Teacher Behavior in Students’ Critical Thinking Ability Development

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Abstract. This study aims to investigate math teacher learning activity that student’s critical thinking ability development-oriented. The subject is four junior high school math teachers who observed for three meeting each person. The research data is collected by the observation sheet and analyzed descriptively. The result shows that the learning process by the teachers has not been optimally oriented at student’s critical thinking ability development.

1. Introduction
A classroom with many problem and challenge, a key distinction between novice and expert teachers is their ability to notice what is important in classroom situations. A good teacher can separate what children need and do some strategies to solve those challenges and problems. One particularly important focus of teacher noticing is student mathematical thinking. Since teachers’ use of student ideas has been identified as an important element of effective mathematics instruction [1]. Problem solving ability is an essential ability or competence in mathematics learning which is recommended to be raised and taught to children from primary school [2] That is, every student at all levels of mathematical proficiency and levels of education must be facilitated and trained to solve mathematical problems. Nevertheless, the fact that up to now the students’ problem solving ability is not yet optimal because several gap from concrete operation level to formal operation level, students experience lateness in the transition phase.

The importance of mathematical problem-solving in mathematics is also expressed by Mullis et al [3] and Suryadi [4] that learning emphasizing more on reasoning and problem-solving activity is closely linked to students’ high performance. Piaget [5] suggested that students are ready to develop concept or material when they have necessary scheme meaning that learning process of students is impended when the formal reasoning of students is not appropriate to material which is taught. While this might seem time consuming, students gain a deeper understanding of the work, they are doing than if they simply copied examples that instructor put on the board. Students are learning the process of thinking through problems as an expert would approach a problem and practicing higher-order thinking skills [6]. Some example mathematics learning such as Japan and Korea which is emphasized on reasoning and problem solving aspect is able to produce well-performing students in mathematics tests conducted by TIMSS.

One of the mathematical capabilities that support problem-solving abilities is the ability to think critically. Predominantly, the ability to think mathematically can be developed when students are in an intense process of problem solving. This shows that critical thinking skills can be developed in mathematics learning if the teacher is capable of creating a learning atmosphere that promotes intensive mathematical problem solving. In other words, mathematical skills will develop if the learning process allows students to perform observation, elaboration, and solution, so that they are encouraged to ask questions, questioning their ideas and express them.
Common learning activities created by teachers emphasize the ability “to know” rather than “to do.” This is thought to be one of the main factors that hold up the development of critical thinking skills of students. In this context, learning management that emphasizing thinking activity should be shown. The thinking process that was built up from the beginning in an attempt to solve a problem should be done deliberately and completely. In this case, completeness means that students who undergo the process really use their skills so that they understand and control what they do during the process. To support learning principles, students must be trained so they can think mathematically.

Insight into the importance of promoting the learning environment where students can create and develop their critical thinking skills, it is necessary to assess extent teachers can help students develop mathematical skills. The essence of the facility is how the teacher's efforts encourage students to formulate, question and express their ideas so that critical thinking can be awakened and developed. The importance of this study is based on two primary considerations, namely: (a) developing thinking skills at a high level, of which critical thinking is the core objective of learning mathematics in the curriculum; (b) teachers’ act in teaching the students an important factor in encouraging and developing mathematical skills at a high level, of which critical thinking is a prerequisite.

Based on these considerations, this study attempts to investigate teacher activities in mathematics, which demonstrate the potential to encourage and develop the critical thinking skills of students.

2. Literature Review

Critical thinking is not easy to define. Several experts define critical thinking but just a few of them can relate to mathematical thinking. In Mathematics, critical thinking usually comes when students ask why, rather than taking what they learn at face value. Critical thinking leads to skills that can be learned, mastered and used [7]. Critical thinking also determined as a complex intellectual activity which emphasizes the following skills; problem formulation, problem reformulation, evaluation, problem sensitivity[8]. According to Krulik and Rudnick [9] critical thinking in mathematics includes a process of thinking that tests, questions, connects and evaluates all aspects of a situation or a problem taking place. Ennis [10], critical thinking is actually a process of thinking that occurs to a person and aims to carry out reasonable decisions about what to believe or do. Desmita [11] suggests critical thinking is an in-depth understanding or reflection of the problem, keeping the mind open to a variety of various approaches and perspectives, not simply believing in information from various sources (oral or written), as well as reflective and evaluative thinking.

The statement above reflects that critical thinking is marked by being able to provide reasons in expressing opinions and why something is as it is when information is received or obtained. Critical thinking aims to evaluate the best and believed actions. Thus, if the decision is not based on reliable information and assumptions, the conclusion has no right basis. Students need to think critically when they face certain challenges as they have to consider and carefully evaluate information received before they can take a decisive action [12]. Six fundamental elements that must be considered in critical thinking [10], abbreviated as FRISCO, are focus, reason, conclusion, situation, clarity and general research. If all these elements have been carefully considered, people can make rational decisions. A situation that places a person in a state of urgency will cause him to think critically before acting to make the right decision. Fisher [7] highlighted that the critical thinking skills training had helped in stimulating students’ intellectual capability and make them engaged more in classroom activity. In other words, if students need to be trained to think critically, they have to confront a situation or challenging and interesting problem to solve.

Because the learning sphere in the classroom is seen as an environment that may influence students thinking entirely; because it is full of sources that can be referred by the student, teacher behavior is crucial in the development of students' critical thinking skills. This notion reflects how far the teacher behavior can offer interesting challenges for students and can hold the intense critical thinking of the students. It is acknowledged that there are opinions saying the thinking activity occurs automatically in every mathematics lesson in the classroom or integrated into learning; so these thinking skills take place and should take part in a study of mathematics. But the question is: "until what extent and at what level
do you think that happened?” In line with this, it is necessary to know what kind of questions can trigger
the students to think critically [13].

Santrock [11] and Fisher [14] state that to be able to think critically, students need to play an active
role in the learning process. In this context, the teacher should constantly create a classroom atmosphere
in which students can develop their critical thinking skills. Accordingly, teachers need to know the
stages in the development of critical thinking: creating cognitive conflicts, providing the opportunity to
explore, and drawing conclusions, clarification and resolution [15].

The indicators of teacher behaviors in encouraging and facilitating the development of students' critical thinking capacities are derived from one theories[9,11,15]. The indicators consist of two core components: (1) teacher behavior that stimulates the critical thinking skills of the students; (2) teacher behavior in facilitating students in developing skills for critical thinking.

A fun, interestingly challenging learning environment represent the characteristic of a class that offers the potential to develop the critical thinking skills of students. In this respect, the teacher needs to acknowledge the condition of students so that the given challenges can be countered correctly. In other respects, there are three things to consider: student experience, time and encouragement (motivation).

Strive to make the students never stop when answers are found because they will precious time in
the thought process they go through; they have worked hard building designs and choosing a variety of strategies to solve the problems. Since they are motivated to solve the problem and are happy with the results achieved, the feeling of pleasure and motivation must be maintained by giving new assignments to students, such as asking the problems: "What if..." and " What do you do?"[9].

3. Research Method

The subject of this study was four mathematics teachers at a junior high school in Kandis sub-district of Siak district, Riau province, Indonesia. To collect data, observations sheet was used, which consists of the indicators of questions/statements addressed by the teachers to encourage students to think critically. Teacher activities to encourage students to think critically, as defined in this study is the teachers’ verbal activity (speech/utterance) in the learning process that encourages students to think critically. There are two aspects of teacher verbal behavior which becomes the object of observation in this study, they are (1) the aspect of developing critical thinking skills, with the indicators: prompting cognitive conflicts, urging the students to investigate or discover something in their study, asking the students to make conclusions from their learning, asking the students to clarify or reinforce an idea regarding the context being discussed and asking the students to make a resolution or generalization of the context in question; (2) the aspect of facilitating the development critical thinking ability, with the indicators: preparing students' learning experiences before prompting cognitive conflicts, facilitating the resolution of the problem being discussed, allowing enough time in the process of thinking of students, and providing a reinforcement/motivation that encourages students to continue dealing with the problem.

This research data was collected by observation sheet. The observer highlighted the behavior of each teacher in connection with the efforts to stimulate and facilitate the development of the ability to think critically with the identified indicators. Each teacher was observed in three meetings. Research data were analyzed using descriptive statistics.

4. Results And Discussion

4.1 Results

The observation obtained the data on the frequency of occurrence of the teacher behavior in managing learning, with regard to efforts to encourage students to develop critical thinking ability. Quantitatively, the obtained facts of the occurrence are shown in Table-1.

| Behavior Aspects | Frequency | % |
|------------------|-----------|---|
| A. Encouraging Critical Thinking Ability | | |

Table 1. Frequency of the Appearance of Teacher Behavior in Learning
1. Triggering Cognitive Conflict  
2. Asking students to investigate or discover something in learning  
3. Asking students to conclude what they learn  
4. Asking students to clarify or emphasize an idea related to discussed context  
5. Asking students to make a resolution or generalization from discussed context

| B. Facilitating critical thinking ability development |
|-----------------------------------------------------|
| 1. Preparing students’ learning experience before setting up cognitive conflict |
| 2. Facilitating problem solving of the discussion |
| 3. Allowing enough time for students’ thinking process |
| 4. Giving reinforcement/motivation to students’ to stay within the discussed problem |

Table 1 shows that within 12 meetings of learning activity, only around 17.4% of the overall behavior of teachers is associated with encouraging students to think critically through cognitive conflict. Looking at the mean value, it can be stated that in one lesson, only about 1% of the behavior of a teacher triggers cognitive conflict for students. This suggests that teachers' awareness to the fundamental problems in the development of students’ critical thinking skills is still low. In addition, it should be noted there are still lessons where the teacher does not impart any behavior to increase cognitive conflict, to give students the opportunity for discovery and drawing conclusions, or to let the students make resolution or generalization of the things they have learned. This fact at least gives the impression that substantially, the teachers have not optimally made efforts in developing students' critical thinking skills.

Moreover, the dominant behavior of the subject teacher in encouraging the critical thinking skills of students is clarifying the idea being discussed. This shows that students possess the strength to think back about their ideas, so that they can restructure their thinking process as a means to develop the process of further thinking. At least, from the original ideas put forward by students in the thinking process, the teacher can see the maturity and thinking process of students. This will enable the teacher to provide appropriate interventions and to open students' thoughts on the subject being discussed, so that it is clearer.

In facilitating the development of the thinking skills of students, the dominant behavior of the teachers is motivating students. This shows that the teachers’ behavior in developing the atmosphere of learning for students to stay in their learning tasks is good enough. On the other hand, giving sufficient time for students to work is identified as the teacher's behavior with the least frequency of appearance in the aspect of developing the thinking skills of students. This shows that the teacher does not fully aware of the capacities and the characteristics of the students for the tasks given. Teachers should provide students with sufficient opportunities to organize their ideas to solve the given problems. Because each student has unique characteristics, the time needed to solve problems is also different. Interrupted time during the thinking process may interrupt the process itself, so the intensity of students’ work could not be sustained. Therefore, the teacher must be able to estimate the right time to solve a problem by taking into account the student's condition and the characteristics of the given problem.

The observation also identified some behaviors of teachers which are seen as obstructing the efforts to develop students' critical thinking skills:

1. Teachers do not try to intensify students’ effort in advanced problems after succeeding in solving a problem by asking: “Solve this problem in a different way.”; "Ask questions...”; "What if... ”; "What is wrong?"; “What will you do?”
2. Teachers make generalization even though there is not enough information and does not optimally involve students.
3. Teachers often forget to reward the efforts of students in completing their learning tasks.
4. Teachers give too many similar examples so it is not challenging enough for student
5. Teachers ask a particular student who is assumed to be capable of presenting his/her work

4.2 Discussion
In the previous description, it is stated that this study focuses on (1). Describing the behaviors reflected by math teachers in lessons with the potential to encourage and develop the critical thinking skills of students; (2). Describing the dominant behavior reflected by the mathematics teachers in lessons with the potential to encourage and develop the critical thinking skills of students.

Regarding the first point, based on the results of the data analysis, the fact is that the dominant teacher behavior in encouraging students to think critically is clarifying the students’ ideas. This shows that the behavior of teachers in lessons has not facilitated students to optimally develop critical thinking ability.

In comparison with the teacher behavior that triggers cognitive conflicts, the frequency of occurrence of the act of encouraging students for discovery in learning is significantly different. Whereas both behaviors are seen as the main triggers encouraging students to think critically about what they are learning and how they can complete the given tasks.

The above facts can be used as an indicator showing the learning managed by the teachers is not yet aimed at developing the critical thinking skills of students. This statement is in line with some experts that state that challenging is the most important characteristic showing that a classroom is focused on the development of critical thinking skills of students[16,17,18].

Then, based on the observation, the frequency of the teacher behavior providing opportunities for students to discover something in their learning and to find a solution for the tasks that they do is relatively small. This shows that the learning paradigm applied by the teachers neither offers opportunities for students nor familiarizes them with organizing learning experiences. Whereas when students are used to organizing their learning experiences, it will train them to develop their reasoning, so that they become more critical in thinking. Offering opportunities for students to disseminate their ideas when completing (finding solutions) a problem through discovery (exploration) is very effective to develop the critical thinking skills of students [18].

Based on the discussion, it can be stated that the teachers have not optimally promoted critical thinking ability. Here arises a question of whether the teacher does not aware of the importance to create an atmosphere of learning that offers students opportunities to develop their critical thinking skills. In this respect, the researcher conducted informal interviews with the teachers at the end of the research activity. The interviews revealed the teachers do aware of the importance of promoting critical thinking in class. However, they do not know what kind of behavior that can lead students to think critically. This is supported by the fact revealed during the observation; in solving a problem, the teacher rarely tries to increase the intensity of the students to solve advanced problems, which has the potential to maintain students’ critical thinking situation.

Teachers’ act in motivating students to continue working on their task is the best behavior in facilitating the critical thinking skills development of students. It is assumed that this behavior can increase students’ confidence to play an active role in learning. Motivation given during the learning process will encourage students to stay upright in their learning tasks. As a result, it is highly possible to maintain an atmosphere of learning that has the potential to develop critical thinking skills.

Moreover, the maintained thinking process of students, as a result of motivating them, shows that students’ attitude towards their active role in learning may vary, depending on their acceptance in learning activities. In this context, teachers should always be aware of and understand ways to build students' self-confidence in learning to stay in their learning tasks. Teachers should: constantly encourage students in asking questions and expressing ideas without being ashamed of themselves; facilitating the preparedness of students if the ideas they express are inappropriate; reinforcing the
students’ ideas. These are the behavior to promote positive attitudes of students in an attempt to build their thinking skills.

Regarding the above statement, the data in the table below provide a description of students' attitudes when they are involved in learning in terms of self-acceptance that is believed to impede attempts to improve their critical thinking skills.

Table 2. Student Attitudes that Inhibit Their Active Role in Class[19]

| Student Attitude                  | Rarely | Sometimes | Usually | Often |
|-----------------------------------|--------|-----------|---------|-------|
| Fear of negative comments         | 2%     | 19%       | 46%     | 33%   |
| Lack of preparation               | 2%     | 8%        | 38%     | 52%   |
| Dislike of showing ignorance      | 1%     | 14%       | 44%     | 42%   |
| Shyness                           | -      | 14%       | 44%     | 42%   |

Considering one of the main objectives of reforming mathematics education in Indonesia is to increase the ability of high-level mathematical thinking, it seems the mathematics teachers have paid no attention to it. So, the observed behavior may trigger students to build these skills into their habits in every learning process. Put differently, it can be indicated that the math teacher does not have the insight and the skills to implement the main objectives of mathematics education in the curriculum. As a result, educational presentations, that have been raised by the teacher have not characterized education that encourages students to think critically.

The observation also shows that within the teacher behaviors, the aspect of "facilitating" the development of critical thinking among students is more dominant compared to the "encouraging" aspect which is more related to the learning objectives of mathematics. This shows that the instructional behavior of teachers in an attempt to increase the critical thinking of students has not been optimal. In other words, in general, the teachers’ learning management is not focused on learning that has the potential to encourage and develop critical thinking skills.

This Instructional behavior may be related to some factors:
1. Teachers do not view critical thinking as an essential and necessary goal to achieve other learning objectives, namely cognitive and affective aspects.
2. Teachers do not have sufficient knowledge of how students' critical thinking skills can be developed/improved in learning, or about the right strategies for presenting materials through learning that is focused on critical thinking.
3. The learning paradigm managed by teachers (the subject) adheres to the principle of teachers as the implementer of the curriculum (not the curriculum developers). This can be one of the factors that influence their doctrine, as explained in this study. That is why it is considered important to analyze the curriculum in depth and explain it to the teachers. Therefore, they can reflect on their behavior in learning that is aimed at encouraging and developing critical thinking.

5. Conclusion
Based on the results of the study it can be concluded that, in general, the behavior of teachers in managing learning has led to efforts to encourage and develop students' critical thinking skills, but not yet optimal. Teacher behavior which is seen as one of the main triggers to encourage students to think critically in their appearance is very low, is to create convoluted conflicts, make conclusions and generalize things learned. Fortunately, teachers' ability to notice student mathematical thinking is a skill that can be learned and has thus become a focus in many teacher preparation programs. Incorporating learning-to-notice activities in structured settings is part of a growing movement to provide “opportunities to practice elements of interactive teaching in settings of reduced complexity” [1]. Krulik and Rudnick [20] who suggest that critical thinking will grow and develop if the learning process can encourage students to think who test, question, connect, evaluate all aspects in a situation or a problem. Furthermore, Sabandar [20] state that to build critical thinking in learning students need to be confronted
with contradictory and new problems that trigger the emergence of cognitive conflict, so that he constructs his mind looking for truth and clear reasons. Furthermore, based on the results of interviews that one of the causes of the emergence of not yet optimal teacher behavior in encouraging and developing students' critical thinking skills is the lack of teacher knowledge about behaviors that have the potential to trigger students to think critically.

6. Recommendations
Related to the results of the study, several things are proposed in re-examining similar problems:
1. Indicators of observed behavior should be more detailed to capture deeper and more specific research objects.
2. Observations should be accompanied by the application of learning models or strategies that are seen as opportunities for students to increase their role in building critical thinking.

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