Corresponding Habits of Mind and Mathematical Ability

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Abstract. Objective of learning process regarding system of Indonesia government should consist of knowledge, attitudes, and skills, or in general we call cognitive, affective and psychomotor. These objective are apply to mathematics education also. Attitude in mathematics known as habits of mind. The teacher should create a learning objective which including all, cognitive, affective and psychomotor. In general, math teachers in Indonesia pay attention to aspects of knowledge, and they ignore other aspects. Habits of mind is term which means the tendency to behave intellectually or intelligently when faced with problems which is immediately known solution. This article examines the math teacher's attention to students' habits of mind. The research done by survey method to 38 students at Islamic School 32 Jakarta academic year 2015/2016 from April to May 2016. Habits of mind are observed in this research restricted to persisting, thinking about thinking, thinking flexible and applying past knowledge to new situation. Based on survey, conclude that teacher, without realizing, they have to improve students' habits of mind, as long as teaching and learning only persisting and thinking about thinking are already well developed, while flexible thinking and applying past knowledge to new situation has not well developed. We hope, math teacher can pay attention not only cognitive aspect but habits of mind also.

1. Introduction

The purpose of education regarding to Indonesian government should create an atmosphere of teaching and learning process, whereas students are actively developing their potential to have spiritual power of religion, self-control, personality, intelligence, character, and skills, and society. This purpose is apply to teaching and learning mathematics. Therefore, math teacher have to think objective of learning process to cover of that. They create learning process to mastery in cognitive, affective and psychomotor [1]. To knowing effectiveness of teaching and learning process, the government holding the final exam. National rate score test, at Banten Provence about 63%. This score is contradiction to math teachers' opinion. They feel difficulty to deliver mathematics because students' understanding on mathematics is still low. There are two fundamental reason why students' success in national exam meanwhile not success in school exam. It is because of instrument test. National exam use multiple choice but school exam use essay test. In other word, students success in cognitive aspect but is not success in other aspect.

As Cuoco said that students have studied mathematics but has very little to do with the way mathematics is created or applied outside of school. One reason for this has been a view of curriculum in which mathematics courses are seen as mechanisms for communicating established results and methods for preparing students for life after school by giving them a bag of facts. [2]. Mason and Watson says that “If students are to make mathematical sense themselves, then they need to be able to assert things for themselves. They need to use technical terms with facility to express their ideas” and
if students do not understand theory then when they “come to apply a theorem or technique, they often fail to check that the conditions for applying it are satisfied” [3]. Then, there are 16 indicators habits of mind, such as: persisting, thinking and communicating with clarity and precision, managing impulsivity, gathering data through all senses, listening with understanding and empathy, creating, imagining, innovating, thinking flexibly, responding with wonderment and awe, thinking about thinking (metacognition), taking responsible risks, striving for accuracy, finding humor, questioning and posing problems, thinking interdependently, applying past knowledge to new situations, and remaining open to continuous learning [4], [9].

Based on the explanation before, we conclude that teaching mathematics is not only to make students well in cognitive but they should well in habits of mind. So that, students can apply mathematics concept into daily life problem. Habits of mind is defined as tendency to behave intellectually or intelligently when students faced to problems, especially problems that are not immediately known solution. In other words, habits of mind should be developed in learning process because when students are faced with the problems and occur with anxiety, then it will form a certain intelligent behavior patterns to encourage success in solve the problems. In this research only four aspect of habits of mind, such as: persisting, thinking about thinking, thinking flexibly and applying past knowledge to new situations are used to observe students activity in the math class.

2. Habits of Mind and Mathematical Ability
Habits of mind is defined as a characteristic or a bunch of skills, attitudes, and values is done by intelligent people when they are faced with a problem which is the solution cannot be easy known, with productive action to synergize between intellectual and emotional brain when to face or resolve existing issues [4], [5], [8]. Habits of mind as one of level of learning outcomes, and the position is highest [4]. Look at Figure 1.

![Figure 1. The four levels of learning outcomes](image)

It is clear, Figure 1 explain us that four of learning outcomes should create to improve classroom instruction, curriculum and assessment. In math, teacher must teach content as a basic in math, than teacher train students to use their thinking skills with new problem. After that teacher extend to cognitive task that demand skilful thinking. And in the high level, teacher leads students to habits of mind. Furthermore, habits of minds has five dimensions of learning: (1) Attitude and Perception - learning increases a student’s motivation, (2) Acquire and Integrate Knowledge - student connects new learning to what they already know, they learn new skills, practice the skill, learn how to make the skill useful leading to performing the skill easily, (3) Extend and Refine Knowledge – students to get a deeper understanding of their learning, (4) Using Knowledge Meaningful - teachers should provide an opportunity for students to make the knowledge meaningful, and (5) Productive Habits of Mind - Students learn to regulate themselves and think critically and creatively. The fifth dimension of
learning are interrelated one another and form a framework that can be used to improve the quality of learning [7]. The four of habits of mind are used in this research: Persisting, as thinking diligent and earnest in completing a task through to completion, not easy to give up, able to analyse the issue, making stronger system, structure, and use strategies to solve problems. Thinking Flexible, as ability to control of the powerful, able to change the angle of view when receiving new data, search and do a lot of goals and activities simultaneously, and using a set of problem-solving strategies, knowing when to think big or globally and when to think a careful and detailed. Thinking about Thinking, as ability to find out what is known and not known, so as to realize the measures/strategies used and to reflect on and evaluate the productivity of their thinking; and Applying Knowledge to New Situation past, as ability to extract meaning from experience and being able to apply them to new situations and make analogies [4], [9].

Mathematical ability in this research focus to generalization ability. Generalization ability is defined as a thinking skills that covering distance between previous knowledge and new notions, or make link from previous knowledge to reach new related concepts [11], and also generalization can helps people to blend their experiences with useful knowledge to solve their problems in new conditions and lets them to be more creative [10]. The indicators of generalization are used in this research consist of: perception of generality: students are able to perform the process of identification of the pattern; expression of generality: students can use pattern identification results to determine the structure: symbolic and manipulation of generality: students are able to use generate general rules and use them to solve problems [12].

3. Method
Survey method is used to collect data of habits of mind and generalization ability from April to May 2016. The subject were students 8 grade in mathematics classroom at Islamic School 32 Jakarta for academic year 2015/2016, consist of 38 students. There are three instrument are used in this research: Questionnaire habits of mind, observation sheets and tests of generalization test. Questionnaire habits of mind and observation consist of 16 statement with reliability coefficient $r_{11}=0.88$. Generalization test consist of 4 essay with reliability coefficient $r_{11}=0.952$. Habits of mind are elaborated to be 4 indicator, such as explain in Table 1.

| HOM Indicator | Indicator |
|---------------|-----------|
| Persisting    | Diligent, using systematic methods to analyse problem, distinguish ideas between good idea or not, look for different ways to solve the task/problem |
| Thinking about Thinking | Working or doing as a plan, aware to their thinking and actions, devise a strategy to get information to solve the problem, illustrate the steps used to solve problem |
| Thinking Flexibly | Open-mind, have different ideas to solve a case, change of their idea when you faced to new information, use different ways to solve the problem |
| Applying Past Knowledge to New Situation | Use own knowledge to understand problem or situation, connect between old and new knowledge, describe of the meaning of an experience to solve new problems |

Researchers conducted observations for 5 times, each observation performed about 30 minutes in the early. There are two kind of observation, observation to students’ activity and observation to students’ worksheet. While questionnaire and generalization test are given to students in the end of teaching and learning.
4. Result and Discussion
As mention by Miliyawati, individual success is determined by the habits, the habitual is done continuously will be stronger and settled on the individual therefore difficult to change [6]. And Marita also find that form covering 16 categories of habits of mind, category of thinking interdependently, and thinking and communicating with clarity and precision shows good performance, while in the other category are less performance [5], in this research show that habits of mind has an impact on mathematical ability for 8 grade students at Islamic School 32 Jakarta. Percentage of the emergence students’ habits of mind in five times observation in mathematics class is shown at Table 2.

| HOM                               | Questionnaire | Activity | Worksheet |
|-----------------------------------|---------------|----------|-----------|
| Persisting                        | 75.56         | 53       | 52        |
| Thinking Of Thinking              | 70.60         | 97       | 54        |
| Flexible thinking                 | 66.31         | 29       | 7         |
| Using past knowledge to new situation | 61.15       | -        | 18        |

From Table 2, researcher observe students activity for three indicator, while questionnaire and students worksheet for four indicator. The result shows that observations on worksheets and activity in the class shows the same score, meanwhile the average values obtained habits of mind in each category did not different significantly. Score of flexible thinking and using past knowledge to new situation is different significantly because all students solve the problem with the same ways similar to the example that’s given by teacher. And based on the indicator, we conclude that persisting and thinking about thinking are already well developed, while flexible thinking and applying past knowledge to new situation has not well developed.

**Problem for thinking of thinking:** A block has length 12 cm and a width 9 cm. If the length one of diagonal space is 17 cm, then the area of surface is ...

**Figure 2.** Photograph of students’ works on thinking of thinking

Figure 4.a shows that students solve problems with systematically, He solve problems using numbering, they think what kind of work that they need done for resolving the problems, and to determine the accuracy of the size of the sides geometrical been obtained aided by drawing a block beforehand, different with other students in the Figure 4.b, he feels confident with the completion strategy because the formula very familiar and he solve the problem with that formula. Habit of writing down the steps of completion will lead to careless students in solving problems.

After teaching and learning process finish, student are given test mathematical ability of generalization. The result shows at Table 3.
Table 3. Description of Mathematical Ability

| Statistics       | Generalization Test |
|------------------|---------------------|
| Mean             | 59.7363             |
| Std. Deviation   | 18.2628             |

Than researcher analyse data of habits of mind and mathematical ability with linear regression using SPSS version 22 [13], then the conclusion is correlation between habits of mind and mathematical ability is described as linear regression \( Y = (-86.165) + 2.116x \), with the influence of habits of mind to the mathematical ability was 40.9%.

Constant value of \(-86.165\) does not mean that the habits of mind of students is negative, but can be understood that when the ability of the student mathematical value \(y\) is zero, then the value of habits of mind it:

\[
Y = -86,156 + 2,116x \leftrightarrow -86,156 + 2,116x = 0 \\
\leftrightarrow 2,116x = 86,156 \\
\leftrightarrow x = \frac{86,156}{2,116} = 40,72
\]

In other words, every child has the habits of mind in itself, teachers need to explore and develop, so the potential to develop their knowledge. Cases were found in this study, and mathematics scores of zero, in fact students have habits of mind about 40.71%. This is in line with the results of observations conducted by researchers that the average value HOM that appear in the learning process amounted to 68.96%.

5. Conclusion

It can be concluded that basically everyone has the potential in themselves, whether it is in form of knowledge, attitudes and skills. The results of the analysis showed that the learning process of mathematics of the students’ habits of mind are less developed in the learning process. Without any treatment given to the habits of mind. The result shown that impact of habits of mind toward mathematical ability is 40%. If teachers can develop their students’ knowledge, attitude and skills holistically, as expectation, then the potential of students to acquire knowledge in mathematics will be higher or better.

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