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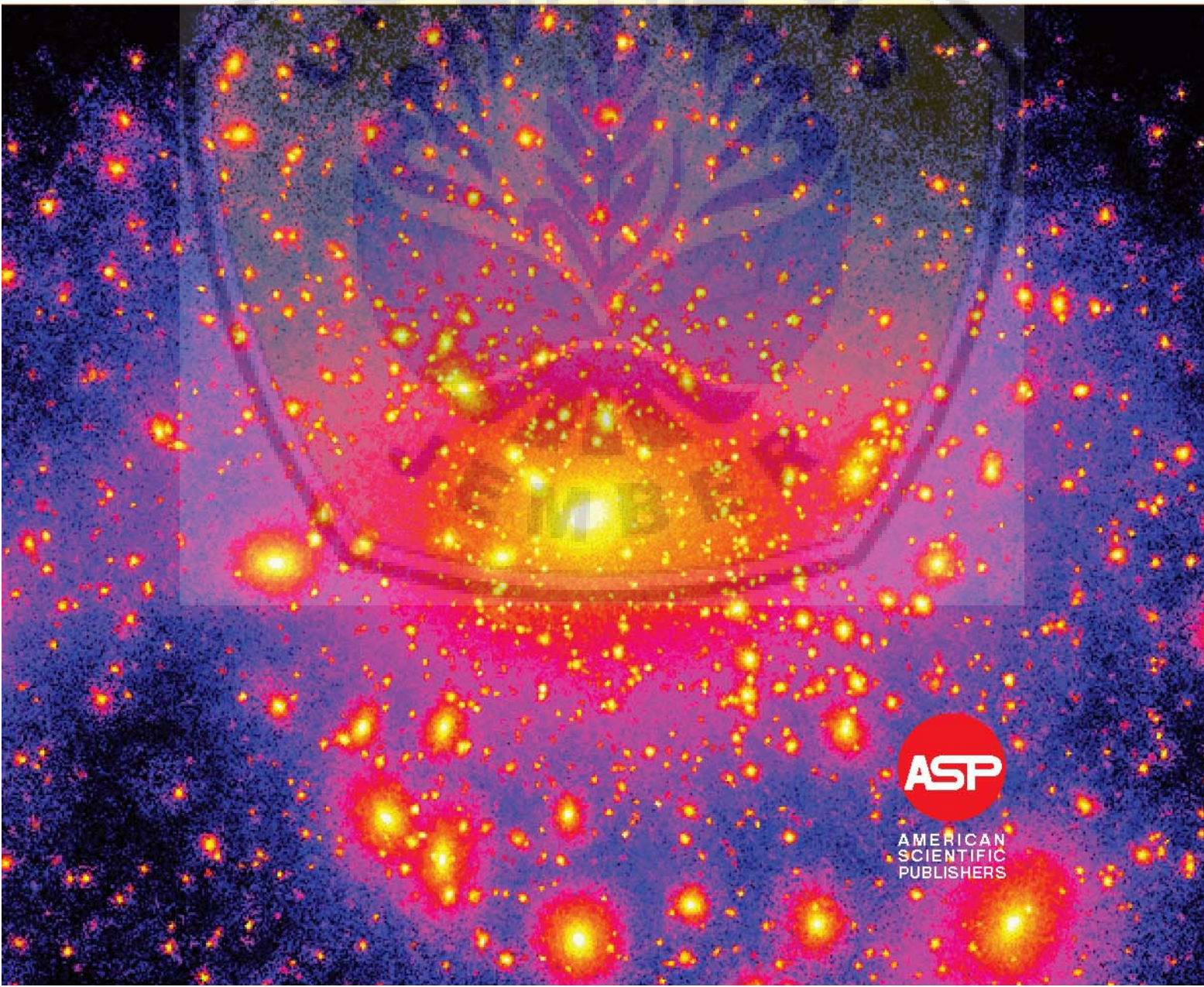

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The Higher-Order Thinking Process of Students Around a Coffee Plantation Based on Revised Bloom's Taxonomy Criteria During Mathematics and Science Collaborative Learning

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Received: 27th Oktober 2017 Accepted: 3rd November 2017

The research aimed to describe the higher-order thinking process of students around a coffee plantation based on the revised Bloom's taxonomy during Mathematics and Science collaborative learning. The indicators of the higher-order thinking skills under investigation comprised of analyzing, evaluating, and creating. The research subjects were 71 junior high school students around a coffee plantation in Jember regency, East Java, Indonesia. The stages of this research operationalized the stages of qualitative content analysis, namely (1) implementing collaborative learning, (2) giving test to the students, (3) analyzing the students' answers based on the higher-order thinking skill criteria, and (4) doing in-depth interview. Based on data analysis and discussion, the research concluded that 14 students met *creating* criteria, 39 students satisfied *evaluating* criteria, and 18 students met *analyzing* criteria. The students who mastered analysis skills tended to describe the conceptual parts of given problems, while those who mastered evaluation skills tended to describe, distinguish, and interpret the given problems. Furthermore, the students who satisfied *creating* criteria tended to find new ideas through continuous discovery.

Keywords: Thinking Process, HOTS, Revised Bloom's Taxonomy, Mathematics and Science Collaborative Learning.

1. Introduction

With regard to higher order thinking skills, especially pertinent to critical thinking and metacognition ability, 80% of the students around Garahan coffee plantation in Jember regency, Indonesia, are at *apprentice* level [1]. The very level signifies the competence in solving problems related to Mathematics and Science correctly. However, the students at this level have not been able to explain the reason of every step in logical problem solving. In addition, the students are able to connect former materials with new ones, so the process of reconstructing their knowledge within their mind can develop. This notion is also in line with the results of other studies that focus on the problem solving skills of students in Jember regency in solving PISA-standardized questions. These studies reveal (1) that the students tend to master sufficient problem-solving abilities, such as the ability to link information to problem with relevant concepts, organize hypotheses, organize and construct plans in solving the problem, and (2) that the students are not able to find additional solutions [2].

Based on those findings, the present study delves into investigating the students' tendency in problem solving ability and higher order thinking skills in general. It is by knowing the higher-order thinking process of students that teacher be informed to improve their ability to higher level. Researches on cognitive skills corroborate that facilitating students' high-order thinking skills in learning process helps to make them more aware of their own thoughts and also promotes learning performance and cognitive development [3]. In addition, these higher order thinking skills are activated when students encounter unusual problems, questions, or hardships in their lives.

Successful activation of higher order thinking skills in Mathematics and Science will result in valid explanations, decisions, and products in the context of existing knowledge and experience. Furthermore, these skills require students to transfer scientific knowledge and apply it into new situations in their lives [4]. Based on the background by this explanation, the research aimed to describe the higher-order thinking process of students around a coffee plantation based on the revised Bloom's taxonomy during Mathematics and Science collaborative learning. The research question was "How the higher-order thinking process of students around a coffee plantation based on the revised Bloom's taxonomy during Mathematics and Science collaborative learning?".

Students' collaboration ability is essential to allow them to learn with their friends for improving their higher order thinking skills. This is deemed true because collaborative learning in Mathematics and Science is a model for all teachers who respect and support all students' activities by creating safe, enjoyable, and encouraging atmosphere [5]. There are four core principles to the success of collaborative classroom in both Mathematics and Science, comprising of 1) the interdependence between social and academic curricula,

2) fostering caring relationships and building an inclusive as well as safe environment, 3) classroom learning experience actualized around knowledge constructed by the student through active engagement, and 4) respecting and building on students' intrinsic motivation, leading to their active involvement and achievement [6]. The term higher order thinking skills originates from Bloom's taxonomy in the cognitive domain introduced in 1956 [7]. The cognitive domain involves knowledge and development of intellectual thinking skills [8]. There are six main categories of cognitive processes, ranging from the simplest to the most complex ones. Bloom classifies intellectual behavior into six levels: knowledge, understanding, application, analysis, synthesis and evaluation [9].

Bloom's taxonomy ranges from concrete hierarchical cognitive development to the abstract one [10]. Hierarchical developments identify lower levels to higher cognitive levels. The first three levels in Bloom's taxonomy require basic knowledge recognition, understanding, and application. These skills are deemed at lower level thinking skills. Furthermore, the higher order thinking skills, according to the revised bloom taxonomy, is the ability operative at the cognitive level of analysis, evaluation, and creation [11]. In this study, the concept of higher-order thinking skills refers to the model proposed by Bloom, comprising of analysis, evaluation, and creation. In this study, the indicators of higher order thinking skills were (1) analyzing: restructuring information into smaller parts to find out patterns or correlations, differentiating the causes and effects of a complicated situation, identifying and connecting elements of parts, which eventually clarifies the hierarchy of elements. (2) evaluating: evaluating opinion, solution, and methodology operative against existing standard to ensure its benefit value, proposing hypothesis, criticism, and testing hypothesis, approving or rejecting a statement based on a standard chosen beforehand, (3) creating: drawing general conclusion based on an idea or point of view on something, designing a strategy to solve problems, organizing parts or elements to create a novel structure.

2. Research Method

The present study was qualitative descriptive in nature, devoted to describing higher order thinking skills of students around a coffee plantation in Garahan of Jember regency, Indonesia, when solving problems in collaborative learning on Mathematics and Science. The research subjects in this study were 71 junior high school students, consist of 27 first-grade students, 23 second-grade students, and 21 third-grade students. Collaborative learning was conducted in 2 meetings for each level with the integration of Mathematics and Science materials.

The data collected for analysis were obtained from video recording on students' learning activity, the results of their work, and interview. The research operationalized the stages of qualitative content analysis, which involved (1) implementing collaborative learning in each class, (2) giving test with 2 items to the students, (3) analyzing the students' answers based on the higher-order thinking skill criteria by identifying the fulfilled and unfulfilled indicators, and (4) doing in-depth interviews with the aim of probing deeper students' higher-order thinking skills based on the problem-solving outcomes. The determination of interview was based on the results of data saturation. In this case, the data were considered saturated when the results of interviews between the first subject and second subject were alike, or similar data between test results and interview results were evident.

3. Results and Discussion

Based on the analysis results of students' answers during collaborative learning, the researchers found that 14 students met creating criteria, 39 students satisfied evaluating criteria, and 18 students met analysing criteria. Based on the analysis data, the students' tendency in their analytical skills pertains to rebuilding information into smaller units to identify the pattern or relationship between what was known and the way to solve problem, to distinguish the causes and effects of problems given when learning, and to identify and connect the elements of problems. These were all done to clarify the hierarchy of conceptual elements concerned with problems at hand. In general, students who mastered analytical skills were able to describe the conceptual parts and details known about the problems.

There were 39 students who mastered the ability to evaluate. 10 students were found to reach creation level although they still unfulfilled one indicator, which was drawing conclusion from an idea or point of view on a matter. In addition, 9 students were found unable to reach creation level. So, in general, there were 9 students with the maximum ability at evaluation level. The tendency of students with evaluation skills was to assess their ideas and solutions to a given problem, to test the truth of answers or solutions proposed, and to approve proven solutions or to reject solutions when proven wrong.

The interview was done as triangulation, devoted to comparing and probing deeper into the students' higher order thinking skills during collaborative learning. The first interview was conducted to students who mastered analytical skills, i.e. S02, (chosen randomly

among students mastering analytical abilities). Student S02, upon solving the problem, was able to write down known details and used correct symbol. From those known details, student S02 was able to determine the relationship among known concepts and determine the ideas manifest in relationship he found. When interviewed, similarities between the student's answer sheet and his verbal response was evident. However, the data had yet to be saturated, so one more subject was interviewed to gain saturated data. Student S12, found to master analytical skills, was selected. Student S12 tended to show similar ability to S02, but they could determine the truth of details known from problem solving. As a corollary, student S12 mastered higher ability than did student S02. The result of the interview to student S12 evinced the same the result as the responses in his answer sheet, finally resulting in saturated data. This was because similarity was evident between student S02 and S12, as found from interview and their answer sheets.

The next stage was conducting interview to subjects with evalution ability. Student S30 with evaluation ability was randomly chosen from 39 students. The student's tendency was found at the first level of creation ability, which was finding new ideas or new concepts from his experience when solving problems associated with his experience in everyday life. However, the discovery of new ideas or concepts was not evident through continuous observation and research. In general, student S30 could perform evaluation because the creation ability had not been maximized. Student S55 with evaluation ability was interviewed. Student S55's tendency was different from student S30, because student S55 had not reached the stage of finding new ideas or concepts associated with experience in everyday life. Student S55 was able to find solutions correctly and prove the truth for his answer using a logical reason.

The last stage was interviewing the subjects at creation level. There were 14 students who mastered creation ability. Their tendency manifested the fulfillment of indicators corresponding to creation ability, which encompassed (1) drawing general conclusions from an idea or perspective on something, (2) designing a strategy for solving problems, and (3) organizing parts or elements to develop a new structure.

4. Conclusion

Based on the results, and 18 students fulfilled analysis criteria. Simply put, in general, the students' tendency alluded to the mastery of higher order thinking skills at evaluation level. The students who mastered analysis skills tended to describe the conceptual parts of given problems, while those who mastered evaluation skills tended to describe, distinguish, and interpret given problems. Furthermore, the students who satisfied creation criteria tended to find new ideas through continuous discovery.

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