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Scaffolding in Geometry Teaching and Learning for 8th Grade

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Abstract. According to curriculum in Indonesian, instruction in classroom or learning approach has changed to be student-centered approach from teacher-centered approach. Based on psychology, student-centered approach is supported by constructivist learning theory. That theory is as learners who construct their understanding based on experience. Not only for student but also for a teacher who has the big impact in teaching and learning. In learning, a constructivist teacher needs to develop opportunities to activate prior knowledge and to acquire, understand, apply, and reflect on knowledge because there are three critical components of learning: 1) learning is a process, not a product; 2) learning involves change in knowledge, beliefs, behaviors, or attitudes; and 3) learning is not something done to students, but rather something students themselves do. Effective teaching requires knowing and understanding mathematics, students as learners, and pedagogical strategies. Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well. The distance between the actual developmental level or what students know as determined by independent problem solving and the level of potential developments determined through problem solving under adult guidance or in collaboration with more capable peers is called by Zone of Proximal Development (ZPD). A process in ZPD area is called by Scaffolding. The point of scaffolding in teaching and learning mathematics based on student-centered approach is process and supported by the teacher or knowledgeable adult to the student when completing tasks and helping a children to move from their actual performance level to their potential level about concept and solving problem in geometry for 8th grade through questioning or question.

INTRODUCTION

Indonesia is facing a changed process about teaching and learning [1]. The changed process is from a student was given to look for knowledge, a teacher as a only one source to be a various source, and contextual instruction to scientics instruction. According to curriculum in Indonesian, instruction in classroom or learning approach has changed to be student-centered approach from teacher-centered approach. Based on psychology, student-centered approach is supported by constructivist learning theory. That theory is as learners who construct their understanding based on experience. There are two point about understanding that student must have based on the basic competencies in curriculum. Those points are concept and problem solving. The basic competencies [2] in curriculum for 8th grade in geometry teaching and learning are:

3.9 Differentiate and determine the surface area and the volume of cube, square prism, prism, and pyramid.
4.9 Solving a problem related to surface area and volume of cube, square prism, prism, and pyramid and also their combination.

There are three critical components to this definition about learning: 1) learning is a process, not a product. However, because this process takes place in the mind, we can only infer that it has occurred from students' products or performances; 2) learning involves change in knowledge, beliefs, behaviors, or attitudes. This change unfolds over time; it is not fleeting but rather has a lasting impact on how students think and act; 3) learning is not something done to students, but rather something students themselves do. It is the direct result of how students interpret and respond to their experiences — conscious and unconscious, past and present.

Instruction [6] is a much more subtle process in which several important ideas are involved. One of ideas is about

Contingent teaching (or scaffolding). This is the process by which a more knowledgeable adult or peer can help a child move from her actual performance level to her potential level, giving just enough help to move the child from one to the other. Six ways scaffolding [8] to support student learning activities can be distinguished: a) feeding back, b) the provision giving hints or clues, c) instructing or command, d) explaining or describing, e) modeling (modeling or demonstration) and f) questioning or question: involves asking questions that require an active linguistic and cognitive response.

Effective teaching [9] depends on the knowledge and skills that teachers bring to instruction decisions and the choices teachers make in implementing this pedagogical knowledge. Teachers must make many decisions about the way they teach.

The point of this paper is the importance of scaffolding in teaching and learning mathematics at geometry based on student-centered approach. What kind of scaffolding should teacher give to student in teaching and learning mathematics at geometry based on student-centered approach?

I. SCAFFOLDING IN TEACHING AND LEARNING

There are three critical components to learning definition: 1) learning is a process, not a product. However, because this process takes place in the mind, teacher can only infer that it has occurred from students' products or performances; 2) learning involves change in knowledge, beliefs, behaviors, or attitudes. This change unfolds over time; it is not fleeting but rather has a lasting impact on how students think and act; 3) learning is not something done to students, but rather something students themselves do. It is the direct result of how students interpret and respond to their experiences — conscious and unconscious, past and present.

Learning in Indonesia based on student-centered approach. That approach is supported by constructivist learning theory. Constructivist learning theory is based on the central notion that as learners who should construct their own understanding of the world around based on experience as they live and grow. They select and transform information from past and current knowledge and experience into new personal knowledge and understanding.

Based on among of expert, instruction [4] may be thought of as involving three fundamental but interrelated activities: 1) Deciding what students are to learn, 2) Carrying out the actual instruction, and 3) Evaluating the learning". Gagne [5] explains that "instruction as a set of events external to the learner designed to support the internal process of learning".

There are some aspects in instruction design [3]. The crucial issues include the manner in which instruction is provided (e.g. emphasizing group work, a chalk-and-talk didactic teaching approach, discovery learning methods, peer-mediated negotiation about what is to be learned and how), how feedback is given (e.g. the language used) and how personal attributes, qualities and attitudes contribute to successful learning (e.g. demeanour, competence in controlling classroom behavior, enthusiasm for the job, and respect for the rights and views of others).

Instruction here [6], however, is not the one-directional process involved in behaviorism. It is a much more subtle process in which several important ideas are involved. Those idea are:

1. The zone of proximal development: This is the 'gap' between what the learner can achieve on his own and what he can achieve with help from a more knowledgeable adult or peer. Or Vygotsky says, "Zone of Proximal Development (ZPD) is the distance between the actual developmental level as determined by independent problem solving and the level of potential developments determined through problem solving under adult guidance or in collaboration with more capable peers"
2. Contingent teaching (or scaffolding): This is the process by which a more knowledgeable adult or peer can help a child move from her actual performance level to her potential level, giving just enough help to move the child from one to the other.
3. Self-regulation: In interacting with more knowledgeable peers or teachers, pupils can begin to think about and regulate their own thinking. This could involve questioning their habitual first responses, refining their solutions, asking themselves questions and trying alternative approaches.

In general, scaffolding [8] was built as the support given by the teacher to the student when completing tasks that might not be able to be completed. Furthermore, Six ways scaffolding to support student learning activities can be distinguished: a) feeding back, b) the provision giving hints or clues, c) instructing or command, d) explaining or describing, e) modeling (modeling or demonstration) and f) questioning or question: involves asking questions that require an active linguistic and cognitive response.

Scaffolding is process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts. Scaffolding [4] is the degree of support, guidance, and direction you provide students when they set out to complete the task". There are two different approaches to scaffolding [7]. First, scaffolding can be planned intervention. This implies that a teacher – planned intervention is most likely to have been planned by a teacher – will have made a decision to provide a means to assist progress

towards preplanned learning outcomes. Second, it called “ad hoc” interventions. These opportunities for scaffolding are more difficult to plan. They depend upon the teacher/adult being in the right place at the right time in many cases, the informed professional judgement of the adult in other situations or a group situation when dialogue is being developed between an adult and the class. Attention to the process of intervention is given importance in the materials provided by the National Strategies are:

1. Which: Identify which pupil is making less progress than expected.
2. What: Identify what it is that this pupil needs to enable him or her to make progress.
3. Why: Identify why this pupil needs support to make progress.
4. Try: Intervene to meet the needs of the pupil.
5. Evaluate: What was the impact of the intervention you provided?

Based on the those definition above, the scaffolding is process and supported by the teacher or knowledgeable adult or peer to the student when completing tasks and helping a children to move from their actual performance level to their potential level through feeding back, the provision giving hints or clues, instructing or command, explaining or describing, modeling and questioning or question. Yet, in this paper, the point of scaffolding in teaching and learning mathematics based on student-centered approach is process and supported by the teacher or knowledgeable adult to the student when completing tasks and helping a children to move from their actual performance level to their potential level about concept and solving problem in geometry through questioning or question.

Effective teaching [9] depends on the knowledge and skills that teachers bring to instruction decisions and the choices teachers make in implementing this pedagogical knowledge. Teachers must make many decisions about the way they teach. Teachers plan worthwhile mathematics experiences, interact with children while they are learning, and monitor student’s progress. Successful teachers understand how children learn and vary their teaching based on group and individual needs.

Mathematical meaning [9] is constructed by the learner rather than imparted by the teacher. Mathematical learning occurs most effectively through guided discovery, meaningful application, and problem solving rather than imitation and reliance on the rote use of algorithms for manipulating symbols.

According to the van Hieles, the learner, assisted by appropriate instructional experiences, passes through the following five levels, where the learner cannot achieve one level of thinking without having passed through the previous levels.

1. Level 0: The student identifies, names, compares and operates on geometric figures (e.g., triangles, angles, intersecting or parallel lines) according to their appearance.
2. Level 1: The student analyzes figures in terms of their components and relationships among components and discovers properties/rules of a class of shapes empirically (e.g., by folding, measuring, and using a grid or diagram).
3. Level 2: The student logically interrelates previously discovered properties/rules by giving or following informal arguments.
4. Level 3: The student proves theorems deductively and establishes interrelationships among networks of theorems.
5. Level 4: The student establishes theorems in different postulation systems and analyzes/compares these systems.

Polya [10] develops model, procedure, or heuristic about problem solving which consists of stages as follows:

1. Understanding the problem which refers to the ability to identify facts, concepts, or information which require to resolve the issue. Understanding the problem also involves questions such as "What did you know about?" And “What is problem about?". It is often helpful to draw a diagram that represents the problem and the provided information.
2. Devising a plan or Making a plan of the problem that refers to the ability to construct a mathematical model of the known issues. In designing a plan, someone trying to find a relationship between the data and the unknown.
3. Carrying a plan or carring out the problem-solving planning refers to the ability to complete the mathematical model that has been prepared.
4. Looking back or Generalizing refers to check or correct back solution has been completed about correct or not the answer. In addition, checking out other ways to solve the problem.

CONCLUSION

Scaffolding in teaching and learning mathematics based on student-centered approach is process and supported by the teacher or knowledgeable adult to the student when completing tasks and helping a children to move from their actual performance level to their potential level about concept and solving problem at geometry through questioning or question. The basic competencies in curriculum for 8th grade in geometry teaching and

learning are: 3.9 Differentiate and determine the surface area and the volume of cube, square prism, prism, and pyramid.

4.9 Solving a problem related to surface area and volume of cube, square prism, prism, and pyramid and also their combination.

So in this paper, scaffolding emphasizes to a question about concept which relate to the learning level in geometry for 8th grade and solve a problem based on polya's model.

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