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## LEARNING SCIENCE IN ELEMENTARY SCHOOL BASED ON HOTS

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### Abstract

This study is aimed to explain learning science in elementary school based on Higher Order Thinking Skill (HOTS). The current development demands every individual especially students to be able to compete in many ways of life to face 21st century area. All those matters can be materialized if students get used to solve their problems. In order to solve the problems, higher order thinking skill (HOTS) is needed. HOTS can be applied in elementary school through learning science.

As the Curriculum 2013 demands higher order thinking skill, therefore the process and the science learning assessment have to reflect to HOTS. The main discussion of this study is how the process and the assessment of science based on HOTS. The learning processes based on HOTS are Problem Based Learning (PBL) and Contextual Teaching Learning (CTL). The learning assessment based on HOTS has include cognitive dimension level C4 (analyzing), C5 (evaluating), and C6 (creating). By using learning model and being supported by assessment that reflects to HOTS, it is expected that it will be able to increase the quality of education in Indonesia.

**Keywords:** learning science, HOTS

### INTRODUCTION

In this progressive era, it demands every individual, especially learners to be able to compete in various things of life when facing the 21<sup>st</sup> century. Partnership for 21<sup>st</sup> Century Learning or P21 has developed 21<sup>st</sup> century learning framework which requires learners to mastering skills, knowledge and ability in technology, media and information, learning and innovation skills, and life and career skills (P21, 2015). One of the aspects that closely related to learning is learning and innovation skills. In which teachers are required to design learning that can improve learners' ability to think critically and solve problems.

Aspects of understanding, application, and reasoning in the realm of cognitive ability as applied to TIMSS can be used to demonstrate students' ability to think. In these three aspects, aspects of understanding and application included in basic thinking skills. Aspects of reasoning are included in higher-order thinking skills. Based on the TIMSS results, it can be said that the students' higher-order thinking skills are still low. This can happen because the students' learning process is less motivated in improving the higher order thinking skills (Pratiwi and Fasha: 2015). Friedman (2006) stated that entering the 21<sup>st</sup> century, the paradigm shift to student-centered learning, and learners needs to be equipped with Higher Order Thinking Skill (HOTS) (Wilson, 2000; Lawson, 2002; Zohar, 2004).

The current curriculum of Kurikulum 2013, in learning use constructivistics-based methods or models that involve scientific approaches such as:

Problem Based Learning (PBL), also in learning learners should be able to find and link concepts with discoveries that have been made through Contextual Teaching and Learning (CTL).

The Kurikulum 2013 curriculum demands higher order thinking skills, so the process and assessment of natural sciences lessons must reflect HOTS. The subject of this study is how the process and assessment of natural sciences with HOTS based. Learning process based on HOTS are problem-based learning (PBL) and contextual teaching learning (CTL). In line with Sudarman's opinion (2007), PBL is a learning approach that uses real-world problems by applying critical thinking processes and problem-solving skills to acquire essential knowledge and concepts from learning materials. HOTS-based assessments are those that include the cognitive dimensions level of C3 (analyzing), C4 (evaluating), and C6 (creating).

### DISCUSSION

#### *Sains Learning*

*Sains* can also be interpreted as *Ilmu Pengetahuan Alam* (natural sciences) (Bundu, 2006: 9). *Sains* can be learned in elementary schools through *Sains learning*. *Sains Learning* in elementary schools becomes a way to better understanding the knowledge about living beings and their environment.

Subali, et al (2009: 1) stated that Natural Sciences or *Sains* concern in understanding the various natural phenomena systematically.

In essence, Natural Sciences learning in elementary school or *Sains learning* has four

dimensions of attitude, process, product, and application. Attitudes is related to curiosity about objects, natural phenomena, living things, and causal relationships that cause new problems, that can be solved through the correct procedure, natural sciences is open ended. The process is related to problem-solving procedures using scientific methods that include formulating hypotheses, designing and conducting investigations, collecting and analyzing data, and drawing conclusions. Natural Sciences product are concepts, principles, laws, and theories. Applications is related to the application of scientific methods and *Sains* products in everyday life. The above four dimensions are complete *Sains* features that can not be separated from one another. Therefore, *Sains* learning should cover these four aspects above.

*Sains* process leads to series of logical steps done by the scientist when he wants to answer his curiosity about nature, when he wants to find a solution to the *sains* problem he faces. Observation, problem identification, hypothesis formulation, experimenting, recording and processing data, truth testing, and drawing conclusions are examples of process elements that scientists often experiment with (Carin & Sund, 1989; Jinks J., 1997).

### Higher Order Thinking Skill (HOTS)

The concept of higher order thinking (HOT) originated from the Bloom (1956) taxonomy of cognitive domain (Forehand, 2010), these cognitive domains involves knowledge and the development of intellectual skills and in hierarchically ordered from concrete knowledge to abstract (Pappas et al., 2012).

HOTS or higher-order thinking skills is not only oriented to memorization and understanding of concepts, but rather to analysis, evaluation, and creation. this ability is very necessary to teach to learners. There are several indicators that included in higher-order thinking skills by Anderson & Krathwohl (2001) which are analyzing, evaluating, and creating. Newman and Wehlage also (2011) stated that "HOT requires students to manipulate informations and ideas in ways that transform their meaning and implications, such as when students combine facts and ideas in order to synthesize, generalize, explain, hypothesize, or arrive at some conclusion or interpretation. Models and approaches that can spur high-order thinking skills in learners are Problem Based Learning (PBL) and Contextual Teaching and Learning (CTL).

### Problem Based Learning (PBL)

Problem Based Learning is a pedagogical approach that encourages those who take part in its

processes to act both as supportive change agents working in collaboration with colleagues, and also as individuals to use their creativity in finding solution to practical problems. The process of questioning the issues and finding problem solutions using the creative spirit are also challenging for those who teach and deliver PBL based curriculum, and poses some fundamental question. (Armitage: 2015)

According to Arends (2008: 41), PBL is learning that presents the variety of authentic and meaningful problem situations to students that can serve as a milestone for investigation. While Sanjaya (2009: 214) also believed that PBL can be defined as a series of learning activities that emphasize the process of solving problems scientifically. According to Shoimin (2014: 129), Problem Based Learning (PBL) learning model is a model of learning that can train and develop the ability to solving problems that oriented to the authentic problems of the students' actual life.

Suyadi (2013: 137-139) stated that there are six steps to be able to implement PBL well, which are:

(1) Realizing Problems, (2) Formulating Problems, (3) Formulating Hypotheses, (4) Collecting Data, (5) Testing Hypotheses, (6) Determining Completion Options. Problems are the gap between reality and hope. Not all learners can be aware of any problems. If the learner is aware of a problem then he/she is sensitive to the situation. Thus in this stage, they are trained to higher-order thinking. Although can improve the higher-order thinking, PBL has several disadvantages.

The disadvantages of PBL are as follows:

(a) if students experience failure or lack confidence with low interest, students are reluctant to try again; (b) The PBL takes sufficient time to prepare; and (c) poor understanding on why problems are solved, so that students are less motivated to learn. (Sanjaya (2008: 221); Todd in Zabit (2010: 23).

### Contextual Teaching and Learning (CTL)

Research conducted by Ahri (2013) and Rubini (2014) showed that CTL approach is one of the approaches that can be applied to improve the ability of higher-order thinking of learners.

Johnson (2002) said that Contextual teaching and learning engages students in significant activities that help them connect academic studies to their context in real-life-situation. By making these connections, students see meaning in scholwork. When students formulate projects or identify interesting problems, when they make choices and accept responsibility, search about information and reach conclusions, when they actively choose, order,

organize, touch, plan, investigate, question, and make decisions to reach objectives, they connect academic context of life's situations .

The CTL approach has seven main components (Nurhadi, 2002: 5), which are Constructivism, Inquiry, Questioning, Learning Community, Modeling, Reflection, dan Authentic Assesment. The following describes the seven components of CTL approach:

- a. **Constructivism**  
Constructivism is the philosophy of CTL approach, that knowledge is built by humans little by little, that results are extended through narrow (tight) context. In a constructivist view, "acquiring strategy" takes precedence over how many knowledge that learners gain and remember.
- b. **Inquiry**  
The inquiry is a core part of CTL-based learning activities. Knowledge and skills that acquired by learners are not expected to result in remembering a set of facts, but the result of finding themselves. The inquiry cycle is observation, questioning, hypotheses, data gathering, and conclusion.
- c. **Questioning**  
The knowledge that someone has, always start from "ask". Questioning is the main learning based on CTL. Questioning is seen as teachers' activity to encourage, guide, and assess the thinking of learners. The question in the classroom can be applied between learners with learners, between teachers with learners, between learners with others who come to class and so forth.
- d. **Learning Community**  
Learning community occurs when there is two-way communication process. In a learning community, there are two or more groups are involved in the communication of learning of mutual learn. A person involved in a learning community activity provide the information needed by his/her conversational partner and at the same time asks for the required information from his/her study partner.
- e. **Modeling**  
In a lesson, there is always a model that can be imitated. The teacher gives a model on "how to learn".
- f. **Reflection**  
Reflection is also an important part of learning with CTL approach. Reflection is a way of thinking about what was just learned or thinking back on what has been done in the past. Learners settle what they just learn as new

knowledge structures, which are enrichment or revision of previous knowledge.

- g. **Authentic Assesment**  
Assessment is the process of collecting various data that can provide a depiction of the learning development of learners. A depiction of the learning development of learners needs to be known by the teacher in order to ensure that learners experience the learning process correctly. Correct learning should indeed be emphasized on helping learners to learning how to learn, rather than emphasizing on gaining information as much as possible by the end of the learning period.

**Assesment Based on HOTS**

The Kurikulum 2013 curriculum now requires HOTS-based assessment. When the former may still LOTS (Low Order Thinking Skill) but now teachers are required to prepare and use HOTS assessment for learners.

The reason for the learning assessment directed to HOTS according to Kemdikbud (2017) is because 21<sup>st</sup> century challenges are more complex. How learners can face the variety of challenges, one of them is by study through learning in school, whose assessment is also directed toward higher order thinking. With the aim that learners are accustomed to solvig problems.

HOTS-based assessment stage is first must be developed assessment instruments based on HOTS, like the development of instruments that have been done by Pratiwi and Fasha (2015). Further, Pratiwi and Fasha said their HOTS instruments have been able to measure higher order thinking skills because achieving the success of an assessment instrument with HOTS score of 73.3%

Table 1. Cognitive Dimension

	Creating (C6)	Reasoning (Cognitive level 3)
HOTS	Evaluating (C5)	
	Analyzing (C4)	
MOTS	Applicating (C3)	Application (Cognitive Level 2)
	Understanding (C2)	Knowledge and Understanding (cognitive level 1)
LOTS	Remembering (C1)	

Source: Anderson & Krathwohl (2001)

From table, 1 there are levels of cognitive dimension. Which included in HOTS C4, C5, and C6 are analyzing, creating, and evaluating.

- 1. **Analyzing**  
That is to describe the parts and determine

the connections. Included analyzing ie = differentiate, focus, select, integrate, define, structure, define bias/views/value/attention

2. Evaluating  
That is making consideration based on criteria and standards. Included evaluating which is coordinating, monitoring, testing, weighing/considering
3. Creating  
Creating means installing elements to form a functional unity; included forming new patterns/structures, proposing hypotheses based on criteria, completing the task, finding a product.

Depdiknas (2017) HOTS questions measure ability:

1. transferring one concept to another concept,
2. processing and applying information,
3. looking for links of different information,
4. using the information to solve the problem,
5. examining ideas and information critically.

Developing HOTS stimulus according to Depdiknas (2017)

- a. Choose some information, images, graphics, tables, discourses, etc. that have a linkage in a case.
- b. Stimulus should require the ability to interpret, seek relationships, analyze, conclude, or create.
- c. Select cases/problems which is contextual and interesting (current) that motivate learners to read. Exceptions for subjects of Language and History may not be contextual.
- d. Directly related to the question (main problem), works.

Teachers should be able to develop an assessment that actually measures the ability of C4, C5 and C6 of learners by taking into consideration the principles of HOTS measurement and stimulus above.

## CONCLUSION

To meet the demands of the 21<sup>st</sup> century, learning must be designed in such a way that the learners' skills to higher order thinking can also be better. Learning that can increase HOTS of learners is by Problem Based Learning and Contextual Teaching and Learning. If the teacher's model or approach is appropriate, then the assessment should also be appropriate. Appropriate assessment to develop HOTS learners is the one that can measures C4, C5, and C6. with proper learning and judgment, the higher order thinking skills of learners can be well realized.

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