaya and implemented in the even semester of the academic year 2016/2017. The subjects consisted of 3 (three) Grade VIII students who had received algebraic material, especially on algebraic forms and operations on algebra. The three students, each belonging to a group of students with high, medium, and low math skills. Here are the general research procedures.

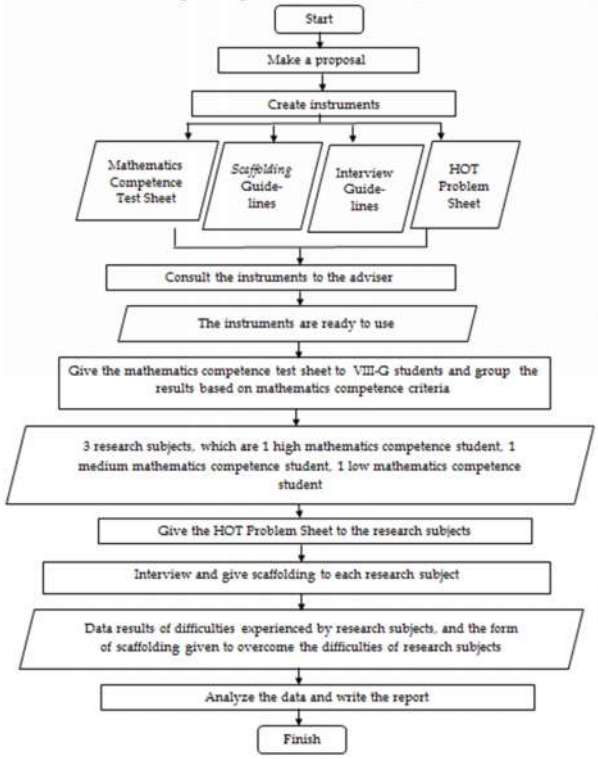
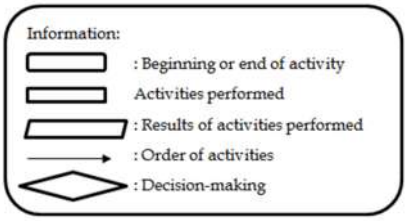


Figure 4. General Research Procedures



The research instrument used are: (1) researcher as main instrument; (2) Mathematics Competence Test Sheet; (3) HOT Problem Sheet; (4) Interview guide; (5) Scaffolding guide.

The determination of research subjects is based on the test score in doing Test of Mathematics Competence by students in one class. The test scores of the Mathematics Competence Test then grouped into three groups, and each took one high, medium, and low mathematics student competence based on the criteria of mathematical ability.

Furthermore, the three subjects of the study were given a HOT Problem Sheet which contains the question of higher order thinking of algebraic material that serves to provide information to the researchers about students' difficulties in solving the problem of higher order thinking of algebraic material before being given scaffolding. The HOT Problems Sheet consists of 4 questions. The four questions consist of questions that based on the cognitive level of analyzing namely distinguishing, organizing, and attributing and cognitive level of creating. After getting the data about the difficulties of students in solving the problem of higher order thinking of algebra, then the process was continued with interview and giving the right scaffolding to overcome the difficulties of each research subject in solving the given problem.

Data collection techniques used in this research are: (1) Paper and pencil test (2) Interview. Furthermore, data analysis in this study was conducted with three stages, which are data reduction, data presentation, and drawing conclusions (Miles & Huberman, 2006).

RESULT AND DISCUSSION

Difficulties of students in solving the problem of higher order thinking algebra material revealed through the work of HOT Problem Sheet consisting of 4 (four) questions. After working on the HOT Problem Sheet, the research subjects were given appropriate scaffolding to overcome the difficulties experienced. Scaffolding in question refers to the scaffolding proposed by Anghileri (2006). For scaffolding level 1, it has not been directly related to the mathematics material so it is more emphasized to regulate the environmental conditions to be used, the attention and encouragement given to the students, and the acceptance of the students in following the activities. Furthermore for levels 2 and 3 are used to help students. Here's the presentation of research results:

1. **The difficulties experienced by junior high school students in solving the problem of higher order thinking of algebraic material before being given scaffolding**

   Based on the results of junior high school

students' work in completing the HOT Problem Sheet, the three junior high school students with high, medium, and low mathematics competence have the same difficulties. The difficulties experienced by the three junior high school students are to make a mathematical model of the sentence that exists on the matter of algebraic counting operations, to complete the algebraic calculation process, to write the final result of algebra calculation, and to make the solution according to the problem of the given algebraic counting operation.

2. The form of *scaffolding* given to junior high scholl students to overcome difficulties in solving the higher order thinking problem of algebra

The form of scaffolding provided by the researcher to overcome the difficulties of junior high school students in solving the problem of higher order thinking algebra material based on scaffolding guidelines that have been made by researchers. Scaffolding guidelines used refers to the scaffolding proposed by Anghileri that is scaffolding level 2 and level 3.

Based on the result of HOT Problem Sheet given, the three junior high school students with high, medium and low mathematics have the same difficulties. The difficulties experienced by the three junior high school students are to make a mathematical model of the sentence that exists on the matter of algebraic calculation, to complete the algebraic calculation process, to write the final result of algebra calculation, and to make the solution according to the problem of the given algebra calculation.

To overcome the difficulties of junior high school students in making mathematical models of sentences that exist on the matter of algebra counting operations, it is given scaffolding in the form of asking junior high school students more thoroughly read and look at what is asked on the matter (*Reviewing*), conducting question and answer to direct junior high school students to justify the answer (*Reviewing*), and explains the importance of making a supposition in turning sentences in the problem into a mathematical sentence (*Explaining*). For junior high school students with medium and low mathematics competence are also given scaffolding in the form of reading the problem by giving emphasis intonation on the things that are important (*Restructuring*). As for junior high school students with low mathematics competence, researchers also provide scaffolding by providing a similar example in changing the matter into a mathematical sentence (*Explaining and Reviewing*).

Furthermore, to overcome the difficulties of junior high school students in completing the process of algebraic calculation, all junior high school students are given scaffolding by asking the junior high school students to be more accurate again on the results of the calculations done (*Reviewing*) and conducting questioning to direct the junior high school students to justify the answer (*Reviewing*).

For the difficulties of junior high school students in writing the final result of algebraic calculation, scaffolding is given by asking the junior high school students to look again at what is asked by the matter *(Reviewing*) and do question and answer to direct the junior high school student to justify the answer *(Reviewing*). While for junior high school students include medium and low mathematics competence scaffoldings are also given in the form of question and answer and ask the junior high school students to pay attention to the writing of the unit (*Reviewing*).

Then for the difficulties of junior high school students in making solutions in accordance with the problems of algebra counting operations, the type of scaffolding given are in the form of question and answer and bring the junior high school students back to the problem asked on the matter (*Reviewing)*. However, for junior high school students with medium mathematics competence are being given as well as scaffolding by providing similar examples in making solutions of problems (*Explaining and Reviewing*), reading the problem by giving restraint in restructuring, and asking the junior high school student to write down the solution in accordance with the questions asked (*Reviewing)*. While for the junior high school students with low mathematics competence, the type of scaffolding given are in the form of reading the problem by giving emphasis intonation *(Restructuring),* asks junior high school students to connect what is asked on the problem with the results obtained (*Developing Conceptual Thinking*), and ask junior high school students to write conclusions in accordance with asked on the matter (*Reviewing*).

CONCLUSION

Based on data analysis and discussion of the workmanship of students in solving the problem of higher order thinking algebra material, it can be conclude that:

1. The three research subjects of both students with high, medium, and low mathematics competence experienced similar difficulties, which are making a mathematical model of the sentence that exists on the problem, complete the process, write down the final result, and make a solution in accordance with the given problem.
2. To overcome students' difficulties then the students are

given appropriate types of scaffolding. Scaffolding that is given to refers to the scaffolding proposed by Anghileri, (2006) which consist of Explaining, Reviewing, Restructuring, and Developing Conceptual Thinking.

SUGGESTION

Based on the research that has been done, the researchers put forward some suggestions for further research development, among others:

1) For teacher
   a) Based on the results of research still found the difficulties of junior high school students in solving higher order thinking problem of algebra material then it is suggested to the teacher to give exercise about higher order thinking problem to train students ability in solving the problem of HOT. By giving exercises about the ability of students in solving the HOT problem the better and learning achievement is expected to increase.
   b) Based on the resultsof research that the difficulties of junior high school students in solving the problem of HOT algebra material can be overcome by giving the right scaffolding. Teachers should know the theory of scaffolding to help students who have difficulty in solving a problem in teaching and learning activities.
2) For other researchers
   a) Based on the implementation of this study, students at the time of data collection of the data is less excited because the time is noon and the atmosphere is less conducive. Implementation of data retrieval should be done in the state of students are fit and a conducive atmosphere in order to get complete information as expected.
   b) The interview should be conducted calm and relaxed atmosphere so that students can be more focused in answering questions posed by interviewer.

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