

Effectiveness Problem Based Learning And Scientific Approach To Improve Higher Order Thinking Skills

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Abstract— This article aims to describe theoretically the effectiveness of problem based learning and scientific approach to improve higher order thinking skills. Problem-based learning and scientific approach is the same approach - the same student-centered, students not only gain knowledge directly, but also students should build their own knowledge. Problem-based learning is an approach centered learning students the basic problem is presented in the form of real problems, charming, authentic, ill - structured and a variety of variations to finish with the advantages of developing the problem solving ability of students, develop higher order thinking and scientific skills, integrating theory and practice, and motivate them, develop time management and data collection. While scientific is an approach to learning students actively integrating students in the process of thinking and the use of methods that are scientifically proven by conducting experiments to test the hypothesis, with the advantages of encouraging and inspiring students to think critically, to inspire learners are able to think hypothetically see the different, similarities and link to one another on the substance of learning materials. Higher order thinking skills is a process of thinking skills in depth and widespread that involves information processing in critical and creative in facing and resolving problems that are complex include critical and creative thinking skills. Syntax of PBL used to increase HOTS include (1) supply issues, (2) strategic planning, (3) investigation, (4) presented the results and (5) evaluating, whereas syntax of scientific approach used include: (1) observing, (2) questioning, (3) associating, (4) reasoning and communicating.

Keywords: *problem-based learning approach, scientific approach, higher order thinking skills*

I. INTRODUCTION

The development of science and technology in the century - 21 is rapidly have led to competition in many areas of life , including education. Human resources will be generated from the high-grade quality education, to train students' thinking skills and produce high-quality output that will require higher thought processes, skill in question is a high-level thinking skills are often called Higher order thinking skills (HOTS). Higher order thinking skills is a process of thinking skills in depth and widespread that involve processing the information critically and creatively in facing and resolving problems that are complex include critical and creative thinking skills [1], [2], [3], [4], [5], [6], [7]. Therefore, the government did not remain silent to always make changes such as holding facilities and infrastructures then revise the current curriculum of the Education Unit Level Competence (SBC) was revised to Curriculum 2013. The curriculum is aimed at improving the quality of human resources and enhance the nation's competitiveness, and along with the development of science, technology and art. The curriculum is expected to produce human resources productive, creative, innovative and affective competencies through strengthening of attitudes, knowledge and skills [8]. But the fact that the government declared curriculum has not been fully realized with the expected, according to [9] there are four obstacles teachers in implementing the curriculum in 2013 one difficulty to enable students in the classroom.

In the learning process needed both models, strategies, and learning approaches that can optimize the learning activities of students in the training of high-level thinking skills. One of them problem-based learning (PBL) is a learning approach centered on the students the basic problem is presented in the form of real problems (real word), charming, authentic, unstructured (ill - structured) and a wide variety to complete [10], [11], [12]. PBL theoretically could increase higher order thinking skills [13], [14]. Learning problem based learning is conducted in stages presents a problem, strategic planning, investigation, presented the results and evaluate. In addition leraning problem based learning, curriculum 2013 also recommends the scientific approach. Approach scientific an approach to student learning actively integrating students in the process of thinking and the use of methods that are scientifically proven by conducting experiments to test the hypothesis, with the advantages of encouraging and inspiring students to think critically, to inspire learners are able to think hypothetically in seeing the differences, similarities and link to one another on the substance of the study [15], [16] [17], [18].

Scientific taught us to think why something is happening ?, and what causes something to happen? then what about the solution of the problem that has occurred? [15]. From here students are encouraged to think radically and critically. The scientific approach is conducted in stages: observe, ask, gather information, reason and communicate.

Based on two approaches that have been mentioned are problem-based learning and scientific approach theoretically they can increase students' higher order thinking skills are critical and creative, so it is important to compare the two, which is more effective when used in learning, especially learning math.

II. DISCUSSION

A. Higher Order Thinking Skills

High-level thinking skills necessary to be applied to the students, because it will train students to think critically, creatively and skeptical of the problems encountered in the century - 21's. [19] states: "The definition of essential thinking skills: thinking is Generally assumed to be a cognitive process, a mental act by the which knowledge is acquired". This is in accordance with [20] on Graduates Competency Standards for Primary and Secondary Education stated qualifications in the ability of junior-dimensional skills have the ability to think and act of effective and creative in the realm of the abstract and the concrete in accordance with the learned in school and learning resources similar.

Thinking is a mental activity that a person experiences when faced with a problem or situation that must be resolved. [21] revealed some sense thinking: (1) thinking is a process that involves surgery - mental operations such as induction, deduction, clarification and reasoning, (2) thinking is a process of representation symbolically (through language) various objects and events real use it to find a symbolic representation of the principle - essential principle. (3) thinking is the ability to analyze, mengkritik and make generalizations. Furthermore, [22] declared four levels of thinking (level of thinking) as follows; (1) Recall (Given) at this stage a person requires the ability to review the event / experience before ever done or ever learned. (2) Basic (Basic) ie prior knowledge as a foundation for higher capability of basic capabilities such as addition, subtraction, multiplication and division. (3) Critical thinking (critical thinking) is the ability to evaluate and analyze more complex. (4) Creative thinking (creative thinking) is able to create ideas / new ideas that had not been done.

According to [1] Higher Order Thinking skills are categorized into 3 parts: "definitions that I find into three categories: (1) Reviews those that define higher order thinking in terms of the transfer, (2) Reviews those that define it in terms of critical notes thinking, and (3) Reviews those that define it in terms of problem solving ". In this case the definition of higher order thinking skills are categorized into three: (1) as a form of transfer of learning outcomes (2) as a form of critical thinking and (3) as a problem-solving process. While [6] expressed a high level thinking consists of understanding (comprehension), problem solving (problem solving), critical thinking (critical thinking) and creative thinking (creative thinking). [2] states HOTS characteristics as follows: "The characteristics of higher order thinking skills: higher order thinking skills encompass both critical thinking and creative thinking", there are two underlying characteristics HOTS is critical and creative thinking.

Characteristics HOST expressed Resnick (1987: 3): "Higher order thinking skills is non algorithmic, complex, Often yield multiple solutions, Involved nuanced judgment, involves applications of multiple criteria, Often involves uncertainty, involves self-regulation of the thinking process, involves imposing meaning, effortful ". This means HOTS has the following characteristics: unstructured step - step process, is complex, many of the solutions, involving variations in decision-making and interpretation, many criteria and more effort in doing it. [2] states that: "Higher order thinking skills Contribute to academy achievement". HOTS can be said to support the academic achievement of students.

Furthermore, [3] states: "Higher order thinking Occurs when a person takes new information and information stored in memory and interrelates and or rearranges and extends this information to Achieve a purpose or find possible answers in perplexing situations". So think high tigkat can occur when someone takes and stores the information in his brain and process well and extend that knowledge to reach the goal and immediately find the appropriate answer. According to [23] refers to the cognitive realm of Bloom's taxonomy consists of six levels: 1) Knowledge (knowledge): the ability

to remember the material they have learned from the experience of learning. 2) Understanding (compprehension): the ability to grasp the subject matter can be words, numbers, explaining causation. 3) Applications (application): the ability to use the subject matter that has been learned through the experience of learning to the circumstances and conditions that are more concrete. 4) Analysis (analysis): ability to break down the material into parts sehigga organizational structure of matter can dimegerti, 5) Evaluation (evaluation): the ability to take a decision to give an assessment or value judgment on a subject matter in accordance with the objectives. 6) Create (create) is able to make a product / idea either the formulation or form tools.

Level think high-level visits of the cognitive domain Bloom's taxonomy of time at the level of analysis, synthesis and evaluation, meaning the new taxonomy HOTS this to the level of creation. Associated with the revised Bloom taxonomy, is the higher - order thinking is the ability to think from analyzing aspects to creating. The following phases of Higher Order Thinking skills according to [24]:

- 1) Analysing: involves breaking material into its constituent parts and Determining how the parts are related to one another and to an overall structure. This means that learners fragmenting learned information into its parts in order to obtain information that he can be understood as well as possible. The activities can be grouped Analysing: differentiating, Organising and attributing.
- 2) Evaluating is defined as making judgments based on criteria and standars. Learners make decisions based upon deep reflection, critique, and assessment. The activities can be grouped evaluating: Checking and critiquin.
- 3) Creating have students make a new product by mentally reorganizing some elements or parts into a pattern or structure not present before Cleary. Learners mengkreasi new ideas by utilizing previously learned information. Thinking activities that can be categorized aspects of creating: Generating, Planning and Producing.

Critical thinking according to [25]: "critical thinking is the ability to a make rational decisions about what to do or what to believe". that argument is expected for students in a lesson can always respond to critical issues. In addition [26] states that: "critical thinking is a deep thinking process, the which helps us to understand what may be right or wrong. It is analyzing our past experiences and it helps us to resolve situations ". Then [27] states that: "critical thinking is reasonable reflective thinking focused on Deciding what to believe or do". This means that critical thinking is reasonable and reflective thinking focused on determining pa trust and what to do. Creative thinking is not separated with activities - activities that lead to a person's creativity, in the opinion [28] states that: "creativity is puspurposeful and involves effort to the make something better, more meaningful, or more beautiful. Meaning: creativity is a goal that involves an attempt to create a job, create a better, more meaningful or more beautiful. On the other hand think creatively defined by [29] stated that: "creativity is the capacity to create, to produce new things". This means that creativity is the ability to create, to produce things - new things. Trying to think creatively is not easy, a creative thinking must dare to fail and try to continue to find new ideas.

From the above it is creative thinking is the ability to think for someone to develop the power of reason, thus bringing forth ideas - new ideas that can be used to solve the problem.

Based on the theory study mentioned the Higher Order Thinking Skill or higher level thinking skills is the process of thinking skills in depth and widespread that involves processing seacara information critically and creatively in the face and solve problems that are kompleks.Soa - math problems in addition to test memory and the understanding and application must also be able to test learners up to level HOTS or can test the process of analysis, evaluation and creative. These questions can be designed with the teacher to see the indicator higher order thinking skills that have been formulated before associating it with a verb that included cognitive operations such as analyzing (C4), evaluating (C5) and creates (C6). Here's a list of verbs operations that can be used to form the matter at the level of higher order thinking skills.

Tabel 3.8 Verbs operations of level C4, C5 dan C6 [30]

Analyzing (C4)	Evaluate (C5)	Create (C6)
differentiating Organize attribute	Check criticize Prove	Build Plan Produce

diagnosing detailing analyze detecting tie Separate	Maintain Validating Support project	Combine devise Reconstruct Make Create abstracting
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If the five indicators associated with the verb HOTS operations on HOTS indicator will be formed as follows:

Table 3.9 Gratings Higher Order Thinking Skills

No	Aspects HOTS	Indicator	Alternative operational verbs that can be used
1.	Critical thinking	Linking the relevant information in accordance with the focus of the problem.	Analyze, select, define, combine and categorize
		Assessing the quality of the precision of an idea / ideas.	Distinguish, compare, predict and assess,
		Detecting the presence of consistent and inconsistent data or information received along with good reason.	Prove and criticize.
2.	Berpikir Kreatif	Develop knowledge of the ones to form new knowledge.	creativity, planning, constructing, designing, finding
		Being able to make a conclusion in accordance with the focus of the problem	Generating and making

B. Why choose PBL?

Characteristics of problem based learning that prioritizes real problems in learning, learning is collaborative, communicative, cooperative and inspiring, train students to learn independently and responsibility, to stimulate the curiosity of students in the investigative process and utilize learning resources are varied [31], [32], [33], [34]. Based on constructivism understand that learning is student center and student should be able to construct his own understanding in building schemes - schemes in mathematics. Problem based learning approach designed to assist students in the learning process of mathematics. Problem based learning approach utilizes real context of learning so as to make the students better appreciate the usefulness of mathematics dikehidupan day - her day, and familiarize students in solving complex problems that require higher-level thinking processes of students. But not all the problems in mathematics can be contextualized, so the use of problem-based learning, must be clever - clever teachers to pick and choose the material characteristics corresponding to problem-based learning. Problem-based learning when viewed from characteristics is appropriate when applied in the study of mathematics, because mathematics is essentially abstract so as to comprehend the students need to approach the real context in order to be meaningful and useful mathematical material. The advantages of problem based learning according to [31]: (1) it develops students problem - solving skills, (2) it develops sociability level and communication skills, (3) it develops students high-level thinking and critical thinking, (4) it united theory and practice, (student acquire the skills of time management, focusing, the data collection and evaluation report preparation. step - step problem-based learning, namely:

Table 1.1 Steps of problem based learning

No	Steps	Learning activities
1	Presents a problems	Teachers presents problems associated with real world context
2	Merencanakan strategi	Students on the settlement plan that has been accepted
3	Melakukan investigasi	Student and his group find and use various sources, both from books, the Internet or other sources that support problem solving
4	Presenting the works	Processing data later Students present the results of discussions that have been in if the group
5	Evaluate	Students reflect on the results and the process of problem-solving

C. Role Important Scientific Approach

Adopt a scientific approach of the scientific method, prior to be studied more deeply about scientific then we need to know what science is ?, Scientific involve all knowledge contained therein, according to [15]: "science is the activity the which aims to further our understanding of why things happen as they do in the natural world ". The point is that science is an activity that aims to expand / develop an understanding of why - it happens as it happens in nature. From this scientific opinion teaches us to think why something is happening ?, and why? then what about the solution of the problems which have occurred ?. From here students are encouraged to think radically and critically. Experts have different versions - depending on the definition of the scientific method. [35] states that: "scientific method is oversimplified and given too much precedence in science teaching. The version presented here is more complex, allowing for divergence from a set of specific rules ".

According to [16] of the scientific method is a scientific method often used by scientists to analyze the problem and found a solution scientifically. Then, according to [35] states that: "The" scientific method "seems to be an insignificant part of science in a system where the essential finding may be withheld if the" right "answers are not forthcoming". The meaning of this quote is the scientific method seems to be an important part of the science in a system to find the correct or tidaknay an opinion / answers that are useful in the present life and future. The scientific approach used in the curriculum K13 now basically refers to the scientific method used by scientists to study the problem of scientific excellence approach saintific namely the advantages of encouraging and inspiring students to think critically, to inspire learners are Able to think hypothetically see the different, similarities and link to one another on the substance of learning materialsLangkah in scientific approach, namely:

Tabel 1.2 Steps of Scientific Approach

No	Tahap	Aktivitas pembelajaran
1.	Obseving	Seeing, hearing, reading, listening (sign and instrument)
2.	Questioning	Asking questions of a factual question to the question hypothetical. Beginning with the guidance of teachers to independently
3.	Assocciating	Determining the necessary data from questions Specifies the data source either from books, the Internet and books other than textbooks.
4.	Reasoning	Analyzing the data into categories, define data

		relationships, concluded from analysis of data from the data structure that is simple to the complex
5.	Communicating	Delivering results conceptualization in writing, orally or pictures and diagrams.

III. CONCLUSION

Based on the characteristics and advantages of each of the two approaches, problem-based learning and scientific approach can both be used as an alternative approach to learning that can improve students' higher order thinking skills, especially in mathematics. Theoretically and supported by the results of relevant research, the problem-based learning is more effective than a scientific approach, it is because the problem based learning using real context in the learning process, so that students can imagine what will be learned.

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