The analysis of students’ self-efficacy in learning mathematics

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Abstract. The purpose of this research is to analyze the self-efficacy of students in learning mathematics viewed by Bandura’s theory. This research used the qualitative method with the triangulation for collecting data in the forms of interview, observation, and documentation. The subject in this research were students from the 10th grade at one of the high schools in Bandung. Based on the results of research, it was concluded that students have the low self-efficacy since the majority of students in the high school have less confidence in solving mathematical problems and class discussion during learning mathematics. Another interesting result from this research was no correspondence between the self-efficacy of students and their level of cognitive, which means students with the high level of cognitive is not necessarily have the high self-efficacy, and vice versa.

1. Introduction

Bandura stated that self-efficacy is people’s beliefs with their abilities to do something according to the aims that be intended [1, 2]. In this context, we talk about students’ beliefs in doing mathematical problems according to the learning goal. Self-efficacy is so important for students to make them constant to try to do the tasks which are given, although the task is not easy. For example, in mathematics some problems which are given is difficult, sometimes they start with the easy one, but getting harder and harder because of the development of the concept. Students with the high level of self-efficacy will have a commitment to survive for achieving the learning goal, compared with students with low level of self-efficacy [3, 4].

If we analyze the mathematical learning content from the curriculum of education in Indonesia [5], the mathematical concepts that must be learned by high school students are more complicated concepts compared with the concepts learned in elementary school and junior high school. Even though, not all of the students clearly understand the concepts that they learned before. For example, in learning the absolute value in the high school, at least students must clearly understand about algebraic operations and one-variable linear function that they have learned in the junior high school. But, the fact is not all of the students understand and be able to internalize their knowledge, so the consequences are a lot of mathematical concepts, that they have learned, are easy to be forgotten. Here is the importance of the high level of self-efficacy for students, so they are committed to learning mathematics even though it is not easy to them.

Depending on the result of class observation of learning mathematics in senior high school, an indication of students’ self-confidence crisis, when learning mathematics, is found. Many students, even
with the high cognitive level in mathematics, did not believe in their answers when the teacher gives some problems to students. Often, the familiar question, that comes from the students, is “Miss, is this right?” while students show their answers to their teacher. For anticipating that problem, several researchers have examined efforts to improve students’ self-efficacy, that are Miliyawati’s research about improving the critical thinking and the self-efficacy with an investigative approach, Moma’s research about improving the self-efficacy through generative learning, Hendrayana’s research about improving the self-efficacy through metaphorical thinking, and other researchers about improving students’ self-efficacy [6]. All these researchers indicate that students’ self-efficacy is low, so their focus is to improve students’ self-efficacy. But the fundamental questions are whether the high school students also found phenomenon that students’ self-efficacy is low, and if the phenomenon is right, why self-efficacy of high school students is low. These will be the fundamental questions of this research.

2. Method
This research used the qualitative method with a descriptive design, so the analysis of the phenomena is done more deeply [7]. The technique used for collecting data was the triangulation in the form of the subject interview, the class observation in learning mathematics, and the documentation with the questionnaire. The subject in this research was 106 students from tenth grade at one of the high schools in Bandung. Research procedures were reviewing kinds of literature about self-efficacy and making the observation instrument, selecting the subject and place of research, researcher as a teacher teaches as usual while observing students during the learning process (observation), giving the questionnaire of self-efficacy analysis to students (documentation), analysing them depending on the data that has been collected, interviewing several students depend on the result of the first analysis, final analyzing all data, and concluding the research results.

3. Result and discussion

3.1. The analysis of learning observation and interview
Researcher as a teacher observed in two concepts, that are the vector and the absolute value. Based on the results of learning observation, some interesting things are found during the learning process, related to students’ self-efficacy, that are interesting to discuss. Earlier, let’s first understand several dimensions of self-efficacy, those are magnitude, generality, and strength [1]. The magnitude is a level of students’ optimism when are given a difficult problem. Generality is students’ self-efficacy in the overall learning, not only in one mathematics concept. Strength is the students’ commitment to complete the task that given.

The first finding, related to the magnitude dimension, is found when researchers gave the task to students so they could independently solve problems about vector. The problems were arranged from easy to difficult, based on previous learning concepts with a few developments. However, most of the students were unsure with their work, especially in the difficult ones, and asked their teacher or their friends who were considered more intelligent to get the confirmation. When students were faced with difficult problems, even students with the high cognitive level, asked their teacher or friends to make sure their answers were correct. The reason is they don’t want to do a mistake, whereas the teacher has already informed that discussion section will be held at the end of the lesson. In this case, student tended to want to verify their answers before continuing to work to other problems. In the difficult problem, the teacher asked students, “Are you sure of your answers?” then most of the students answered that they nor really sure and gave the question back “Is this really true, miss?” Though, there were also students with the high cognitive level who are confident with their work. They tend to be more confident when their answers were the same as the answers of their friends, especially same with their friends who are considered clever in the mathematics. Thus, even self-confidence for the majority of students is still relatively low, consequently, the magnitude dimension in the self-efficacy is low too. This can happen as a result of the unfamiliarity of students solving difficult problems independently in previous learning.
[8]. Students tend to seek shortcuts to solve their problems by asking people who are considered more understand about that problem, because they themselves are not even entirely sure of their answers.

The second finding, related to the strength dimension, is the cognitive level of students not fully affected their ability in completing tasks on difficult learning activities. This happens when the vector learning, the students were divided into 8 groups and the learning method was each group gave 2 questions to the others group, if the answer of a group is correct then the points of that group is added by 10 and if the answer is wrong then the points of that group is reduced by 5. In one group with the members were students-A (who has high cognitive level of mathematics (high)), student-B (medium), student-C (medium), and student-D (low), student-A had found the right answer to the problems given faster than other groups, but she didn’t want to advance to the front of the class for answering the question. It happened more than 2 times, student-B asked her to try to just answer, but very difficult seemed to persuade student-A. Finally, after 3 problems missed then student-A tried to go forward to answer the problem that given, and the answer is correct. Student-B seemed to want to affirm to student-A that if she could solve the problem then tried to answer it, even if it is wrong. However, after that, student-A no longer solved problems in front of the class even though she was able to do it on her seat. So, until the end of the lesson, the final point of this group only 10, see Figure 1.

![](image)

**Figure 1.** Result points of a quiz in three classes.

In Figure 1 is also another interesting thing, that one group of students (student-E’s group) won absolutely over the other groups because that group collected very high points, that is a contrast with the points of the other groups. Student-E is classified as a student with the high cognitive level in mathematics, although in reality, the students' cognitive abilities in the other group are not far under student-E. This indicated that not all students with high cognitive level have no confidence, like student-A. Conversely, student-E were very confident in her ability for solving any problems.

Furthermore, for most other groups, students with similar cognitive abilities with students-A, even students who belong to medium cognitive level, were competing to solve problems that given. They looked very sure with their answer, so they were enthusiastic to try to answer the questions given by his friends in front of the class, even though the answer is not always true. The finding showed that not all students with high cognitive level, and are able to solve a mathematical problem, have a higher level of strength dimension on self-efficacy than the other students with the same ability, or even below. However, there are students with high ability and high strength dimensions level too.

Another thing, still related to the strength dimension finding, is when learning the absolute value. Students are grouped heterogeneously, they had studied the definition of $|a|$ with $a$ a real number and some form of absolute value i.e. $|f(x)| = c$, and $|f(x)| = g(x)$. Then, students assigned to make settlement of form $|f(x)| = |g(x)|$ independently in a group. The interesting thing is that in a group with members of 1 student with high cognitive level (student-F), 2 students with medium cognitive level, and 1 student with low cognitive level (student-G). In this group, their group answer was represented by student-G’s answer, not student-F’s answer. Although not entirely the answer is correct, see Figure 2, but he looked very sure of his answer. He also assured his group friends, including student F. On the other hand, based on interview result, student F had no idea about how to solve the problem and finally
agreed with student-G's answer to represent his group's answer. This can happen because students with high cognitive abilities may not necessarily use their ability to deal with difficult situations [9].

![Figure 2](image1.png)

**Figure 2.** Group of student-G answer.

The other group headed discussions between group members as well as between groups, so they get almost uniform answers even though not all of the groups were right. As for a group with 2 students in high cognitive level (student-H and student-I), they argued to defend each other's arguments that actually originated from the difference in mindset about the from that has been studied previously. From this case, it was found that students with high cognitive level and equally have high strength dimension require the mediator who comes form a person who considered more expert than them, in this case, is the teacher. The teacher must be able to conclude fair opinion, which is more correct, and what is the reason.

In the different classroom, a group of students with medium cognitive level (student-J) and 3 students with low cognitive level, student-J could formulate \(|f(x)| = |g(x)|\) to four divide cases with a simple thought, but it is correct, see **Figure 3**.

![Figure 3](image2.png)

**Figure 3.** Group of student-J answer.

In **Figure 3** we see that his thought is very simple, starting from a combination of the sign (+) and (-). Although he eventually rethought his answer, he was convinced of his answer is right. Student-J’s answer in **Figure 3** shows that students with a medium cognitive level in mathematics can have strong strength dimensions with learning stimuli and environmental demands. He committed to completing the entire tasks without much hoped to his group’s friends, but it did make him has a high level of strength dimensions due to social comparison influence [9].
The third finding, related to the generality dimension, is most students, they themselves, have the same self-efficacy level in almost all mathematics learning. The self-efficacy is influenced by several factors except gender [2, 8-10]. In the observation of this research, several factors that affected the student’s self-efficacy level are the student’s cognitive level, social comparison, teacher assessment on previous learning, and the nature of students. The student’s cognitive level clearly influences the self-efficacy level of most students but not all students, some contra examples for this element have been discussed earlier. The students’ social comparison in their class also affects self-efficacy, the more they are classified as ‘clever’ the more confident they to be able to complete all the tasks that are given during the learning process. Moreover, if there is their friend who is not classified as ‘clever’ has solved a difficult task, then they are motivated and optimistic in completing that task. Assessment of teachers such as positive judgment on students during previous learning also provides the psychological impact that can improve student’s self-efficacy and vice versa. The last is the nature of the student, e.g. the student is not classified as a student with high mathematical cognitive ability, is not considered clever class, and not also get the positive judgment on previous learning. But, if the student has a very high self-confident and willing to try to keep learning, then the student’s self-efficacy will grow as well, although sometimes it still needs correction from the teacher.

3.2. The analysis of questionnaire
This questionnaire, to measure whether students’ thinking is erratically or strategically and optimistically or pessimistically [11], was distributed before the students performed a daily test on vector materials, questionnaires were administered before and after the students performed a daily test. see Figure 4 and Figure 5. Giving questionnaire as much as 2 times was with a purpose to compare students’ answers before and after doing a test, whether they optimistic in doing a test and have self-efficacy or vice versa.

| No | Pertanyaan                                                                 | Tidak 1 | 2   | 3   | 4   | Ya 5 |
|----|---------------------------------------------------------------------------|---------|-----|-----|-----|-----|
| 1  | Saya dapat mengingat dengan baik seluruh materi mengenai bab ini.         |         |     |     |     |     |
| 2  | Saya telah belajar secara optimal untuk ulangan ini.                      |         |     |     |     |     |
| 3  | Saya berusaha mencari soal lain yang lebih menantang, selain soal soal yang diberikan oleh guru. |         |     |     |     |     |
| 4  | Saya yakin dapat mengejakan seluruh soal yang tersedia dengan baik.      |         |     |     |     |     |
| 5  | Saya yakin dapat menyelesaikan seluruh soal sulit yang ada.               |         |     |     |     |     |
| 6  | Saya memiliki strategi yang efektif dalam mengejakan soal ulangan.       |         |     |     |     |     |
| 7  | Saya yakin akan mendapatkan nilai bagus untuk ulangan ini.                |         |     |     |     |     |
| 8  | Saya memiliki minat yang tinggi dalam pembelajaran bab ini.               |         |     |     |     |     |
| 9  | Saya merasa bab ini sulit.                                               |         |     |     |     |     |
| 10 | Merasakan sulit, saya merasa kenaan tugas untuk berusaha maksimal dalam belajar materi ini. |         |     |     |     |     |
| 11 | Merasakan sulit, saya akan tetap berusaha menjawab seluruh soal yang tersedia dengan sejujur-jujurnya. |         |     |     |     |     |

**Figure 4.** Questionnaire before student did a test (Q1).
The first discussion is about the questionnaire results in the magnitude dimension, represented by the questions on the numbers 1st, 3rd, 5th, and 9th in Q1, and 1st, 3rd, and 6th in Q2, see Figure 4 and Figure 5. The results of the analysis are most students, even smart ones, choosing a scale of 2 to 4 and only a small percentage of students who steadily chose scale 5 for this magnitude dimension, indeed proved they get very good replication results although not maximized. This is showed that the average students have a medium level for this dimension. Thus, students feel that they are less able to remember learning optimally, less looking for challenging problems, and less able to solve difficult problems optimally. Based on the results of the analysis, can be concluded that the average students have a medium magnitude dimension in the optimistic face of a problem, in this case, the question of the test.

The second discussion is about the questionnaire results in the strength dimension, represented by the questions on the numbers 2nd, 4th, 10th and 11th in Q1, and 2nd and 7th in Q2, see Figure 4 and Figure 5. There are three results of the analysis in this dimension. The first is most students choosing scales 4 and 5 to represent themselves in those statements except number 4th, below scale 4. So this means that students feel that they have learned optimally and tried their best, but they are not sure that can complete the test well. The second is in the 4th statement, about their believe can do test well, most students with high cognitive level do not choose scale 5. But, unique there is a student (medium) choose scale 5. The last is in the 4th statement, there are also students who chose scale 1 before doing the test but chosen scale 5 after doing the test. Indeed the test results are excellent although not optimal. Based on the results of the analysis, can be concluded that the average students have the toughness to try to complete the task (dimension strength) at the medium-high level.

The third discussion is about the questionnaire results in the generality dimension, represented by the questions in the numbers 6th, 7th and 8th in Q1, and 4th and 5th in Q2, see Figure 4 and Figure 5. There are three results of the analysis in this dimension. The first is most students choose to a scale of 2 to 4 for represent themselves in statements 6th, 7th, and 8th. Thus, this means that student’s feel medium interested in learning, less have an effective strategy for repetition and are not too sure of getting a maximum test score. The second is there are students with low cognitive level, who choose scale 1 for this dimension. There are also students with low cognitive levels have good interests and strategies but their beliefs of getting good grades are still medium. The third is in the other side, there only a small percentage of students with medium to the high cognitive level who steadily chose scale 5 (optimistic). Based on the results of the analysis, can be concluded that the average students have medium generality dimension.

4. Conclusion
The conclusions obtained based on observation, interview, and documentation is self-efficacy level in the average students in class X high school is the medium. This means that most of them do not believe maximally in their abilities, many students with great potential but less confident of themselves so that the potential is less channeled optimally in learning.

Figure 5. Questionnaire after student did a test (Q2).
Inadequate students’ self-efficacy in high school is caused by several factors are the students' cognitive level, social comparison, teacher’s assessment of previous learning, and the nature of the students. Thus, it does not mean that students with high cognitive levels have high self-efficacy as well, vice versa.

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