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Values of Matematics: How Implementation of Values of Mathematics in School

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Abstract: This study aim is to learn how to apply mathematical values to mathematics learning. This study uses descriptive qualitative methods and objects that discuss one of the mathematics teachers who teach at one of the junior high schools in Bandung. In general, the problem of education in Indonesia is mathematical values that are difficult to understand, mathematics learning and character education are taught separately in the world of education. As character education was obtained from religious education and PKN (Citizenship Education), therefore, the development of student character was the responsibility of religious teachers and PKN teachers. This is contrary to the nature of mathematics. The results showed that, of the ten values highlighted in this study, only some were applied by the teacher. As rationalism that is not applied is the accent on mathematical proof, indicator of openness the teacher does not civilize the giving of opinions on student answers, not allowed to develop creative ideas such as making posters and uploading on social media. And the persisting indicator, learning does not emphasize problem-solving in a different way. The teacher focuses on the student's weaknesses and the teacher's mastery of the core of values of mathematics has not been deep.

Keywords: Values, Values of Mathematics, Education of Mathematics

1. Introduction

Mathematics is one of the subjects studied at all levels and in all fields of science. Referring to [1] that mathematics is the basis of knowledge of other sciences, such as the fields of science and technology that are closely related to humans.

Based on its application, mathematics is always experiencing developments that are directly proportional to the development of the era [2]. Therefore, it is certain that humans are always in contact with mathematics.

Mathematics has two directions of development, namely the development of the present and the development of the future [3]. They further explained that the development of mathematics today leads to an understanding of mathematical concepts and ideas and other sciences. Whereas future mathematical developments lead to providing opportunities for developing logical, systematic, critical, and careful, creative reasoning, fostering self-confidence, and feeling the beauty of the regularity of mathematical traits, as well as developing objective attitudes and openness. Furthermore, stressed by [4] mathematics is a branch of exact science and systematically organized. Mathematics is also logical

reasoning related to numbers, knowledge of facts and problems about space and form, logical structure and strict rules. Therefore, mathematics can be seen as a crucial thing that must be emphasized in the development of logical, systematic, critical, and careful, creative reasoning, growing confidence, and feeling the beauty of the nature of mathematics.

Based on the explanation above, known that mathematics is involved in developing cognitive and affective. As stated [2] that mathematics learning has a positive impact on attitudes such as being conscientious, meticulous, frugal, honest, assertive, responsible, unyielding, and confident. In addition, mathematics learning must involve the environment and interests of students [5]. Learning that involves the environment can develop student communication skills whereas if it involves student interest it will build student confidence. If the learning of mathematics is applied in accordance with what is said by Fathani, Sembiring, Hadi, and Dolk, then mathematics learning will achieve the learning objectives of mathematics that develops the positive and affective [2, 5].

However the facts that occur in the world of education,

mathematics learning and character learning are taught separately [6]. Character education was obtained from religious education and PKN (Citizenship Education), therefore, the development of student character was the responsibility of religious teachers and PKN teachers [7]. Furthermore, things that are in harmony said that mathematics learning emphasizes the achievement of cognitive domains, where students are introduced to formulas and are limited to the application of concepts [8]. Learning mathematics without instilling affective values in mathematics learning is contrary to the nature of learning. Whereas explained by Fathani [2] above, that in learning and learning there is the formation of the affective domain of students not merely cognitive. Learning that only emphasizes concepts, formulas, structures, patterns in mathematics is learning that ignores one of the main tasks of mathematics education, which is to instill effective values that can be applied through mathematics learning.

Based on the nature of mathematics has one specific characteristic, namely as an exact science, deductive mathematics, cumulative character, and mathematical statements that are always true [9]. While Soedjadi described the characteristics of mathematics as having abstract studies, relying on agreements, deductive mindsets, having empty symbols, paying attention to the speaker's universe, and being consistent in the system [4].

Wahyudin and Soedjadi's explanation above is an approach that connects mathematics with characters learning from mathematics [9, 4]. As explained by Tapsir and Paa that mathematical values are categorized as ideological, sentimental and sociological values, mathematical values are related to social behavior and actions [10]. On the other hand, Hendriana et al. said that mathematics has characters such as commitment, consistency, deduction, and the universe [3]. Mahmudi suggested the existence of mathematical characters such as critical, careful, coherent, analytical, rational, and efficient [11]. Bishop said that mathematics has the value of cultural studies, which culture is seen as related to language, beliefs, rituals or habits practiced in groups or using mathematics as a way to survive [12].

Lancaster categorizes mathematical values into three categories [13]. First, conceptual culture, how mathematics encourages students to do their best (work hard), an attitude of respect for others, and have an attitude of tolerance. Second, mathematics as a social and political tool, that is, giving justice to all people, having honesty and trust, and having integrity. Third, mathematics as an individual, which is talking about caring for oneself and having a responsible attitude. The characters mentioned above are included in the values of mathematics.

Based on the description of values of mathematics above, it can be seen that mathematics has the character that characterizes mathematics learning in which there is cognitive and affective formation. But in fact, there are mathematics educators who do not know about values of mathematics, they tend to stop learning to instill the character of students [14]. This is emphasized by Bilda

mathematics learning tends to be contrary to what it should be, where educators are less aware that one of the goals of education is to instill students' character education [8]. Furthermore, Bishop said that some mathematics learning does not instill values, because mathematics is seen as independent of cultural studies, where the cultural studies in question are related to language, beliefs, and rituals. In line with Bishop's opinion [15] and Bilda [8] emphasized that learning mathematics only emphasizes concepts, formulas and rules without raising values of mathematics in developing student character.

Based on the explanation above, we can be state that character education exists in mathematics. Thus, this study examines how the implementation of values of mathematics in mathematics learning.

2. Research Methods

This type of research is a descriptive study using a qualitative approach. This type of research used in this study is grounded theory. The instrument of this research is the researcher himself. The researcher plays the role of planner, executor of data collection, analysis, interpretation of data, and in the end the researcher reports the results of the study. While supporting instruments in the form of observation and interviews [16]. This research was conducted at a school in Bandung.

In this study, researchers asked two observers to observe the learning process conducted by the teacher who teaches at the school. The next step is data analysis and conclusion drawing by open coding, axial coding and selective coding. From the results obtained a memorizing process is carried out in which the researcher writes the ideas that develop during the coding process after which a conclusion is drawn.

3. Results and Discussion

3.1. Result

In this study, researchers describe how the implementation in integration is related to the values of mathematics. The values discussed only focus on rationalism, objectivism, control, progress, openness, mystery, persisting, thinking of thinking, thinking flexibly, and applying past knowledge to new situation values. Researchers conduct learning integrated with the value of mathematics observed by two observers. In addition, researchers also used questionnaires and interviews with students.

Based on the results of the interview, the implementation of values of mathematics in mathematics learning, in general, most of the values studied were applied well. The following values are presented below.

Tabel 1. Implementation Values of Mathematics.

No	Values of Mathematics	Implementation
1	Rationalism value	No

No	Values of Mathematics	Implementation
2	Objectivism value	Yes
3	Control value	Yes
4	Progress value	Yes
5	Openness value	No
6	Mystery value	Yes
7	Persisting value	No
8	Thinking of thinking value	Yes
9	Thinking flexible value	Yes
10	Applying past knowledge to new situation	Yes

Teacher who teach at the school has implemented seven values can be seen in Table 1. Three other values have indicators that have not been implemented, such as rationalism values, aspects that are not applied by the teacher, namely mathematical proof. He said that for mathematical proofs it could not be fully carried out by grade VII students. Furthermore openness values, the teacher does not encourage students to defend or justify their answers. The teacher tends to give answers right away, and the other students are told to correct answers and improve right away. In addition, an aspect of openness value that has not been applied is encouraging students to display students' creative ideas through posters and making math bulletins, or web pages where they can display their work. For persisting value, what he has not done is emphasizing to look for different ways to solve problems / tasks. He argues that, this cannot be done because it will take too much time, but sometimes if students solve answers in different ways and have logical reasons, it will acceptable. But the most of them, students only provide one way to answer the question.

3.2. Discussion

3.2.1. Rationalism Value

Rationalism value is one of the character values of values of mathematics. To see whether this value is applied or not, Bishop makes indicators of the application of values, this is based on the adoption of values from [17-19].

The indicator of rationalism are encourages students to argue (argue), stimulate debate in class, emphasize proof, show examples of evidence from different mathematical or accounting history. If this is done by the teacher, then the rationalism value has been applied in the classroom [17].

Refers to the indicators described. By researcher try to find answers how to implement of rationalism value in the classroom. Researchers conducted observations and interviews to the mathematics teacher.

The interview results obtained from the teacher are rationalism values applied in mathematics learning. But the application is only limited to encourage students to argue, provide opportunities for students to argue (argue). While emphasizing mathematical proof and emphasizing other evidence such as proof from the history of mathematics cannot be done in class. According to him, grade VII can not teach to emphasis in mathematical proof, or other proof obtained from mathematics history. Although, at any time he sometimes provides mathematical proof using a deduction and induction approach, so that students easily understand.

The results of observation show that rationalism value is not well implemented. Because the teacher does not prioritize mathematical proof or proof of a concept from mathematics. Although the teacher still provides opportunities for students to argue and debate in the classroom.

Referring to Bishop, rationalism value is not implemented well. Bishop noted that [17]:

"*Valuing rationalism means emphasizing argument, reasoning, logical analysis, and explanations, arguably the most relevant value in Mathematics education.*

Rationalism values have been discussed by Bishop [18]. Values are built from ideological values that relate to a person's feelings for knowledge. Furthermore, Seah and Bishop said that, in applying rationalism values, teachers need to teach mathematical proof [20].

Implementation of values of mathematics affects the teacher's understanding of these values. Bishop says that to apply values, teachers must first realize their own values, how their teaching influences and then how their taught values can influence their students [20].

But in reality, the teacher focuses on student weaknesses. The teacher assumes that systematic proof cannot be applied to seventh grade. Whereas in conveying rationalism, the teacher must emphasize mathematical proof [17] but the teacher prioritize to the example of giving the material. To make meaningful learning in values emphasis, mathematics teachers must be able to express mathematical values explicitly or implicitly [17].

3.2.2. Objectivism Values

Objectivism value is one of the character values of values of mathematics. To see this values applicable whether this value is applied or not, Bishop made an indicator of the application of value, this was made based on the adoption of values from Bishop [17, 18].

The indicators of objectivism are to encourage students to use their own symbols and terminology before showing the truth. In solving certain problems, use geometric drawings to use algebraic calculation relationships. Shows the different numbers used from cultural or historical differences. Discuss the need for simplification and make a summary in making symbols [17].

The results of interviews with subject teachers are objectivism values applied in mathematics learning. In emphasizing this value, when learning algebra for example, the teacher tells students to give their own variables before the teacher gives the variables that are commonly used. In addition, the teacher also provides an opportunity for students to give certain variables to certain problems such as a box containing a ball. This, the teacher tells students to describe and also give certain symbols.

Based on observations from two observer it was found the teacher tells students to provide their own variables, make problem solving by describing first, and provide a summary of the material. But the teacher does not give a different symbol from the general symbol that is usually used.

Based on research conducted by Bishop, he noted how

teachers apply objectivism values in learning mathematics [17]. He said that:

Valuing Objectivism means emphasizing objectifying, concreting symbolizing, and applying the ideas of Mathematics.

Objectivism value is built from ideological values which refer to individual values of mathematics learned or taught [21]. This value is as a complement to the rationalism value Seah& Bishop [22]. Rationalism value involves separating ideas from related objects, and focusing on the use of deductive reasoning as the only correct way to reach explanations and conclusions, objectivism values describe mathematical relations with abstract ideas efficiently by concreting and treating these ideas as if they are objects.

To strengthen values, if the teacher emphasizes the rationalism value of learning, then the teacher cannot forget to strengthen objectivism value. Because these two values complement each other. When the teacher emphasizes mathematical proof, there are abstract forms that must be simplified so that they are easily understood by students. Therefore we need to give symbols to these abridgment forms.

Cultivation of values, such as objectivism values, this not only addresses the relationship between humans and the environment, but also leads to the learning of mathematics which leads to ideological culture [15]. Thus, this is very related to the understanding of the teacher in learning. Learning of mathematics encourages students to give their own symbols when learning mathematics before giving the actual symbol. The relationship between geometry as an illustration of algebra, can be use to summarize the material and apply the symbols consistently.

To strengthen the values in learning mathematics is one of the efforts in leveraging the learning of mathematics in social life [19]. Emphasis on objectivism values, Bishop, Clarkson, Fitz, Simons, and Seah said that teachers encourage students to find various ways to symbolize and represent ideas, and then compare their symbols for conciseness and efficiency [20].

3.2.3. Control Value

Control value is part of sentimental which is a component of values of mathematics. Control value is emphasizing mathematical skills through the mastery of rules, facts, procedures, and application of criteria [17]. In this case, the measurement of this value, Bishop affirms the teacher to instill this value by emphasizing answers not only right answers, but also why incorrect answers can not become correct. Students are encouraged to analyze and understand a problem whether it is a routine problem or a non-routine problem. Always show an example of a mathematical idea that can be used in people's lives.

To find out how to implement control values, researchers conducted interviews. Results shown that this value is applied in mathematics learning by giving a check on the wrong answer when doing the problem. And this is done where each question must be solved using a method. Furthermore, in working on problems, students are taught to observe questions and pay attention to whether the information is enough to solve the problem, if it is sufficient, then it is done to work on the problems, and given realistic questions.

In the learning that the teacher applies, the researcher makes observations. From the two observers who observed, the researchers got different results. The Observer found that the control value is well implemented. This is seen in the teacher where he checks student answers and confirms with follow-up questions or looks at the information in the textbook. The teacher also asks students to analyze how to draw a circle diagram using degrees or percent. Learned at the time the teacher try to connect the material learned with people's lives.

From previous research, Bishop to implement control values needs to answer the following questions [17]:

Valuing Control means emphasizing the power of Mathematical knowledge through the mastery of rules, facts, procedures and established criteria.

Referring to Bishop's opinion above, when a teacher does the three aspects above, then he has instilled control values in students. This value is done indirectly by the teacher. This value planting is very important to do. According to Bishop, Clarke, Corrigan, and Gunstone said that this control value is important to do in mathematics or science [23].

In instilling the control values carried out by the teacher, at that time the teacher was also instilling mathematics learning that was connected to the cultural context, namely sentimental value. In a sense, the teacher has implanted values that connect students' personality with science [21]. If students already have an individual's closeness to knowledge, it will make them easier to be interested in exploring knowledge independently.

Seah and Bishop said that control value is a value that directs everything important in mathematics to get the correct answer without forgetting the method used. In this case, the way the solution is done by students is taken into account, so that every wrong answer is analyzed why the answer is wrong [20].

3.2.4. Progress Value

As control value, progress value is also part of sentimental. Progress value emphasizes the way that fosters and develops mathematical ideas, through alternative theories, the development of new methods and a question of the existence of ideas [17].

In this case, the measurement of this value, Bishop said that the teacher emphasizes the strategy of the problem by using alternative and non-routine answers, along with reasons. Encourage students to broaden and generalize ideas from specific examples. Stimulate students from the development of mathematics in its history.

In this case, the researcher looks at whether the teacher understudy emphasizes this value in the classroom. Through the results of interviews with these teachers, the researchers found that the application of these values occurred during mathematics learning. This is done by asking students why their answers are different when found, students' answers are not the same as the others, then to develop each idea, students

are told to look for it via the internet, giving examples, and to start chapter studies, teachers explain of figures such as those already in the 2013 curriculum book.

Observation results indicate that this value is applied. Here, the teacher directs students in presenting data according to their wishes. Students are given assignments or exercises by finding their data and present it following the concepts they have learned and the teacher motivates students with mathematical figures.

Referring to Bishop, the progress value is implemented well. The teacher has done this value with [17]:

Valuing Progress means emphasizing the ways that Mathematical ideas grow and develop, through alternative theories, development of new methods and the questioning of existing ideas.

Bishop says that, when students are encouraged to solve routine and non-routine problems, the teacher has developed knowledge that is socially transmitted [21]. In learning mathematics, the teacher has implanted knowledge derived from social methods.

Bishop said that progress value is a complement to control value. Because mathematics has a display of acquired knowledge, mathematicians feel able to explore and submit ideas [24]. These values include abstracts and generalizations, both of which are further mathematical growth. On the other hand, Seah and Bishop say that this value has stability, at the same time when this value is implanted, here mathematics is in the realm of a change that has progress [19].

3.2.5. Openness Value

Openness is part of the sociological values of mathematics. Openness value emphasizes knowledge democracy, through democracy obtains proof and individual explanation [17].

In emphasizing openness values, Bishop summarizes that teachers provide learning by encouraging students to defend and answer students in front of the class. Encourage students to display their ideas through the posters they make. Helping students create math bulletins (summaries of mathematical material) or web pages where students can show their potential.

To find out how the implementation of openness value is applied, researchers conducted interviews with teachers. The researcher found, this value had not been applied in the classroom, because in-class learning, students had not been allowed to provide a defense of their answers, but they were immediately told to check their answers again, or directly provide the actual answers on the board. In developing mathematical creative ideas, students are not told to make posters or display every child's ideas in a children's social media account.

Based on the observations of the two observers, this value is not applied properly. In encouraging students to defend their opinions, however, other aspects such as making posters and also developing their ideas using social media accounts are not implemented.

The students self-potential needs to be developed, in learning, teachers need to develop that potential through

learning. And this Bishop said that in tying the potential of children can be done by instilling openness value. Things done are [17]:

Valuing openness means emphasizing the democratization of knowledge, through demonstrations, proofs and individual explanations.

Based on the findings obtained by the researcher, the teacher did not instill values properly. Because the teacher does not provide opportunities for students to defend their answers during learning. The teacher immediately gives the real answer. Besides, teachers do not provide opportunities for students to develop their creative ideas through posters. The teacher thinks this cannot be done because students are still in seventh grade.

3.2.6. Mystery Value

Like openness value, mystery value is also part of sociological which is a component of values of mathematics. Mystery value means emphasizing magic, attractiveness, and mathematical ideas [17].

To instill this value, Bishop emphasized the teacher to tell about ancient math puzzles. The teacher stimulates students' mathematical imagination abilities with pictures, artwork, etc.

Regarding mystery value, researchers ask questions through interviews with the teacher concerned. The interview results obtained that this value has been applied in learning. Usually when at the beginning of learning, the teacher gives explanations for mysterious things like the emergence of phi numbers, etc. and in stimulating students' minds by using pictures or PPT and this makes the students feel happy.

Based on the results of observations made on the teaching teacher it was found that mystery value was applied well. The teacher directs students to imagine certain data and then draw with certain diagrams, in addition to that the teacher is also consistent in making a scale so that the image data presentation is better.

Referring to Bishop, emphasize mystery value by [17]:

Valuing mystery means emphasizing the wonder, fascination, and mystique of Mathematical ideas.

This value refers to the value of sociology so that when teachers instill this value, the teacher is instilling the value of sociology [17]. In learning, the teacher explains the history of mathematics or material. Because in the book owned by the teacher, there are already figures who are mathematical and have a short story about the findings of these figures. Thus, to instill this value, the teacher is easier to instill.

In addition, the teacher also stimulates students to use imagination by describing or imagining in the form of questions before solving the problem. This is done by the teacher so that it makes it easier for students to solve problems.

3.2.7. Persisting Value

In instilling the persisting value, researchers adopt the values raised by Dwirahayu, which are collaborated with Bishop's way of creating values [25]. To instill persisting values, teachers emphasize students to be diligent, use systematic methods to analyze problems, distinguish ideas

between good ideas or not, look for different ways to solve tasks/problems [25].

In implementing this value, the researcher interviewed with the teacher who taught. Researchers want to know whether this value is instilled in students. And the results I found through interviews were obtained that the value of abstinence was done but not as a whole. To encourage students to learn this is done by showing a grading system, and graduation requirements. In working on problems systematically, the teacher emphasizes students to do it right. Differentiation of the right and incorrect ideas is done by giving homework and when working on questions in class and in front of the blackboard, but in solving problems in several ways this is not be done because it is seen that it will be a waste of time.

Based on observations found that this value is applied properly. In learning the teacher gives motivation to students by telling Karl Pearson and will also get a good job if you understand statistics. The teacher also directs students to work through the stages of presenting data correctly and well, starting from reading the data, choosing the diagrams used, etc. In learning the teacher directs students to know their reasons for using solutions, such as when drawing a pie chart, students are encouraged to understand whether they will use degrees or not. The teacher also shows in presenting data, it can be presented in several ways.

Based on the results of the above data, the researcher observes that this value has been done well. The teacher shows a systematic method for analyzing a problem. see or pay attention to good ideas or bad ones in solving problems. As well as providing alternative solutions.

3.2.8. Thinking to Thinking

Thinking of thinking is a value taken from values that are habits of thought. The same thing with the persisting value, the researcher adopts the value that was raised by Dwirahayu, which was collaborated with Bishop's way of creating value [25]. To instill thinking of thinking, the teacher emphasizes students to work or plan, be aware of their thoughts and actions, develop strategies to get information to solve problems, illustrate the steps used to solve problems [25].

To find out how the implementation of thinking of thinking value, researchers conducted interviews with teachers who teach. The results obtained are that this value has been applied to mathematics learning. By planning a plan with a report, and if the student report is good, then they are told to do it. To keep students aware, the teacher shares the attention with students and also reminds students who are daydreaming. Formulating strategies in solving problems, the teacher tells students to search for themselves from the internet or ask friends or older siblings of their class. Illustration of these steps is done responsibly.

Based on observers' observations made by two people, it was found that the teacher applied this value well. In learning the teacher directs students to pay attention to what needs to be done first and the next steps, such as to present data in a pie chart, are explained that the need to multiply by three hundred and sixty degrees. Students are also encouraged to remain active so that they remain in a state of concentration. Students are encouraged to develop strategies by providing a grid to solve problems. Students are also given questions, about how students get certain answers.

3.2.9. Thinking Flexible Value

Thinking flexible value is part of the habits of the mind [25]. Adopting flexible thinking by applying values by Bishop, researcher research by paying attention to how these values are applied in learning.

To know the application of value thinking flexible, the teacher must pay attention to whether the teacher encourages students to think openly, have different ideas to solve a case, change their ideas when you face new information, use different ways to solve problems. This researcher conducted interviews with the teacher concerned. The results found that this value has been applied in mathematics learning. Students are encouraged to think openly by giving answers in own ways. each student's answer can be accepted provided the answer is still logical. Changes in ideas in changing information are made when working on problems and students usually want to change strategies to solve problems when there are changes to the information obtained.

Based on observations made on the learning that teachers do, researchers found based on two observers, namely thinking flexible is not applied properly. In learning the teacher encourages students to think openly, asking students to give opinions under student understanding. also, the teacher gives freedom to students in presenting data, free to use diagrams as they wish. But in changing ideas in solving problems when finding new information, the teacher does not direct.

3.2.10. Applying Past Knowledge to New Situation Value

Applying past knowledge to new situations is also part of the habits of thought [25]. The same way is done as the previous value, adopted and using the method applied by Bishop, researchers aim to see whether this value is implemented in mathematics learning.

To see the implementation of applying past knowledge to new situation value, researcher conducted interviews with the teacher concerned. It was found that this value has been applied in mathematics learning. In this way, students are still allowed to use their old knowledge first. Also, students are reminded that their knowledge when elementary school is still used in learning mathematics. Besides, students' experiences in discussing questions usually students bring up old knowledge such as interpreting a picture, based on that it gives rise to a new thing for example comparison.

Based on observations made by two observers of the learning given by the teacher. The results obtained that this value is not applied properly. The teacher tells students to solve problems according to own abilities. Each student gives their own opinion. The teacher also shows the relevance of the material being learned at that time to those previously able to be used in solving problems such as using the concept of comparative worth. But in the explanation that the experiences that students experience in solving problems will still be used

in solving new problems not implemented.

4. Conclusion

Implementation of mathematics learning by using values of mathematics that concentrate on ten values, some values have not been completely implemented, namely rationalism, openness, and persisting values. This is because the teacher focuses on the student's weaknesses and the teacher's mastery of the core of values of mathematics has not been deep.

An indicator in emphasizing value rationalism that is not applied is the accent on mathematical proof and the weight of other evidence related to the history of mathematics. Learning is only centered on examples without emphasizing mathematical proof. Indicators in emphasizing the value of openness, the teacher does not civilize the giving of opinions on student answers. Besides, students are also not allowed to develop creative ideas such as making posters and uploading on social media. And the persisting indicator, learning does not emphasize problem-solving differently.

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