Improving mathematical habits of mind prospective teachers using metacognitive approach

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Abstract. Research studied for examine differences in habits of mind students’ candidate teacher between the learners use metacognitive approach with usually approach. Method in this research was a quasi-experiment, because existence manipulation treatment in the form of gift metacognitive approach. Population in research is all students candidate teacher at IKIP Siliwangi, while the sample selected two class from force in 2016. The instrument used in research was a set of questionnaire which contains 32 question. Processing data entirely use Microsoft Excel and SPSS 22. From the results data processing obtained conclusion that habits of mind students’ candidate teacher whose learning using metacognitive approach better than from usually approach.

1. Introduction

Habits of mind is one of the affective aspects that every student needs to have and develop in learning mathematics. The rationale of this statement is in accordance with the objectives of mathematics learning in the KTSP and curriculum 2013 [1] which affirms the affective goals in mathematics learning as forming capable, creative, independent individuals who can form soulless citizens democratic and has responsibility, has the character of respecting the functions of mathematics in life, the nature of curiosity, attention, and interest in learning mathematics, and has a resilient and confident [2]. Furthermore [1] say that in completing the tasks of High Order Mathematical Thinking (HOMT) in addition to students mastering the contents of related mathematics, he also needs to have a habit of thinking that mathematics is strong, resilient and willing to relate to people other.

Habits of mind or habits mind as a characteristic of what is done by smart people when they are faced with the problem the solution cannot be identified with easy [3]. Then according to [4] of mind is defined as a pattern intelligent behavior that allows productive action. According to [3] there are sixteen habits of mind category namely persisting, managing impulsivity, listening to others-with understanding and empathy, thinking flexibly, thinking about thinking, striving for accuracy, questioning and possession problems, applying past knowledge to situations, thinking and communication with clarity and precision, gathering data through all senses, creating imagining innovating, responding with wonderment and awareness, taking responsibility, finding humor, thinking interdependently [3].

However, based on observations of investigators during the course last gained some points related to, among others: some students often not focused in working on a given result they make a mistake while doing it, then students sometimes are not sure of the answer, it is seen from the most students cross out the results of execution previously and replaced with a new answer, but after being examined by the lecturers of the first students’ answers are sometimes right. The two things above are things that are found in universities.

To develop mathematical habits of mind, an approach is needed that can accommodate this. One of approach researchers can cultivate habits of mind is a metacognitive approach. [5] argues, metacognitive is an approach that emphasizes the ability to plan a strategy to produce information needed in finding solutions a problem, determine the steps of the strategy to be implemented, as well as reflect and evaluate the productivity of his thinking abilities [6,7]. In words another, metacognition is the ability to know what we know and what we don't know [8,9]. Furthermore [10] suggested about
the steps of metacognitive approach consisting of: modeling, metacognitive scaffolding, paired discussions, small groups, or class discussions; and compile a metacognitive journal.

2. Method
The method used in this study was the quasi experimental method, because of the manipulation of treatment in the form of a metacognitive approach. In this study, two groups were needed, the first group was the experimental group, the group that learned using the metacognitive approach and the second group was the control group, the group that learned using the usually approach. Before and after learning both classes were given a set of questionnaire. Based on the description above, the research design was as follows:

O          X          O
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O          X           O

Information:
O      = Pre-responses /post-responses
X      = Metacognitive approach
----- = Sample selection is not random

The population in the study were all students of IKIP Siliwangi, while the sample was selected in two classes of 2017 totaling 77 people. The instrument used in this study was a non-Likert scale questionnaire containing 32 statements. The validity of the instruments needed in this study is content validity and construct validity. Content validity by asking for discussion from two senior lecturers at IKIP Siliwangi. To get the construct validity of the question after being validated then it was given on students who were not the sample in this study, to assess the validity and reliability of the scale of the attitude. From the results was t-calculation ranged from 2.56 to 8.61 and t-table = 1.76, so it can be concluded that the 32 statements contained in the scale of attitudes habits of mind are all valid, while for reliability from calculation results can r_{11} = 0.92 which according to Guilford [11] is classified as in the very high category. The procedure of this study is divided into three parts, namely (1) the preparation stage includes looking for literature on habits of mind, cognitive approaches, establishing two classes as research samples, making lesson plans, making student worksheets and making habits of mind scale scales, (2 ) implementation stage, include implementing the preresponses of the students, implementing the learning for 8 meeting on experimental class and the class metacognitive approach control using the usual approach, while (3) the evaluation stage includes the provision of pastresponses, and data processing.

3. Result and Discussion

3.1. Result
Based on the results of processing data on the results of the preresponses, pastresponses and the N-gain results are shown in Table 1 below:

**Tabel 1. Results of data processing preresponses, postresponses and and N-Gain Habit of Mind.**

| Measured | Metacognitive Approach | Usually Approach |
|----------|------------------------|-----------------|
|          | Preresponses | Postresponses | N-Gain | Preresponses | Postresponses | N-Gain |
| Habit of Mind | x s | x s | x s | x s | x s | x s |
| Mind     | 90.39 5.72   | 101.03 11.48 | 0.37 0.29 | 91.07 5.89 | 92.32 5.87 | 0.02 0.15 |
The normality test is then carried out using the Kolmogorov Smirnov test with testing criteria: if the significance is > 0.05 then the data are normally distributed, the results of the normality test are presented in Table 2 below:

|                         | Measured | Statistics | df | sig  | Statistics | df | Sig   |
|-------------------------|----------|------------|----|------|------------|----|-------|
| Preresponses            |          |            |    |      |            |    |       |
| Metalcognitive          | 0.138    | 36         |    | 0.080| 0.120      | 41 | 0.142 |
| Usualy Approach         |          |            |    |      |            |    |       |
| Postresponses           | 0.135    | 36         |    | 0.096| 0.109      | 41 | 0.200 |
| N-Gain                 | 0.158    | 36         |    | 0.023| 0.110      | 41 | 0.200 |

Based on Table 2, for the pre-response of significance values an experimental and control class was obtained in one row of 0.080 and 0.096, for both classes significance value greater than 0.05, then the value of the pre-responses of both classes of normal distribution, post-responses to be obtained the significance value of experiment class and control class was 0.096 and 0.200 respectively, because the significance values of the two classes were greater than 0.05, the final scale value of the two classes was normally distributed, while for N-gain the significance of the experimental class was 0.023, the significance value smaller than 0.05, the post-responses data of the experimental class is not normally distributed, for the control class a significance value of 0.200 is obtained, this significance value was greater than 0.05, it is concluded that the final class of control class is normally distributed.

For testing the pre and past-responses, the homogeneity test and for the N-Gain was continued followed by the Mann-Whitney test. The homogeneity test results for pre-responses and post-responses are presented in Table 3. The following:

|                         | Responses | Lavene Statistics df1 | df2 | Sig. |
|-------------------------|-----------|------------------------|-----|------|
| Preresponses            |           | 0.027                  | 1   | 75   | 0.870 |
| Postresponses           |           | 13.92                  | 1   | 75   | 0.000 |

Based on Table 3, the pre-responses obtained a significance value of 0.870, the significance value was greater than 0.05, then the second variance was homogeneous, while for the post-responses the significance value was 0.000, the significance value was less than 0.05, so the variance of the two groups were not homogeneous. Hypothesis test used t-test, t'-test and the Mann-Whitney test. The test results using the t-test, t'-test and Mann_Whitney test were presented in Table 4. The following:

| Responses  | Name of test | t/Mann-Whitney | Df/Z | Sig. |
|------------|--------------|----------------|------|------|
| Preresponses | t-test       | -0.515         | 75   | 0.608|
| Postresponses | t'-test     | 4.105          | 50,587| 0.000|
| N-Gain     | Mann-Whitney | 327,00         | -4,197| 0.000|

Based on Table 4 obtained significant value for the pre-responses of 0.680, the significance greater than 0.05, it was concluded that there were no differences in the pre-responses habits of mind of prospective student teachers who were taught using the metacognitive approach rather than the usual approach, for post-responses obtained a significance value (2-tailed) of 0.000, then for 1-tailed according to [12] \( \frac{0.000}{2} = 0.00 \), the value was smaller than 0.05, so it is concluded that
achieving the habits of mind of all prospective teacher students taught using the metacognitive approach is better than the usually approach, whereas for N-gain the significance value (2-tailed) is 0.000, then for 1 tailed according to [12] is $\frac{0.000}{2} = 0.00$ The value is less than 0.05, it is concluded that the increase in students' habits of mind prospective teachers who taught using metacognitive approach is better than the usually approach.

3.2. Discussion

Based on the results described above, it can be concluded that the achievement and improvement of the habits of mind of prospective teacher students taught using the metacognitive approach is better than the usually approach. This is in line with research [13] which concludes that learning independence of students taught using the metacognitive approach is better than conventional approaches, then this study is in line with [14] which concludes that the improvement of reflective thinking disposition and learning independence of students taught using an approach metacognitive is better than the usually approach.

As for the better habits of mind of prospective teacher students taught using the metacognitive approach compared to the usual approach caused by the following:

In the first step in the metacognitive approach is modeling. In this modeling the teacher is required to provide examples and examples to students, so that students can solve problems learned during learning. This fosters student metacognitive skills and trains students, and fosters an attitude of determination. This is in accordance with the habits of mind with indicators namely persisting. Students who have habits think persisting (capable) work on the assignment given with earnest to completion, no easy to give up, able to analyze problem, make a system and structure, capable of using various strategy in solving problems, able to gather evidence that show that the solution strategy the problem is successful and if the strategy is fail then they know how overcome it and try other strategies. [3]. In the process learning, students who have habits last (persisting) will be able to learn earnestly and not breaking up hope when facing a problem that isn't the resolution is immediately known. They will struggle to do the task given to completion, work diligently and focus on purpose [14], survive or never give up that when facing complex problems, trying to analyze the problem, then developing systems, structures, or strategies for solving problems trying to analyze the problem; looking for alternative strategies for solve the problem; not easy frustration [15]. Besides that with modeling can grow metacognitive skills, this is also in accordance with the indicator thinking about thinking. An indicator developed to measure thinking about thinking, namely: accustomed to working or acting accordingly plan; accustomed to being aware of thoughts and his actions, used to designing strategies to bring up the information needed to solve problems, and get used to describing steps to use for do problem solving, students who has habits of mind Thinking of thinking” is a very large student who is aware of his thoughts, when he is faced with problems he will be able to realize what is already known. An indicator developed to measure thinking about thinking, namely: accustomed to working or acting accordingly plan; accustomed to being aware of thoughts and his actions, used to designing strategy to bring up the information needed to solve problem, and used to describing steps to use for do problem solving. Students who have habits of mind “thinking of thinking” is a student who is aware of his thoughts, when he is faced with problems he will be able to realize what is already known and not yet known.

In the second step in the metacognitive approach was metacognitive scaffolding. In this activity students are required to connect activities that can be done with their own abilities with activities that can be completed with the help of others. In scaffolding by asking questions from lecturers, students require students to develop their abilities and abilities initially and students use long experience to construct new ideas and skills [16]. Thus students are required to think flexibly, solve problems carefully, use the senses, have many ways to solve problems. This is in line with indicators thinking flexibility that has the characteristics used to be open-minded, used to have lots of ideas and the idea of a thing, used to change the angle of view or thinking of current students have new information or any additional information, and are accustomed useng various ways of solving the problem for solve
the problem. In addition, this metacognitive step is in line with managing impulsivity with the characteristics of using time to be in no hurry to act, Striving for accuracy by characterizing high standards and always looking for ways to increased, through all the data gathering sense with characteristic attention around through feeling, hearing, and vision and applying past knowledge to new situations with characteristics are accessing prior knowledge and transferring this knowledge in new contexts and Creating, imagining and Innovating with characteristic have ideas and new ideas.

In the third step in the metacognitive approach is discussion either in pairs, in small groups, or in class discussions. Based on the theory [17] on the constructivism meaningful learning will take place in the context/social atmosphere. When students discuss, they communicate with each other, they listen to the opinions of others, ask questions and respond effectively, work together in teams to solve problems in mathematics. This is in line with the habits of minds indicator listening with understanding and empathy with the desire to accept the views of others, questioning and problem posing with the characteristics of finding problem solving, looking for data and answers and thinking interdependently with characteristics be able to work and learn with others in the team, thinking and communicating with clarity and precision with the characteristic always communicate orally and in writing accurately, Responding with wonderment and awe with characteristic have curiosity about the problems in life.

In the fourth step in the metacognitive approach is writing metacognitive journal. When students write an important and interesting topic to be published in a journal, the student will arrange it carefully and dare to be responsible and face risks regarding the correctness of the journal made during the teaching learning process take place. In this way, students must explain and reflect on their thoughts rationally and appropriately and students are required to teach the school continuously and develop humorous qualities. Such activities illustrate that students have been able to use their cognitive meta-thinking methods. This is in line with indicators habits of mind that is taking responsible risk with characteristic taken risks responsibly, finding humor with characteristic enjoy unworthiness and unexpected, pleasant, Remaining open to continuous learning with characteristic keep trying to continue to learn and accept that there is not known.

Based on the description above, the step relationship in the metacognitive approach with indicators of habits of mind can be seen in Table 5.

| Steps to the Metacognitive Approach / Habits of Mind Indicator | Modelling | Metacognitive scaffolding | Discussion | Writing metacognitive journal |
|---------------------------------------------------------------|-----------|--------------------------|------------|------------------------------|
| Persisting                                                    | ✓         |                          |            |                              |
| Managing impulsivity                                         | ✓         |                          |            |                              |
| Listening with understanding and empathy                      | ✓         |                          | ✓          |                              |
| Thinking flexibly                                             | ✓         |                          |            |                              |
| Metacognition                                                 | ✓         |                          |            |                              |
| Striving for accuracy                                         | ✓         |                          |            |                              |
| Questioning and problem posing                                | ✓         |                          | ✓          |                              |
| Applying past knowledge to new situations                     | ✓         |                          |            |                              |
| Thinking and communicating with clarity and precision         | ✓         |                          |            |                              |
| Gathering data through all sense                              | ✓         |                          |            |                              |
| Creating, imagining and innovating                            | ✓         |                          |            |                              |
| Responding with wonderment and awe                            | ✓         |                          |            |                              |
| Taking responsible risk                                        | ✓         |                          | ✓          |                              |
| Finding humour                                                | ✓         |                          |            |                              |
| Thinking interdependently                                     | ✓         |                          |            |                              |
| Remaining open to continuous learning                          | ✓         |                          |            |                              |

Table 5. Relationship of Steps in Metacognitive Approach with Habits of Mind Indicators.
4. Conclusion
Based on the results and discussion described above, it can be concluded that the achievement and improvement of habits of mind taught using the metacognitive approach was better than the usually approach.

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