Students' metacognitive ability in contextual teaching and learning of mathematics based on jumping task

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Abstract. This research aimed to describe the process and result of the develop Mathematics teaching administration by using Contextual Teaching and Learning (CTL) based on jumping task as well as to know its effect on the student’s metacognitive capability. This type of research was a mixed method, which combines quantitative and qualitative research. The development model used in this study is Thiagarajan 4D. Respondents involved in this study consist of two classes, namely an experimental class of 36 students and a control class of 36 students. The research result shows that (1) the teaching administration is valid, practical and effective criteria (2) there is difference of metacognitive ability in control class and experiment class. This is indicated by the significant effect on of application of learning by using CTL based on jumping task.

1. Introduction
The Indonesian National Curriculum 2013 are the improvement of the previous curriculum. The development of the curriculum 2013 stimulated students to be better able to make observations, ask questions, reason, and communicate what is obtained after receiving learning material. One of the abilities developed in the curriculum 2013 is metacognitive ability. Metacognitive is a form of ability to see oneself so that what is done can be controlled optimally. Metacognitive ability in learning is very important to develop students' abilities in learning cognitive strategies. Students' metacognitive skills has been in stated previous studies, stating that students were better in solving problems when they had a high of metacognitive skills [1,2,3,4,5,6].

Metacognition is the student's capability to planning, monitoring (supervise), and evaluating a learning process. Metacognition is also often referred to as "thinking about thinking" which expresses that "metacognition is a high-level thinking skills involving someone metacognitive awareness during the learning process" [7,8].

Contextual Teaching and Learning (CTL) is a learning approach that emphasizes the process of full student involvement to relate learning material with the real situations, so that the knowledge they achieved may become meaningful [9]. Whereas Jumping Task is giving challenging questions / tasks to students in the hope that students work together in working on problems through dialogue, interaction, and collaboration. Jumping task is a concept of continuing professional development adopted by Japan from the Lesson Study for Learning Community (LSLC) program [10].
Based on interview with the mathematics teachers of MTs. Kebunrejo Genteng, it was revealed that the learning process all this time had been by using the lecture method, focusing students for memorize information conveyed in class without be commanded to relate learning material with the real situation. The students only listen and copy notes from the teacher without understanding the concept. The student worksheets consist of practice questions not supporting to develop mindsets, the students did not optimally work cooperative in groups, the students tended to think individually and did not care for their friends who felt difficult in learning. If the students' ability is limited to remember without understanding the concept from the material, this resulted of the students not being able to understand their abilities and not being able to evaluate it.

One of the effort that can be done to improve students' ability to monitor the learning process and evaluate it by using the metacognitive ability. Metacognitive ability can be applied by integrating it into the learning process. Therefore, teaching administration were needed to accommodate applying these characters in learning. Teaching administration also becomes guide for teachers in implementing learning. Preparation of teaching administration requires a good plan [11,12,13,14]. Metacognitive capability can be monitored from learning journal prepared by the teacher. The applied process of takes place during a lessons study for learning community[15].

Considering the problem explained above, it is necessary to have a specific research of the develop mathematics teaching administration with approch CTL based on jumping task and how its effect to the students' metacognitive ability. The componen in this learning is (1) Constructing, (2) Finding, (3) Questioning, (4) Collaboration, (5) Modeling, (6) Reflection, (7) Authentic Assessment, and (8) Jumping task.

2. Research method

This research used a combination research methods is mixed of qualitative and quantitative methods wich Concurrent triangulation strategy model. The development of teaching administration by using the RnD Four D-model from Thiagarajan. This model consisted of four stages are define, design, develop, and disseminate[16]. The quantitative methods using experimental methods type quasi experimental design and using nonequivalent control group design model.

Research and Development in this research to develop teaching administration in the form of lesson plans, student worksheets, tests, including observation sheets, students' response questionnaires, and assessment instruments. The teaching administration is validated by the validator before use. If they were not valid, they would be revised based on the suggestion and recommendation given by the validators.

The research population was grades VII students MTs Kebunrejo Genteng Banyuwangi, East Java, Indonesia in 2019/2020. The sampling technique used was cluster random sampling technique. The sample in this research was grades VII C amount to 36 students, and grades VII F amount to 36 students. Class VII C was chosen as the experimental class which would be taught by using the teaching administration using CTL based on Jumping task, while grades VII F would be taught as usual using conventional models.

Research using t-test. But before using the t-test, a prerequisite test sould be done, namely the normality tests and homogeneity tests. The normality test used Kolmogorov-Smirnov, while the homogeneity test used the Levene's test with level of significance (P)> 0.05. But if the data were not normally distributed, would be done the nonparametric test.

3. Results and discussion

The treatment of the experimental class and the control class after the researcher compiled of the developed teaching administration, and teaching administration made by the researcher must be validated advance by the validator team. The teaching administration developed contain the component of CTL based on jumping task. Mathematical teaching administration were developed not only to improve students metacognitive ability, but also developed to create a collaborative atmosphere in learning. Jumping tasks were also provided in the of teaching administration that were
developed. Jumping tasks were designed for students more advanced with the aim to be able to increase their ability to solve problems at a much higher level.

The validators used to assess development of the teaching administration consists of two lecturers and one mathematics teacher. The researchers revised the teaching administration based on suggestions and comments of the three validators. The results of the validation state that the teaching administration is valid and worthy for use in research, but needs a little revision. The validation results of teaching administration (lesson plans, student worksheets, and tests) of the three validators is presented in the following figure.

Figure 1. Validation Result of Instructional Instruments.

The teaching administration that has been validated and revised, then implemented and tested in the experimental class. Learning activity has been held three times meeting neither in the experimental class nor the control class. The first discussion talked about set concept, the secondly discuss about declare a set, and the thirdly discuss the empty set, universes set, and venn diagram. However, before giving treatment to the experimental class and the control class, pre-test was done advance to know of the students’ metacognitive ability before the implementing of the learning. The pre-test consists of 4 questions with time limited of 60 minutes for each student. The results of the pre-test is presented in Table 1.

| Class     | Highest Score | Lowest Score | Average | Deviation Std. |
|-----------|---------------|--------------|---------|----------------|
| Experimental | 60            | 25           | 33      | 2.007          |
| Control    | 60            | 25           | 35      | 1.903          |

In the experimental class students making groups by themselves which consisted of 4 students. Learning were done collaboratively by using teaching administration that has been developed by researchers. This learning contains several components, namely: (a) constructing, (b) finding, (c) questioning, (d) assessment, (e) presentation, (f) and reflection. While in the control class, using conventional learning model, the teacher played role as the learning center with the lecture method, students also making groups by themselves which consisted of 4 students. The learning activity are discussions used student worksheets were made by publishers, not made by researchers, student worksheets contained only practice questions and brief material descriptions. At the beginning of learning, the teacher giving an explanation of the material in the class by lecture method, next stages students discuss with the group each.

When in the course of constructing and finding in CTL learning, before students collaborate with friends in groups without anyone neglected (caring community), students were directed to think individually foremost. Likewise in assessment stage, the students were served with several exercises, activities were done collaboratively in caring community. In CTL learning based on jumping tasks, it is assumed that every student is accepted and cared for however of their circumstances, beliefs and
weaknesses. It is in line with the opinion stated by Masaki Sato [10,17] that academic ability in every child, developed with the development of social interaction ability.

In the experimental class, grew feel of caring among friends, discussions was very good, they asked questions and respond to one another. The students’ discussion activities of asking and explaining in groups were presented on the following figure (one group is was taken as the sample).

![Figure 2. Group Discussion Activity in Experimental Class.](image1)

In the experimental class the group discussion ran well. In first meeting, only student A get questions from all group members. And student A gave an explanation to all the group members. Student D gets an explanation not only from student A, but also gets an explanation from student B and Student C. The exchanges in sit position occur in the next meeting. Student D who is less active and did not really understand the material sat beside student A who is active and understood the material well. If there is material that is less understood by friends who understand it better, and they still do not get a solution, then they asked the nearest group. For students who already understand about the material, they are willing to share their understanding. They are also want to share the answers to correct each other, and they are do not feel ashamed in expressing opinions. This condition indicated that the students had been able to collaborate and build caring community. It is eviden by their high sense of care among friends [10,18]. Meanwhile, in the control class the group discussion activities that occurred presented on the following figure.

![Figure 3. Group Discussion Activity in Control Class.](image2)

In the control class, students also making groups by themselves which consisted of 4 students. From The first to the thirdly meeting, the discussion were dominating by some members of the group, the first meeting occurred on student E and student F. Students G and student H did not understand the material and did not ask the other friends who had understood. In the next meeting same groups chose to change members, this was due to distrust among the students about they ability of their knowledge. A similar condition occurred at the secondly meeting, where student J provided answers to student E,
student I, and student K without giving explanation. The group members copied answers without understanding the meaning. When on the worksheet there are questions difficult to answer, they are not try to ask for help previously from friends in their groups, but more likely to asking for guidance directly from the teacher. Moreover, the groups that already completed their assignments refused to share knowledge to other groups that need help in learning. Smart students preferred to do the work on their own and refused to offer help even the work result of the other considered as incorrect. In conditions this result did not increase interpersonal relationships.

Overall, in control class the group discussions that occurred just aimed to resolve the problems given without caring whether had understood or not all the members of the group from the results of that problem solving. Unlike in the experimental class, the discussion takes place by means of face-to-face interaction in listening and expressing the opinions of discussion members. In control class there were no exchanges of seat position to create a more interactive atmosphere, but the groups chose to change members. Generally, in experimental class had showed that most of the students were active in the teaching and learning process. This can be seen based on the observation result of students’ engagement including on the activity of arguing, asking, presenting and responding to the group discussion.

In the first to third meetings, open class were conducted and attended by 8 teachers from MTs Kebunrejo Genteng. Open class is one of the activities of LSLC which focuses on how the students learn, while the observations on how the teacher teach as well as the learning material mastery would be given a very small percentage. The result of observations in each meeting were used to reflect on various findings in the learning implementation. Teacher and observers shared the findings related to students learning activities during the learning process to make any improvement in the next meeting in the experimental class. In experimental class from observation result, learning activity and students interaction are supported by instructional instrument with the CTL based on jumping task has gotten improvement for each meeting. Students activity are very good, and the students learning result is very high like in the discussion activity, among the students appear a sense of mutual care, and not be ignored. The students who are more capable, will use communication ability and the students who need an explanation during work in-group can receive an argument in order to their knowledge clearly. The process of functioning communication and argumentation also cannot be separated from the principles that contain in metacognition apability component are planning, information management, monitoring, revising and evaluating.

![Figure 4. Activities rate of the experimental class and the controlling class](image)

From three meetings, the average rate of students' learning activity in the experimental class was 84.9% while the average rate of students' learning activity in the class control was 77.07%. It can be concluded that the activity of students in the experimental class with CTL based on jumping task is better than the activity of student in control class. Based on the questionnaire responses, students’
responses to all aspects was 89.27%. Since the results was above 80%, the students' response was positive.

The teachers who attended open class positively thought that this learning could give a significant effect towards the students’ metacognitive ability. Posttest is conducted after third meeting to know the students’ metacognitive ability after joining the learning process. The result of the posttest is presented in Table 2.

Table 2. Students’ Metacognitive Ability Based on the Posttest

| Class    | Highest Score | Lowest Score | Average | Deviation Std. | Percentage of Classical Completeness |
|----------|---------------|--------------|---------|----------------|--------------------------------------|
| Experimental | 95            | 60           | 71      | 3.328          | 78%                                  |
| Control      | 90            | 40           | 57      | 2.986          | 42%                                  |

The data analysis to know the effect of CTL based on jumping task on the students’ metacognitive ability is begun using prerequisite test. It is the first step that should be done before doing hypothesis test covering normality test and homogeneity test. Normality test using Kolmogorov-Smirnov statistics is summarized in Table 3.

Table 3. Normality Test (Kolmogorov-Smirnov)

| Class | Kolmogorov-Smirnov Statistics | df | Sig. |
|-------|------------------------------|----|------|
| Pre-Test | Experimental | .277 | 36 | .000 |
|        | Control           | .213 | 36 | .000 |
| Post-Test | Experimental | .159 | 36 | .021 |
|        | Control           | .239 | 36 | .000 |

The data originated from the normally distributed population if the probability value (p-value) is bigger than the significance value of 0.05. It is known that the pretest significance value of the students’ metacognitive ability in both classes is sig = 0.000, while the posttest significance value in experimental class is sig = 0.021 and in control class is sig = 0.000. Therefore, it could be concluded that the data of pretest and posttest in both classes were not normally distributed. Therefore, the data is analyzed by non parametric test, i.e Mann-Whitney test. The difference of students’ metacognitive ability in both classes indicated value sig. 0.000 (p < 0.05), so it could be summarized that there is a difference of students’ metacognitive ability between the control class which used conventional teaching and learning and the experimental class which used CTL based on jumping task. The average improvement of each aspect of students’ metacognitive ability in experimental class and control class is presented in table 4.

Table 4: The Analysis of Mann-Whitney U Test

| Metacognitive Ability Improvement | Mann-Whitney U | Wilcoxon W | Z   | Asymp. Sig. (2-tailed) |
|----------------------------------|---------------|------------|-----|-----------------------|
|                                  | 155,500       | 821,500    | -5.603 | .000                  |

The average improvement score of metacognitive ability on each aspect appeared to be very significant in experimental class. There is also average improvement occurred in control class but it is not bigger than what is occurred in experimental class.
The following are examples of the students’ work on the subject of the venn diagram on the thirdly open lesson.

Student 1

The first student, made a plan by making table to simplify in monitoring, then observed the correlation among the member of the set. The first student found that his working making the venn diagram was not good enough (there was something erased on the picture), but the final result on the venn diagram was good.

Student 2

The second student, made a plan and monitored at the same time by marking each same member of the set, and then made the venn diagram. The level of student evaluation was not good enough and not accurate, it could be seen from the students’ worksheet, that all members of the set A become members of the set B. The second student did not fix work as the first student did.
The implementation of CTL based on jumping task showed improving the students’ communication ability and argument. It can be separated from the principles contained in metacognition ability components; those are planning, monitoring, and evaluating. In addition, students’ metacognitive ability were also improved through a instructional instruments developed on the student worksheet by applying a lesson study [15]. By applying the CTL based on jumping task can increase student activity, students’ ability in constructing knowledge that resulted in increasing of students’ metacognitive ability.

4. Conclusion
Based on the results of research and discussion, it is obtained conclusions that the teaching administration resulted is valid. The implementation of the teaching administration is in practical and effective. The teaching administration resulted in very good student activity and a very high students’ learning outcomes. The students’ activities in the experimental class with the application of learning by using CTL based on jumping task through utilization of students worksheet were better than the activities of students in the control class with conventional learning. It also had a significant effect on the students’ metacognitive capability. Both the students who were joining the lesson and the teachers who were attending the open class gave positive responses on CTL Based on jumping task. For further studies, a similar research can be tested on the students with different level of education, different school, and also different learning material.

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