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Cognitive description of students in mathematics learning through lesson study

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Cognitive description of students in mathematics learning through lesson study

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Abstract. This research aimed at describing the students' cognitive aspects in mathematics learning. The description of the students' cognitive aspects in mathematics learning provided understanding to the lecturers as the preparation in planning the mathematics learning to support the maximum achievement of the students during the learning. In the first step, *plan* was the first activity with the Lesson Study team to discuss various preparations needed. The second step, namely *do* and the third step, *see* as the evaluation form of the conclusion through the lecturer expression model and findings of all observer in order to be improved and analyzed by the researchers. The results of the research revealed that the students' cognitive aspects covering the students' mental activities consisting of six levels, namely remembering, understanding, applying, analyzing, evaluating and creating. The results of this research were the initial references which needed to be raised in creating ideas, methods or procedures to solve problems.

1. Introduction

Indicators of the success of the education process can be seen from the results of the learning. Learning achievement can be seen through the cognitive, affective and psychomotor aspects [1]. Academic achievement is influenced by the lecture process, so the students' cognitive abilities need to be known in order to achieve good academic achievement because this is an indicator of success in learning. The student's cognitive ability is the ability of mental activity cognition which involves searching, acquiring, storing and using knowledge, which definitely involves the lecturer in achieving it.

The learning is focused on the strength of cognitive factor predictions on the students' success in their studies, so that in the lectures through the lesson study will explore the effect of cognitive factors in mathematics learning for the students. This is because only few people who say that learning mathematics is fun, it is necessary to find the best solution so that mathematics can be understood easily for the students who study mathematics, especially because mathematics is the basis of all disciplines. Mohsin suggests that lecturers are considered as nation builders and are responsible for the

formation of the students' characters [2]. So that, innovation in learning needs to be done by the educators. The lesson study on the lectures in capita selecta courses is one of the learning model efforts in order to improve the quality of the learning process. A good learning process will have an impact on improving the quality of education, this is as stated [3]. Learning achievement is a realization of the potential skills or capacity of a person.

The implementation of the lesson study is a strategy for exchanging ideas in the development and preparation of the mathematics learning plans. The lesson study in Indonesia is currently intensified by the lesson study activists, this can be seen with an international seminar on lesson studies held by ICLS (International Conference on Lesson Study) at Pakuan University in October 2018. The lesson study applied as a guidance model for teacher candidates is expected to improve the students' ability in implementing the learning strategies [4]. Thus, the lesson study is a learning model that can be used in order to improve the learning processes and achievement collaboratively and sustainably.

Mathematics is defined as a branch of exact science and becomes the basis of logic in science needed in the development of science and technology. Mathematics has an abstract object of study, mathematics bases itself based on agreements show that mathematics fully uses a deductive mindset, and mathematics is imbued with the truth of consistency [5]. James & James define it as the science of logical study on numbers, shapes, arrangements, quantities, measures and others related concepts [6]. The conclusion from various opinions stated by those experts reveals that mathematics is a science containing structured and organized symbols with deductive evidence ranging from undefined elements to the deifned ones, to the axiom or postulate and finally to the argument.

The cognitive term comes from the word cognition which is commensurate with knowing means knowing, in the broadest sense cognition is acquisition, arrangement and use [7]. By following its development, the term cognitive is increasingly popular as one of the human psychological characters which includes mental behaviors related to understanding, consideration, information processing, problem solving, intentionality, and belief.

Cognitive process refers to a process that is centralized in the brain whose functions are to receive, process, and interpret the knowledge and experience obtained through interaction with the environment. Cognitive is a mental activity dealing with perception, thought, memory, and information processing that allows a person to gain knowledge, solve problems, and plan for the future. Cognitive has six aspects covering remembering, understanding, applying, analyzing, evaluation, and creating [8]. Suryantai points out the cognitive abilities are related to how individuals receive, store, process and present the information [9]. Kalyuga states that one of the factors causing the excessive cognitive burden is the learning strategies in which it is poorly used [10]. One of the basic factors that disrupts the learning process is the lack of knowledge and skills to develop it [11].

According to Mena & Eyer, cognitive development turns out to be a concern since it deals with skill, memory, language, and problem-solving ability [12]. Cognitive is the ability to recognize and understand the problems being faced and it is directly related to an individual [13]. From the experts' opinions described above, the researcher concludes that cognitive refers to a mind activity which is centered in the brain so we are able to think, receive, process, and interprete the knowledge in which it covers six aspects: remembering, understanding, applying, analyzing, evaluation, and creating.

Lesson study for the learning community (LSLC) emphasizes on the study of how the students learn and collaborate, rather than on how the teachers teach and master material which are developed according to the emphasis on the aspect of lesson study, which is the study about teacher and the students' masteries on the material rather than the students' learning activities [14] There are three important element contained on LSLC concepts, they involve collaborative learning, learning community, and *jumping* assignments [15]. Collaborative learning is reflected through the students' involvements in learning. Learning community consists of three philosophies: public philosophy means that all parties are the school reformist actors, democracy philosophy means that the education goals of school focus on how the students learn and collaborate with each other, excellent philosophy means that doing their best in learning and teaching [16].

Lesson study helps the students develop their abilities. The application of LSL-based CTL learning

had a positive effect on higher order thinking skill [17]. The positive effect of critical thinking skill is seen through the application of LSLC-based discovery learning [16]. The positive effect of creative-thinking ability is seen through the application of LSLC-based scientific learning. This research examined on how the students' cognitive processes were when they were given Lesson study-based learning.

2. Research methods

The description research of students cognitive in mathematics learning through this lesson study aimed at looking the characteristics of the students while learning mathematics. The subjects of this research were the fourth semester students joining the course of capita selecta of high school. The main instrument in this study was the researchers, therefore at the time of data collection in the field the researchers played an active role during the research process.

The data collection process in this study began with conveying information to the lecturer team in the stage of plan. The focus of the observation was students' attitude and cognitive process during the learning. The data were collected through observation conducted by all researchers by looking at the students' attitude and expression to be noted during the learning process. The result of the observation was presented and noted by the observer in the observation sheet that eventually submitted to the researcher.

3. Results and discussion

Before the lesson study was carried out, the team of lesson study was arranged to collect the data based on the purpose of the research. The lesson study stage consisted of three stages: plan, do and see. This Open Lesson Study was conducted at the capita selecta of high school in the fourth semester. Open lesson in this study was carried out three times within the material of sequence, namely function, equation and quadratic function in the first open lesson. The material presented in the second open lesson was non-quadratic equation and in the third open lesson was circle. The time allocation for open lesson was three times and was adjusted with the schedule of the course that was took place once a week to conduct open lesson.

Open lesson at the initial stage was a plan aimed at designing the implementation of learning, which addressed do and see activities. In plan stage, the member of lecturer team directly altogether looking for the solution to the problem arose by the model lecturers. In the second stage namely do is a form of realization discussed in the plan. At the time of the plan, the researcher said that the model lecturers were the researchers themselves, the member of the team and other lecturers acted as the observer in do activity. The researcher presented plan stage in the forum in which the focus of the observation was all of the students' cognitive activities during the learning.

At the time, the observers looked for a strategic position where they could observe clearly to collect data in the form of photo and video. The activities in stage do invited all the observers to focus on observing all of the students' cognitive activities from the beginning to the end of the learning.

In the last stage of open lesson study namely see stage, all of the observers provided information and input to the discussion forum after the model lecturer gave a presentation regarding to the do activity in the open lesson that had been carried out. The stage of see was guided by a moderator and assisted by a reporter.

The data that obtained in the three open lessons were as follows, the observer code was: $O_{i.j}$ = observer i in open lesson j. The number of students in the open lesson study was 19 divided into 3 groups based on their initial ability. The division of groups was made as fairly as possible based on the average score in an almost balanced group. The order of the abilities based on the score obtained was given a number starting from 1 up to 19, the same number was positioned in order. The member of Group A (1,6,7,12,13,18,19), group B (2,5,8,11,14,17), and group C (3,4,9,10,15,16). The following were the data obtained by the observers:

- $O_{1.1}$ = Group A, student no.19 in working on the problem often looked day-dreaming but he was able to answer question number 1 related to what he thought.

- $O_{3.1}$ = Group C, while discussing, student number 4 was very active and was seen making the stages of problem solving although he was still confused when getting a solution.
- $O_{2.1}$ = Group B, student number 8 was very focused on solving problems that require analysis, while other members were asked to try to solve other problems.
- $O_{3.1}$ = Group A, student number 1 seemed to dominate the discussion and in the presentation he was able to explain the solution very well.
- $O_{1.1}$ = Group C, student number 15 seemed to be less active in the discussion, he only showed signs of understanding after the other group members explained.
- $O_{2.2}$ = Group B, student number 5 also appeared dominating the discussions, he led the discussion and the presentation.
- $O_{2.2}$ = Group A, student number 18 appeared silent but focused on the problem. It seemed that he was trying to remember the material related to the problem in front of them. After a few moments moving the pen and tried to answer the question, after I approached, it turned out to be a matter of memory.
- $O_{3.2}$ = Group C, student number 10 was very eager to work on the application questions related to the formulas that have been memorized.
- $O_{3.2}$ = Group B, student number 14 was pensive when receiving a question from a lecturer. After I observed, it turned out that he tried to understand the problem that must be done by remembering the previous material.
- $O_{1.2}$ = Group A, student number 12 seemed to know the formula related to the problem because he looked so fast in solving the problem. However, after a while he looked as if he felt that the problem was starting to be more difficult.
- $O_{1.3}$ = Group A, student number 7 seemed to be very focused on the problems that require analysis. After he finished, he explained to his group members.
- $O_{2.3}$ = Group C, student number 3 seemed to lead the discussion by directing the part of the questions that could be done by each group member, and it seemed that he himself was working on the part of the questions that needed evaluation to check the truth.
- $O_{3.3}$ = Group B, student number 2 seemed to actively lead the discussion to the point where he represented the group when working on questions by giving explanations that his friends could understand.
- $O_{3.3}$ = Group C, student number 16 looked so calm and often paid attention to his friends if they say something. He also tried to record it if he felt it was necessary.

By looking at the data obtained from observers, it visually illustrated that individual characteristics in learning are very divers. Individual character in learning is a cognitive aspect that involves the work of the brain which always gives additional knowledge stored in the brain. If the data was synchronized with the research hypothesis, it resulted in the individual cognitive aspects of remembering, understanding, applying, analyzing, evaluating, and creating which can be grouped as follows: the cognitive aspects of remembering are the codes $O_{3.3}, O_{2.2}, O_{1.1}$; cognitive aspects in understanding are $O_{3.2}, O_{1.1}$; cognitive aspects in applying are the codes $O_{3.2}, O_{1.2}$; cognitive aspects in analyzing are $O_{1.3}, O_{2.1}$; cognitive aspects in evaluating are the codes $O_{3.1}, O_{2.2}$; and creative cognitive aspects are $O_{3.1}, O_{2.3}$. This is supported by the revised bloom taxonomy that there are six main categories of cognitive processes namely remembering, understanding, implementing, analyzing, evaluating, and creating [8].

4. Conclusion

Through lesson study based learning the cognitive character of students' learning can be described. Based on the discussion of the data obtained, the cognitive description of students' learning through lesson study based learning was that the students' brain activity in learning through the search process by getting a response that resulted in the assimilation and

accommodation process so that it added knowledge and was stored in memory then used when needed. Cognitive students include six aspects, namely: remember, understanding, applying, analyzing, evaluation, and creating. Suggestions for future researchers is to explore how are the students' think processes in every cognitive aspect.

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