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Role Of Scaffolding Toward Enhancing Understanding Of Low-Achieving Students (LAS) In Mathematics Learning

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Abstract— This article set out scaffolding as one of proper tools for heterogenous groups in class. It is particularly useful supporting low-achieving students (LAS). Low achievers have lack of not only minim ability understanding mathematics matery, but also lack of motivation to involve in practices. According to socio-constructivism by Vygotsky, scaffolding is needed to help students achieving zone of proximal development (ZPD). Additionally, *scaffolding* is one of the strategies used by children and novice for solving problem, finishing the tasks, or reaching a goal of learning process beyond their capability. It is northworthy for teachers developing either micro-scaffolding or macro-scaffolding for exploring potential of LAS. Scaffolding can be trigger for students having mathematics problems, especially in inclusive class. Thus, this article exhibit further review how scaffolding is crucial thing to increase LAS understanding in mathematics class.

Keywords: *scaffolding, low-achieving students (LAS), mathematics learning*

I. INTRODUCTION

The attention toward mathematics education becomes so very important in the world. This is evident from some of the developments that are so significant on the planning implementation of learning mathematics happening in the world. In fact, in a innovation study of mathematics will always progressing continuously. The challenge in the development of mathematics education itself is how to develop a meaningful mathematics learning and can provide a deep understanding of the students from each of the materials given during learning. It is inevitable that in any implementation of learning mathematics, many things that are a challenge someone as a teacher. It is happened because the ability of students differ from each other. Anyone has high math ability and others have low math ability. Given the diversity of capabilities that exist in students, then ineducation, especially in mathematics, low-achieving students (LAS),need to get more attention. In this case, poor understanding of the mathematics learning material will result in students having low achievement.

In this condition, there are things that need to be focused on that issue which is focusing on students who have low achievement. The strategy and understanding toward the characteristics of low-achieving students becomes crucial to be considered and acted in order to be able to understand the learning material of mathematics to be meaningful. The ways or strategies that can be done is by learning using strategies scaffolding. Bakker, Smit, and Wegerif (2015) revealed that the scaffolding has thepotential concept form integrated with applications in mathematics education.It indicates that learning through the scaffolding isessential in exploring the differences that exist on the mathematical conceptsthat are interrelated.

In the other side, Makar, Bakker, and Ben-Zvi (2015) revealed that the scaffolding as aassistance temporary and customized by a teacher or a student who has more knowledge to support students with low math ability to solve a mathematics problem. From the above explanation, the authors intend to

provide an overview study about how the scaffolding strategies can help the students to understand learning material of mathematics.

II. LITERATURE REVIEW

A. Characteristic of Low-Achieving Students (LAS)

According to Broza and Kolikant (2015), there is no single definition of low-achieving students (LAS). Nonetheless, based on a recent meta-analysis (Baker et al. 2002), they categorized LAS based on teacher report on standarization of students' performance or informal tests. In this article, the term LAS focuses on mathematics cognitive deficiencies and on behavioral manifestationsof their failures. They are often pointed having mathematical learning difficulties or mathematical disabilities. Craik (2002) refers to this difficulty as *'fragilememory'*, a product of superficial data processing. There are empirical studies that characterise low achievers' mathematical competence and describe the specific difficulties low achievers experience in mathematics. These students often have difficulties in specific arithmetic areas such as conceptual understanding, such as the decimal place value system and problem solving (Mazzocco et al. 2008), and procedural competencies, such as counting or memorizing number facts LAS find it difficult to retrievebasicmathematics knowledgefrom their memory (Gray,PittaandTall cited by Broza and Kolikant, 2015).

Johnson and Schmidt (2006) described many students in this class lack not only accuracy with basic mathematical operations but they have a deep-rooted belief that they will never be very good at solving math problems. One of the goals for mathematics learning class is for students not only to develop their mathematical concept but also confidence in their own ability by helping them to become better problem solvers. They also lack meta-cognitive skills (Goldman1989),and are sensitive to the learning contexts. They have lack of basic of mathematics, thus find it much harder than others to solve simple and complex addition and subtraction problems. These difficulties may lead them to use less sophisticated strategies and commit more errors. Experiencing repeated failures and difficulties in keeping up with the class might in turn decrease the irmotivation and sense of internal responsibility and make them more passive learners. It might also lead themtoact impulsively,relying on the others judgment to them.

Afterward, there is a important question of how to increase the effectiveness of teaching and learning processes presents an important challenge to LAS; what type of support can be provided by the teacher to facilitate the student'construction of meaningful knowledge in mathematics class? Teaching the complex topic of mathematics to low achieving students (LAS)poses a special challenge, due to LAS' weaknesses such as memory deficiencies, inadequate use of strategies for solving mathematics tasks, deficiencies in generalization andtransfer of learned knowledge to new and unknown tasks,social problems, and mathematics anxiety (Haylock cited by Broza and Kolikant, 2015).

Despite LAS are having their difficulties, LAS can as well increase their mathematical conceptual of understanding. Karsenty, Arcavi andHadas (2007) and Chazan (2000) find the fact that LAS are able to display mathematical reasoning orally when placed in intimate and supportive learning circumtances.Peltenburg (2012) revelas that in Mathematics ICT usage, LAS show successfull performance in solving subtraction problems by using an indirect addition strategy spontaneously, rather than the conventional direct subtraction strategy. Similar to these studies, our approachhere is based on the belief that LAS are capable of meaningful learning in mathematics, and on the desire to capitalize on strengths and successes, rather than to focus solelyon weaknesses. LAS tend to contextualize mathematics and their concept of mathematics is associated with "doing"(Gray et al. 2000).

To enhance LAS performance in mathematics learning, They need teachers' supported in term scaffolding to trigger and explore LAS' thingking and behaviour effectivelly. It is a crucial thing for students because Some research suggests that a lack of mathematics competency such as in basic arithmetic operations can have a negative impact on success in math class (Gersten & Chard, 1999), it will affect to their confidence and motivation in the class.

B. Scaffolding

The concept of scaffolding is originated within Vygotsky's theory in learning approach. Cf Gibbons (Prediger & Pöhler, 2015) The main idea of scafsky's classical construct that using as tools to help students through zone of proximal development (ZPD). Wood,Bruner,and Ross (1976)Is first described *scaffolding* as "the process [which] enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts"(p. 89).Broza and Kolikant (2015) defined that there are six elements of scaffolding that involve cognitive, meta-cognitive, behavioral, emotional and motivational aspects (p.1094). In the class, scaffolding designed students' learning performances, keeping the novice to finish learning objectives. Furthermore, the facilitator designing the learning behaviour and makes decisions about which stimulating tasks to use, whether and when to interveneand support,and howmuch and what type of help is necessary(Wood, 2001;Prediger & Pöhler, 2015).

Practically, there is no specific definition to describe what the scaffolding is. Nevertheless, Van de Pol, Volman and Beishuizen (2010) identify the notion of scaffolding published over the years commonly refers to support given by teachers to students or students through interaction (Broza.,et.al 2015) catching cognitive proximal level of students. Broza.,et.al 2015 identify three elemens of scaffolding regularly appeared during teaching and learning (see figure 1); (1) The*contingency*, it is refers to responsiveteaching,orthecalibrated support (Broza.,et.al 2015) students' interaction along the class, providing learningsupport which is contingent on learners'needs when errors occur is considered effective for developinglearners'understanding (Wischgoll, Pauli, &Kurt Reusser, 2015);(2)*fading*, the circumtances which is "gradually removing teacher scaffoldsas the student gainsunderstandingand no longer require the teacher'ssupport" (Broza.,et.al 2015, p. 1094); (3) A gradual *transferof responsibility* to the student. It is needed to be accompanied in fading elements.The teacher offers a lot of support at the beginning,and successively fades out this support in order to transfer responsibility to students.

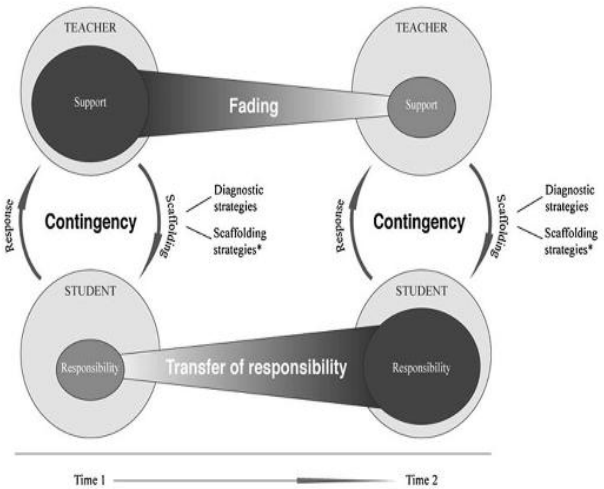

Figure 1. Model of key aspects of scaffolding
Van de Pol (S. Prediger, B. Pöhler, 2015, p. 1180)

According to Hammonds and Gibbon (Plister, et al. 2015), scaffolding can be divided as two notion macro-scaffolding and micro-scaffolding, those distingushed at which those are implemented.Macro-scaffolding has more massive area than micro-scaffolding. Gibbons (2002) and Smit (2013) cited by (Prediger & Pöhler, 2015), Macro-scaffolding as an empirical reconstruction which consists of students' prior experience, the learning goals for sequencing intermediate learning goals and support means, and instructional tasks along the intended learning trajectory. So that, macro-scaffolding includes teachers' preparation of planning, goal setting, classroom organisation, and the selection and sequencing of tasks, and contingent interaction in response to the teaching and learning opportunities.

Meanwhile, Micro-scaffolding is an important *local* phenomenon on a micro-scale of teacher-student-interactions (Prediger and Pöhler, 2015). It is fuzzy specific learning trajectory which is students' responsiveness to construct their concepts themselves, the idea supporting students to move forward in zone of proximal development (ZPD). Prediger & Pöhler (2015) highlight micro-scaffolding includes in macro-scaffolding, the role of micro-scaffolding in the interplay of conceptual and lexical learning.

According to Plister, et al (2015, p. 1080), The best scaffolding usage for students should offer activity consists of (1) *Feeding back*: Inside of scaffoding teachers should be providing information regarding the student's performance; (2) *Giving hints*: providing clues or suggestions will guided them to find the concepts. (3) *Instruction*: The scaffolding demonstrate what to do or how something must be done and why; (4) *Explaining*: providing more detailed information or clarification; (5) *Modelling*: offering behaviour for imitation and (6) *Questioning*: questions that require an active linguistic and cognitive answer. The study reported in this article empirically investigates how micro- and macro-scaffolding *depend on each other* i.e scaffolding implementation depends on the teacher itself.

C. Scaffodling for Low-achieving students (LAS)

Plister, et al (2015, p. 1081) categorizes that they are called "facets", which is aspects of scaffolding to create high quality mathematics learning for low-students. In addition, those facets are used to see how success implementation of scaffolding in inclusive class. They consits of the five following facets are listed and described.

(1)*Cognitive activation*: Krammer (Plister, et al, 2015, p. 1081) argue that cognitive activation is crucial aspect to construct students' conceptual understanding, others, it provides students' (meta) cognitive activation as well. Furthermore, cognitive activation also includes fading and transfer responsibility. To build cognitive activation in learning, students are guided to active participate in whole activity. The more active participation of students in the class, the more the responsibility during their performance will be gotten to them. Then, the last and essential part in this facet is the teachers' should invite students together to do summarize of what has been done or said during the activity (Williamsand Baxter1996),and theemphasis ison asking questions,rather than givingdirections (Lepper, Drake& Johnson.1997);

(2) *Stimulating discourse*: One of the way to achive cognitive activation is discourse orientation for learning, it is about interaction among teachers and students and between students one another (Krammer 2009). They have a time to communicate mathematical concept during the lesson. Williams and Baxter (Plister, et al, 2015) present scaffolding as a coreelement of discourse-orientated learning "…to describe actions taken by a teacher that support the creation of mathematicalknowledgethrough discourse among students"(p.1081). In addition, cooperative learning model can be choosen as the way to build discourse-oriented learning.

(3) *Handling errors productively*: A teacher should have a way to tackle students' errors and misconseption effectively. In the early, most of learning process utilize discourse usage, we often find students getting a misconception and an error. Based on a study by Lepper et al. (1997), the best tutors have the proper way to respond students' errors differently than other colleagues.Teachers are guided able to appear students' awareness about their errors and misconception by posing leading questions or offering hints to prompt students to identify and correct the errors by themselves (Plister, et al, 2015, p. 1081).

(4)Target orientation: In the beginning, teachers has to provides approriate tasks and mathematics problem which is used as guide for students' performance. According to Williamsand Baxter, It consists of utilize compatible questions, instructions, and explanations to draw students' attention that use to construct mathematical concept by themselves.selected instructional examples,
and thus to key concepts or "mathematical ideas" (Plister, et al, 2015).

(5)Using Manipulatives: In mathematics instruction, how to construct mathematics conceptual understanding needs contextual problem, thus theway problems presented is especially important. Teachers should make consideration how to present a problem to the students, includes finding

compatible way to each problems being given examples in term of manipulatives andrepresentations (Lepperetal.1997).Every students in mathematics most likely easy to understanding the matery presented with active representation and contextual problem, particularly for LAS (cf. Sect.Plister, et al, 2015).

The "facets" above can be consideration for the teachers that design techniques of scaffoding to enhance LAS in mathematics learning. Although, the idea of scaffolding was originally developed relying on the teacher itself, for the use in one-to-one tutorial situations by the teachers; however, it is now also able to be applied to classroom situations (Smit et al. 2013).

III. Conclusion and Discussion

In mathematics class, the LAS have a lack of mathematics conceptual understanding and motivation. They show massive anxiety of mathematics based on their failure experience in mathematics class. Pfister et al studies about scaffolding usage (2015) found that scaffolding are usefull tools to increase LAS performance in the class. However, it needs professional preparation before scaffolding used. The five facets which hipothesized are able to enhance LAS performance- means are inluded all of facets, are not as easy as applied during the lesson. Teachers, even training teachers (i.e teachers have got the scaffolding training using five facets), going to find obstacle to provide it to LAS correctly.

Nevertheles, it is important to understand how to encourage classroom teachers to use scaffolding and how to train them to use the various techniques in scaffolding. Lepper et al. (1997) discuss some types of training (i.e.peer-tutoring programs and computer tutors). Because the role of scaffolding toward enhancing understanding of low-achieving students (LAS) in mathematics learning. Thus, On the basis of Lipowsky's (2004) results, we recapitulate that pre-service and in-service (i.e class teachers and special education teachers) training in scaffolding techniques would be an effective option.

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