Teacher’s perspective on values of mathematics

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Abstract. This study is aimed to investigate teachers’ view, students’ response and obstacles on the implementation of the values of mathematics in teaching and learning of mathematics. The main background of this study is due to mathematics education mostly tends to focus on developing cognitive aspect more than involving affective aspect, whereas affective aspect in teaching and learning process is also important. This study applied qualitative approach, by investigating teachers’ point of view, students’ response and obstacles related to the phenomenon. This research was conducted in a school in Lembang, Bandung Barat District, West Java. The result of the research shows that teachers tend to view mathematics as a subject and mathematics as values, which is character building, are separately. While there is a very close connection between them, mathematics as a subject and mathematics as values, which is character building, are separately. While there is a very close connection between them, there is a close connection between them, mathematics as a subject and mathematics as values. Concerning the students’ response, they began to recognize that the values of mathematics which are related to daily activities are a part of mathematics learning. There are some obstacles in the implementation of the values of mathematics in teaching and learning of mathematics. One of them is integrating the mathematical values and the mathematical concepts into teaching and learning of mathematics. In short, the crucial essence of teaching and learning of mathematics is not only about teaching the concepts of mathematics to students, but also internalizing the values of mathematics to students. The result of the study recommends a new sight regarding the importance of mathematical values in teaching and learning of mathematics.

1. Introduction
Mathematics is one of disciplines which organized systematically. It is also a logical reasoning field dealing with numbers, facts and problems of space and form, logical structure and strict rules. Therefore, mathematics must be deemed as a crucial thing that must be emphasized especially dealing with the development of logical, systematic, and critical aspects which leads to meticulous reasoning, creative, and growing confidence so that the students may feel the beauty of mathematical nature [1].

The purpose of mathematics learning is to understand the concepts of mathematics and its application. It is further explained that through mathematics learning, teachers and students tend to apply reasoning in patterns and the nature of mathematics, performing mathematical manipulations to generalize a pattern, constructing evidence systematically, or explain ideas mathematically. To achieve that goal, problems solving in mathematical need to communicate symbols, tables, diagrams or other media.

Mathematics learning has good effect of implementing the sense of appreciating the nature of the usefulness mathematics in life, such as curiosity, attention, and interest in learning mathematics, as well as a tenacious and self-confident attitude in solving math problems [2]. In addition, mathematics learning
also has positive impacts toward students’ attitudes such as meticulous, careful, frugal, honest, firm, responsible, unyielding, and confident attitude [3]. Based on the essence of mathematics and mathematics learning, we can state that its application will improve the affective and cognitive aspects. Regarding changes in behavior, De, Barnes, and Moors said that one aspect that can change behavior is life experience [4], this is included in the experience in learning mathematics.

But the challenge in mathematics teaching nowadays is that teachers rarely teach explicit values of mathematics in the classroom. Most math teachers agree that they should not teach value education in their learning [5].

Previous researches proved that mathematics education and character education were taught separately [6]. Mathematics education delivers the concepts of mathematics, while character education is derived from religious education and civic education. Teaching and learning of mathematics is responsibility of mathematics teacher, on one side, while the development of students’ character is assumed as the responsibility of religion and civic education teachers, on other side [7].

In some cases, mathematics learning emphasizes the achievement of the cognitive domain which learners are introduced to formulas and limited to the application of concepts. While mathematics learning without involving its values contradicts with the nature of learning [8]. It is said that learning process which only emphasizes concepts, formulas, structures, patterns in mathematics is ignoring another part its main tasks: instill affective values which should be applied through mathematics learning.

The explanation above shows that there is an imbalance in mathematics learning between mathematical contents and mathematical values. The mathematical values refer to the character values that appear from the essence of mathematics.

Mathematics has characteristics which aimed as assistive science in daily life. The characteristics emphasizes deductive process which requires logical and axiomatic reasoning, starting with an inductive process which covering the preparation of conjectures, mathematical models, analogies and generalizations through the observation of some data. Besides, it also includes the character of commitment, consistency, deduction (making general to special) and the universe (since mathematics has various symbols with various meanings, its scope must be understood firstly) [2, 9].

Bishop argues that mathematics has six values. The first value is mathematics has rationalism value which means it involves logical reasoning and hypotheses. The second is objectivism value which involves the human ability in symbolizing or other forms of representation in mathematics. The third is control value which takes place as in trade, the seller can control its sales determining the profit and loss and this will be trained if the class has been familiarized. The fourth is progress value which deals with improvements gained during mathematics learning. The fifth is openness value, in which teachers provide opportunities for students to express their ideas and to prove that those ideas are acceptable. The sixth is mystery value which many twists and turns happen in mathematics learning process is very amazing, because everyone who loves mathematics must be able to feel the beauty of mathematics. Like a circle, who thought that its diameter was twice of its radius, and it was accepted in all over the world [10,11].

In addition to be has six values, mathematics also has six characters. The first character is mathematics has abstract study which means the involving objects in mathematics including facts, concepts, operations or relationships, and principles. The second one is rely on agreement which a fundamental agreement is axioms and primitive concepts. The third character is deductive mindset by starting from the general to the specific. The fourth is it has an empty symbol of meaning. The fifth pays attention to the scope of the speaker. And the last one is consistent in the system [1].

The values of mathematics are related to the source, the limitations, and the reliability of mathematics truth as one of the disciplines in a particular culture. Mathematical values are categorized as ideological, sentimental and sociological aspects. Ideology consists of the items related to rationalism, empiricism, pragmatism, and unified values, while sentimental values have control, development, and civilization. The sociological aspect of mathematics consists of items which describe separation, openness and integrated value [12]. With this, mathematics has values that are conceptual culture, hard work, respect
for others, tolerance, socio-political facilities, and individuals [13]. Bishop also said the same thing about mathematics, that mathematics has a study of cultural values that can be related to beliefs, language, habits used by certain groups, and used for survival [14].

Based on the explanation above, it is stated clearly that character education is actually existed in the mathematics itself. So that character education is complements each other with mathematical values. This research explored how the teachers’ perspective on the values of mathematics.

2. Research Method
This research applied descriptive qualitative approach with grounded theory. The instrument of this research was the researcher himself, because the researcher played the planner role, the data collector, the analysis, the data interpreter, and finally the researcher reported the research result. The supporting instruments were observation and interview [15]. This research was conducted in a school in Lembang County, Bandung Barat District, West Java.

The data analysis phase and the conclusion were done by open coding, axial coding, and selective coding [16]. The process coding should be line by line, open coding creating summaries from several date for the date using preliminary labels. Axial coding is used to create conceptual from summaries, followed by selective coding which turns the familiar into a formal framework with a variable that includes all of the collected date [17].

3. Results and discussion

3.1. Results
We conducted research in one of private school in Lembang, West Java, Bandung regency. Observations and interviews were conducted to one mathematics teacher who taught in Senior High School (SMA) and one mathematics teacher who taught in the Junior High School (SMP).

Observation was conducted when learning process took place, high school teacher was teaching differential materials. He raised problems about differential then the students were invited to discuss the answer. Here, the teacher applied discussion and problem solving method. The teacher asked the students to solve the problem by writing the answer in whiteboard. When students cannot answer, teachers provided questions to stimulate students’ understanding in finding the right answers.

Furthermore, through observation, character values were not inculcated during the process of mathematics teaching and learning. Learning process only focuses on material and problem solving. Character education which shown by teacher was not applied through mathematics learning, but from the way teacher treats the students. The teacher gave special treatment for low achievement student, such giving the problem more easily, and telling him to work until it can be finished, while for high achievement students, teacher keep motivating them so that they would be more vigorous and more eager to learn.

Another data found from observation was that the teacher only focused delivering the material and solving the problem, but actually, character education or cultivation of values is important in learning. Instilling values can be done through the learning process or embedded the values of mathematics which found from mathematical material. But it does not appear in this learning process during observations.

In Junior High School, the teacher taught two-dimensional figure material. She explained a bit of two-dimensional theory then provided examples related to material. The teacher gave the students several questions so that the understanding of students can be stimulated and the teacher provided them opportunities to express their opinions. The teacher freed every student who wants to argue or to ask questions. Furthermore, the teacher gave them questions that would be discussed together in the classroom. Each student had the same opportunity to demonstrate their understanding on the board. And the teacher gives the opportunity to the other students to check whether the student's answer is correct. Teachers also tended to motivate students who were not confident to show their potential in working on the problem.
In the process of teaching and learning, it can be seen that the teacher instilled the values of tolerance and foster student self-confidence. However, the teacher has not yet mastered the teaching and learning process in instilling the value of mathematics. Bilda stated that the students in groups were told to measure the classroom and/or the field by meters, then the students were asked to count the area. From that activity, teachers can instil honesty, cooperation and mutual trust in groups [8]. From learning square and rectangles, values of mathematics can be emphasized to students by looking at all four angles of a figure, if they were not exactly 90° then it is not square and/or rectangular. By doing these activities, students can learn that in mathematics there is a firmness.

It appears that Junior High School, teacher instilled the character's value indirectly, it is shown how the teacher treated the students. In inculcating the value of character, we should not only show but also express it directly and clearly, so that student can understand that in the process of learning math, many character values can be applied in our daily life and they can acknowledge that the mathematics learning is about improving good character.

From the results of the interviews, both teachers explained that mathematics is an exact science which dealing with numbers. Mathematics has many things which must be understood such as mathematical concepts, mathematical patterns, and mathematical formulas. It should be transferred either by explaining or by discussion. In mathematics learning, they understand that mathematics must be taught by reasoning to a concept rather than relying on memorizing technique.

Furthermore, regarding to character learning or the cultivation of values of mathematics, teachers realize that the tasks and responsibilities of teachers are not only limited to deliver knowledge, but also instil the value of character to students. The teachers explain in instilling the characters’ value by action which means the teachers do the character's values firstly before teaching the students. And it is done every day.

They usually advise to troubled students to act good, and the teachers give them lesson and math material for other students so that they automatically practice by their own. The teacher motivates students by retelling them about her struggle experiences during youth or the experiences of other success people that the teacher knows. Students stop learning math to listen the teacher's story. Besides, the subject teachers ask students to meet and counselling teachers if they have made mistakes repeatedly.

Based on interviews, character learning and mathematics learning were taught separately. The character is emphasized based on its time and condition with a particular occurrence, and at that time, the learning process of mathematics is dismissed. This is in line with what Nik says in his book [6]. Related to Bishop that the understanding of mathematics teachers is a lesson which free of value [5].

3.2. Discussion
Based on explanation above, the author suggest the audience to keep discussing and improving topics about values of mathematics, some of them are increase the implementation of values of mathematics in mathematics learning, obstacles encountered in implementing value of mathematics, how does the relationship between intelligence and the character of daily students, and student response to mathematics learning based on values of mathematics.

4. Conclusion
One of teachers’ duties in mathematics learning is to inculcate character’s value to the students, while the reality found that teachers only focus in improving cognitive aspect, affective aspects are emphasized based on the condition happen in classroom. It occurs because teachers tend to ignore knowledge about values of mathematics. Teachers understand that mathematics is just a subject dealing with formulas, patterns, and structures. Besides, teachers do not realize that values can be found in Mathematical that useful for our daily life.

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