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The students' activity profiles and mathematic problem solving ability on the LAPS-heuristic model learning

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Abstract

Problem-solving skills that cover the ability to understand problems, design mathematical model, complete the model and interpret the solution obtained are the abilities which students must possess. With regard to above symptom, this study described student's activity and mathematics problem solving ability based on SOLO Taxonomy on Laps-Heuristic learning model. The procedure of the study was done through providing learning with Laps-Heuristic model with mind mapping, observing student activity during learning, giving mathematics problem solving test, analyzing the result of mathematics problem solving test, classifying the result of mathematics problem solving test based on taxonomy of SOLO, choosing the subjects of study, interviewing selected subjects, and compiling the study results. While the procedures of data analysis of this study included data reduction, data presentation, and conclusion. Based on the result of the study, it showed that the students' activity was excellent due the fact that their scores were above 75% and their problem solving abilities were classified based on the SOLO Taxonomy consisting of 8 relational level students, 25 multi-structural level students, and 1extended abstract student.

1. Introduction

According to the Regulation of the Minister of National Education No. 22 of 2006, mathematics learning aims that students have the ability to solve problems which include the ability to understand problems, design mathematical models, complete the model and interpret the solutions obtained. In addition, in Curriculum and Evaluation Standards for School Mathematics, NCTM (2000) poses problem solving as the main vision of mathematics education in addition reasoning, communication, and connections. Hence, problem solving is one of the main objectives of mathematics learning and an important part of mathematical activity.

One of the characteristics of mathematics is possessing abstract study object, or often also called as mental objects (Soedjadi, 2000). The characteristics of this abstract inherent in the branch of mathematics that causes many students in elementary and secondary education have difficulty in studying and solving mathematics problems. The higher level of education, as well as the greater or more abstract properties exist in mathematics.

Based on the results of PISA under the Organization Economic Cooperation and Development (OECD) in 2015, Indonesia ranked 63 out of 70 countries in the field of mathematics with the score below the OECD average. In the same year, the result of the study shows that among the 49 countries participating in TIMSS (Trends in International Mathematics and Science Study), the achievement of Indonesian students in mathematics was ranked 44th. Based on the data obtained, it shows that the problem solving ability of students is still low. This is due to the lack of student interest in mathematics lessons because of the abstract mathematical characteristics. In addition, the problems faced by students above can be caused by the way the presentation of materials or learning models used by the teachers which have not been able to develop student activeness.

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According to Suyitno (2011), learning model that is often used in the learning of mathematics is an expository model which is essentially same as the lecture method and teacher-centered learning. Whereas teacher-centered learning actually less explores the potential of the students, so that learning becomes less active. For that, we need an innovative learning model that can help students to be more active and able to improve their problem solving skills.

Moreover, according to Risnanosanti (2008), to be an efficient problem solver, students need to know carefully what they really know and use their knowledge effectively. To be successful students, they need to know what they learn and how the best way to learn is. They should also know when to seek help when they encounter obstacles/difficulty in their lessons. Regarding to above explanation, one of innovative learning models that can help students to improve problem solving abilities is Logan Avenue Problem Solving Heuristic (LAPS-Heuristic) learning model. This is supported by Anggrianto et al. (2016) which state that problem solving and problem solution finding are the main characteristic of the LAPS-Heuristic learning model.

Again, according to Shoimin (2014), the learning model of Logan Avenue Problem Solving is a series of guiding questions in solution of the problems. LAPS (Logan Avenue Problem Solving) usually uses the question word what the problem is, is there any alternative, is that useful, what the solution is, and how to do it. While heuristic is a guide in the form of questions needed to solve a problem. Heuristics directs the students' problem solving to find solution from a given problem.

Meanwhile, to give a pleasant impression as well as to sharpen the creativity of students, then this learning model assisted mind mapping. According to Swadarma (2013), mapping is a technique of utilizing the whole brain by using visual images and other graphical infrastructure to form an impression. Meanwhile, according to Buzan (2013), the mind map can encourage problem solving by letting us see new creative breakthroughs.

Students' mathematics problem solving skills can be classified into several levels. Biggs and Collis in Putri & Manoy (2013) explain that each stage of cognitive response is the same and increasing from the simple to the abstract. The Biggs and Collis theory is known as Structure of the Observed Learning Outcome (SOLO) which is the observed learning structure. The SOLO taxonomy is used to measure students' ability to respond a problem which is classified into five and hierarchical levels: pra-structural, unsructural, multi-structural, relational, and extended abstract. In the field of mathematics, the SOLO model is used in assessing results. In the field of mathematics, the SOLO model is used in assessing students' cognitive results in several skills and scope of mathematics including statistics, algebra, probability, geometry, error analysis and problem solving (Ekawati, 2013). Thus, the objective of this study is to obtain an overview of student activity and problem solving skills of mathematics students on the model of mind-based Minded LAPS-heuristic based on SOLO Taxonomy.

2. Methods

The sample of this study is the students of class VIIA SMP Negeri 2 Ungaran which are randomly selected by random sampling technique. While the subject of this study is selected by using purposive sampling technique which is a technique of taking data sources with certain considerations (Sugiyono, 2015). The consideration in the selection the study subjects is based on the answers of written test results that are unique and the subject belongs to active and communicative students. Then, the selected subjects were interviewed and analyzed their problem-solving abilities based on SOLO Taxonomy in LAPS-Heuristic learning assisted by mind mapping.

Since the object of this study id to describe student activity and problem solving ability of student mathematics based on Taxonomy of SOLO, the approach of this study is descriptive qualitative study. It is a study that tries to describe and interpret the existing condition or relationship, growing opinion, ongoing process, current result or developing trend (Sumanto, 1990). While the data of this study are quantitative data which consist of observation of student activity and the result of students' mathematics problem solving ability test, while the qualitative data which were obtained from interview. It was done to know the reason of student's answer.

The steps which were done in this study were providing the learning with Laps-Heuristic model with mind mapping, observing student activity during the learning, giving mathematics problem solving test, analyzing the result of mathematics problem solving test, grouping the result of mathematics problem solving skills based on SOLO Taxonomy, selecting study subjects,

conducting interviews on selected subjects, and compiling study results. Furthermore, the methods in collecting study data are mathematics problem solving test, student activity observation, and interviewing mathematical problem solving ability. The result of the mathematical problem solving test was analyzed and then selected by several subjects to be interviewed about mathematical problem solving ability.

Then, the analysis of students' mathematics-solving skills tests was done by using the indicators according to NCTM (2000), namely (1) building new mathematical knowledge through problem solving, (2) solving problems in mathematics-related contexts, (3) applying and adapting various appropriate strategies to solve problems, (4) observing and developing the process of solving mathematical problems. While the analysis of student's mathematical problem solving abilities based on SOLO Taxonomy was conducted by using indicators from Chick (1998), namelyy prastructural, unructural, multistructural, relational, and extended abstract.

The procedures of analysis included data reduction, data presentation, and conclusion. From the data that have been collected, then summarized and reduced to focus on student activity profile and students' mathematics problem solving ability based on SOLO Taxonomy in LAPS-Heuristic learning model assisted by mind mapping.

3. Result & Discussion

3.1. Students' Activity

The observation of student activity in LAPS-Heuristic learning model assisted by mind mapping is by using observation sheet of student activity. The results of the student activity assessment are then analyzed based on the final score obtained. The range of scores used on student activity observation sheets is adjusted to the assessment criteria as shown in Table 1.

Table 1. The Student Activity Observation Sheet Score Score Range

Score Range	Criteria
$1\% \leq x \leq 25\%$	Less
$26\% \leq x \leq 50\%$	Enough
$51\% \leq x \leq 75\%$	Good
$76\% \leq x \leq 100\%$	Excellent

The observations score of students' activity for each successive meeting in four meetings are 76.25; 95; 87.5; and 98.75. It can be seen that the score of the observation result of the students activity during the learning is very good as for they are in the range of score 76% ≤x≤100%.

According to Diedrich (in Hamalik, 1995), students' activities are divided into eight groups: visual, speech, listening, writing, drawing, motor, mental, and emotional activity.

Visual activity has three indicators, they are paying attention to teacher explanation; paying attention, reading, and studying the learning media (LKS); and studying the presentation of friends or other groups. While the average score of visual activity obtained is 3.5; 3.75; and 3.5. The second activity is talking activity which has an indicator that is active in asking questions, and able to express opinions or respond to questions in group discussions. The average score of speech activity is 3 and 3.25.

The third activity is listening activity that has an indicator the students are able to listen to explanations or conversations in the group discussion, and able to listen to explanations of the results of discussion from other groups. In a row, the average score of listening activity was 3.75 and 3.75. Furthermore, the fourth activity is a writing activity that has indicators making important notes or writing teacher explanations and discussion results, and able to make discussion conclusions. The average score of writing activity obtained is 3.75 and 3.75.

For morw, the fifth activity is a drawing activity that has an indicator in order to be able to solve mathematical problems in the LKS and quiz, and to write mathematical sentences according to problem questions. The average score of drawing activity is 3.75 and 3.5. Then, the sixth activity is motor activity that has indicator that student is able to be active in group discussion and ready to accept the next task. The average score of motor activity is 3.75 and 3.

The seventh activity is a mental activity that has indicator that student is able to follow the learning and actively follow the course of discussion or enthusiastic in listening to friend's presentations. The average score obtained for mental activity is 3.5 and 3. As well as the eighth activity is emotional activity that has the indicator that students are able in working on the problem independently, developing confident, discipline, initiative, and responsible character. The average score obtained is respectively 3.5; 3.5; 3; and 3.

Based on the results obtained, 15 of the 20 indicators of student activity are divided into eight activities, including excellent category. The 5 indicators of good student activity are the activity of asking questions (talking activity), ready to accept the next task (motor activity), actively following the discussion or enthusiastic in listening to the friend presentation, developing discipline and initiative character (emotional activity). This increased activity is the result of the application of LAPS-Heuristic learning model assisted by mind mapping.

In addition, the increase is caused by several advantages of LAPS-Heuristic learning model assisted mind mapping, as follows 1) it can cause curiosity and the motivation to build a creative attitude; 2) it generates original, new, distinctive, and varied answers and can add new knowledge; 3) it can improve the application of the knowledge which has been acquired; 4) it invites students to have problem solving procedures ang be able to make analysis and synthesis, and they are required to make an evaluation of the results of the solution; 5) it is an important activity for students who involve themselves (Adiarta et al, 2014). Thus, the student activity in learning with Laps-Heuritudes model assisted mind mapping increased. This is in accordance with Wahyuni et al (2015) study, that the learning model of LAPS-Heuristic as an alternative model of mathematics learning to develop the character of discipline and solving problem ability. In addition, the students also give positive response to the components and learning activities with Laps-Heuristic model (Purba, 2017).

3.2. Problem Solving Ability

The average score of the students' mathematical problem-solving skills is 86.4 with the score of 24 students is above the predetermined KKM. This shows that 79.4% of students reach the KKM. Based on these results, students are further grouped into SOLO Taxonomy level. The SOLO taxonomy is used to measure students' ability to respond a problem which is classified into five and hierarchical levels. The results of students' mathematics problem solving skills test have been grouped according to the SOLO Taxonomy as shown in Table 2.

Table 2. Students SOLO Taxonomy Level

SOLO Taxonomy Level	Number of Students	Percentage (%)
Prestructural	0	0
Unistructural	0	0
Multistructural	8	23,5294
Relational	25	73,5294
Extended Abstract	1	2,9412
Total	34	100

Based on Table 2, from 34 students of class VIII A SMP Negeri 2 Ungaran, which included 8 multistructural students with a percentage of 23,5294%, 25 relational students with a percentage of 73.5294%, and 1 abstract extended student with percentage of 2,9412%, it can be seen that the majority of students are at a relational level because students are able to re-examine the results obtained and can make the relevant conclusions. While there is no students who are at the prestructural and unistructural level because all of them already understand the problem and plan the problem solving well.

The result of mathematics problem solving analysis based on SOLO Taxonomy from 8 selected subjects is one student who belongs to the extended abstract level that is A12 subject. Four students belong to the relational level, they are A14, A20, A31, and A29 subject. Three students belong to multistructural level, as follows, A01, A09, and A15 subject.

While A12 subject is classified as extended abstract level. He is able to solve mathematics problems which are given by the researcher. He can understand the concept and determine the volume formula of building blocks of space and prism. From one item given, the A12 subject is able to work on the problem with three solutions with one of the solutions is by using the fractional concept. It shows that the A12 subject is capable in working on many interactions and abstract systems involving the widespread use of the data provided simultaneously. In addition, he is able to explain the relationship between the three solutions that he writes. In brief, he successfully reaches all mathematical problem solving indicators.

The A14, A20, A31, and A29 subject are in relational level. A14 and A20 subject can solve the problem in four ways. While A31 and 29 subject are able to solve the problem in three ways. The four subjects can understand the concept and determine the volume formula of building a flat

side space, especially the volume of the beam. A14 and A29 subject are able to explain that the problem can be solved using the prism volume formula, but A14 does not write it on the answer sheet. In addition, all of them are able to explain the relationship of some of completions of the written subject. Hence, they successfully reach all of mathematical problem solving indicators.

Furthermore, A01, A09, and A15 subjects are classified as multistructural levels. They are able to solve the problem in two ways. The three subjects can understand the concept and determine the volume formula of building blocks of space. But they are unable to explain the second completion of the written subject. Nevertheless, when they are given a feed then they can explain well. However, A15 subject gives a less precise explanation of the second completion of the written subject. Shortly, they have not reached all the indicators of problem-solving abilities, particularly on indicators of observing and developing mathematics problem solving processes. This is in line with study by Fatchurrohim et all (2016), that the Laps-Heuristic learning model can improve students' conceptual understanding.

4. Conclusion

With regard to the description of analysis above, it can be concluded that student activity with Laps-Heuristic learning model including criteria is excellent. While the students' mathematical problem solving ability which is classified based on SOLO Taxonomy consists of 8 reational students, 25 multistructural students, and 1 extended abstract student.

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