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Mathematical Belief Profile of Seventh-Grade Students in Sleman Regency, Yogyakarta City

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Abstract. Students' mathematical belief is one of the factors that influence how students do mathematics. Teachers are expected to conduct a preliminary study before making a lesson plan so that learning can run meaningfully. This study aims to describe the profile of students' mathematical beliefs of seventh graders in Sleman Regency based on high and low categories, as well as gender differences. This research is quantitative and descriptive. It was conducted in six junior high schools in Sleman Regency with 140 students. First, students filled out a Questionnaire about Students' Mathematical Beliefs, then some students were interviewed for a deeper understanding of the topic. The findings of this study indicate that there is a tendency for overconfidence in male students with high mathematical belief levels, while female students are more careful. Then, male students with moderate levels showed hesitation in working independently. However, they are willing to do the work themselves. The indecision of female students depends on the material, if they like the material they will be more confident. Male students with low mathematical belief levels will try to avoid mathematics. Meanwhile, although female students are more willing to take mathematics lessons, they have a fixed mindset. Both genders felt that teachers favored the smarter students. Based on these findings, most students realize the importance of mathematics. Then, students' self-confidence and the teacher's role in learning are two things that affect students' mathematics learning. Therefore, teachers are facilitators and motivators for students in mathematics learning so that they can assist students in enhancing students' mathematical beliefs.

Keywords: mathematical belief, students' mathematical belief, gender difference, seventh-grade students

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INTRODUCTION

Students who have positive beliefs about mathematics, consider mathematics to be a relatively easy, interesting, and conceptually good subject to learn (Bibi, Zaman, & Idris, 2020). Students who have positive beliefs about mathematics will enjoy learning mathematics both inside and outside the classroom. Furthermore, Pehkonen and Pietilä (2003) stated that beliefs about mathematics touch the domains of knowledge, attitudes, and even emotions. However, they all intersect, for example, the statement "I am not good at mental calculations" can be thought to be related to self-confidence, but also attitudes towards mathematics. Beliefs are defined as "knowledge" formed by individuals. This "knowledge" cannot be proven by others and the truth of this "knowledge" is only proven by itself in the individual (Eynde, Corte, & Verschaffel, 2002).

Callejo and Vila (2009), recognize confidence as a learner's one-sided knowledge of appropriate mathematical content, himself as a mathematics learner, and as a mathematical problem-solver. Beliefs play a huge role in the learning and teaching of mathematics. Student learning outcomes are strongly linked to their beliefs and attitudes towards mathematics (Furinghetti & Pehkonen, 2002). Similarly, McLeod (1992) shares the opinion that beliefs can enhance or weaken an individual's mathematical and problem-solving abilities. Other researchers also support this research (Ahmed, van der Werf, Kuyper, & Minnaert, 2013; Ayebo & Mrutu, 2019; Jäder, Sidenvall, & Sumpter, 2017). Mathematics-related beliefs are significant to study because it can be used to rationalize student behavior in a variety of mathematical settings. Aspects of belief, including belief in mathematics, affect the process when students do problem-solving so it affects students' problem-solving abilities (Ozturk & Guven, 2016). Schoenfeld (2015) states that to have a deeper understanding of students' mathematical performance, researchers need to unveil students' mathematics-related beliefs. Those beliefs include beliefs about themselves, math tasks, social contexts of learning mathematics, facts, procedures, and strategies of problem-solving.

Gender differences in mathematics are a subject that researchers continue to explore. The findings of the researchers were in favor of boys or some cases, no gender differences; rarely a

difference in favor of girls is reported (Markovits & Forgasz, 2017). This difference is something that grows not from within a person (Spelke, 2005). One of the reasons why this has grown is due to socio-cultural factors (Penner & Paret, 2008), which have influenced how boys and girls do mathematics since childhood. This difference resulted in mathematics being dominated by men (Forgasz & Markovits, 2018; Rapp & Borgonovi, 2019). Compared with women, men are more likely to say they like mathematics, find it appealing and beneficial, and express higher confidence in their mathematical abilities (Forgasz & Leder, 1996; Lupart, Cannon, & Telfer, 2004). Although gender differences in mathematics learning appear to be declining (Else-Quest, Hyde, & Linn, 2010; Gilah C. Leder, 1992), the problem may become more specific. Differences such as level of participation (Van De Gaer, Pustjens, Van Damme, & De Munter, 2008), learning styles (Geist & King, 2005), teacher attention (Gilah C. Leder, 1992), role-taking in classroom activities (Horne, 2004), and bias towards males, are constantly found and these changes can begin at a young age (Horne, 2004). There are many factors in society, home, and school, they differ from country to country shaped students' attitudes towards mathematics, beliefs about mathematics, and individual perceptions of one's mathematical abilities, and this pattern may be seen in the early school years (Markovits & Forgasz, 2017).

Gender differences are one of the educational factors that need to be explored by educators to be able to understand their students. How both genders perceive and believe in mathematics will affect learning in the classroom. The initial knowledge of students' mathematical beliefs levels by the teacher is one of the first steps in developing a lesson plan. Then, research on mathematical belief in terms of gender differences is still rarely done. This exploration will be the beginning of how teachers take steps to help both male and female students improve their math skills and provide meaningful learning. In addition, seventh graders are transitional students from elementary school to high school. So, there needs to be an in-depth study of how the male and female students in seventh grade describe. This is to see the picture of students' beliefs about mathematics that they have at the elementary school level. This knowledge is used as the basis for teachers to improve learning in junior high schools. Therefore, the purpose of this study is to look at the mathematical belief profile of seventh graders.

METHODS

This study is descriptive qualitative research because it is more focused on the process than the findings. This research was conducted in the Sleman Region, Yogyakarta City. The population in this study were all seventh-grade students and there were 183 students as samples. Of all the questionnaires that were returned, 43 questionnaires were not feasible so the data collected were 140 questionnaires. 74 were female students and 66 were male students.

First, the students filled out the Mathematical Belief Questioner, then the researcher analyzed the results. Based on the analyzed results, the researcher conducted in-depth interviews with selected students.

The data collection techniques of this study are questionnaires and interview guide sheets. The following is a description of each data collection technique used in the Mathematical Belief Questioner to measure students' mathematical beliefs. The questionnaire had 28 statements with a scale of strongly disagree to strongly agree. Then, the interview guide sheet is used to explore students' mathematical belief results. This needs to be done because the researcher wants to understand some of the students' thoughts and reasoning about their mathematical beliefs. Lastly, the researcher observed the teaching and learning interaction in class and also interview the teacher briefly.

The researchers developed aspects of Mathematical Belief based on previous studies (Atnafu Ayele & Dadi, 2016; Eynde et al., 2002; Sturm & Bohndick, 2021; Yuanita, Zulnaidi, & Zakaria, 2018), namely 1) students' belief in the characteristics of mathematics, 2) students' self-confidence as a mathematician, 3) students' beliefs about the teacher's role, and 4) students' beliefs about mathematics in a social context.

RESULTS AND DISCUSSION

In results and discussion section, we discuss the results of the statistical analysis that has been performed to measure the students' mathematical beliefs. Descriptive statistical results about the students' mathematical beliefs have been included in Table 1.

Table 1. Descriptive analysis results of the students' mathematical belief

Gender	N	M	SD	Max	Min
Male	66	2.81	1.31	96	58
Female	74	2.86	1.48	99	64
Total	140	2.84	.,40	99	58

The minimal score that can be achieved is 28 and the maximal score is 140. According to table 1, the minimal score of the mathematical belief level is 58 and the maximal score of the mathematical belief level is 99. Therefore the students' mathematical belief scores are pretty balanced.

Table 2. The results of the students' mathematical belief level

Mathematical Belief Level	Male (66)	%	Female (74)	%
High	12	18	19	26
Moderate	36	55	38	51
Low	18	27	17	23

Table 2 shows that the students' mathematical beliefs are very diverse. However, it is also seen that there are still some students who do not believe in mathematics. Of the male students, 18 students have a low level of mathematical belief. Meanwhile, for female students, 17 students are at a low level of mathematical belief.

The analysis of the students' mathematical beliefs was based on Ayele & Dadi (2016), the high levels are strongly positive beliefs (4.5 to 5.0) and positive beliefs (3.5 to 4.4). Then, the medium level is neutral (2.5 to 3.4). Lastly, the low levels are negative beliefs (1.5 to 2.4) and strongly negative beliefs (1.0 to 1.4). Therefore, the level of students' mathematical belief is indicated in Table 3.

Table 3. The Nature of the students' mathematical belief level

Mathematical Belief Aspect	Gender	N	M	SD	Level	Description of Level
Characteristics of mathematics	Male	66	2.90	1.37	Medium	Neutral
	Female	74	3.02	1.42	Medium	Neutral
Students' self-confidence	Male	66	3.23	1.04	Medium	Neutral
	Female	74	2.84	1.11	Medium	Neutral
Teacher's role	Male	66	2.89	1.32	Medium	Neutral
	Female	74	3.12	1.40	Medium	Neutral
Mathematics in a social context	Male	66	2.94	1.21	Medium	Neutral
	Female	74	2.62	1.17	Medium	Neutral

According to the findings in Table 3, all of the mathematical belief aspects are at a medium level. The students mostly understand and such a neutral stance on their mathematical beliefs. Male students have a higher mean score on two aspects, they are students' belief in mathematics characteristics and students' beliefs about mathematics in a social context. The difference between male and female mean scores of aspect students' belief in mathematics characteristics is 0.39. Then the difference between both genders mean scores of aspect students' beliefs about mathematics in a social context is 0.32. Meanwhile, female students have a higher mean score on the other two aspects, they are Students' belief in mathematics characteristics and students' beliefs about the teacher's role. The difference between both genders mean scores of aspect Students' belief in mathematics characteristics is 0.29. Then the difference between male and female mean scores of aspect students' beliefs about the teacher's role is 0.23.

The question 'is there a significant difference between male and female students' mathematical belief?' was answered using an independent-sample t-test. Since the normality of the data and homogeneity of variances of the independent variables were met. Accordingly, the results of the independent t-test are shown in Table 4.

Table 4. The Independent t-test for students' mathematical belief for gender

Mathematical Belief Aspect	Group	N	M	SD	df	t	p
	Gender				139	1.031	.087
Mathematics characteristics	Male	66	2.90	1.37			
	Female	74	3.02	1.42			
	Gender				139	.431	.556
Students' self-confidence	Male	66	3.23	1.04			
	Female	74	2.84	1.11			
	Gender				139	1.21	.12
Teacher's role	Male	66	2.89	1.32			
	Female	74	3.12	1.40			
	Gender				139	.318	.761
Mathematics in a social context	Male	66	2.94	1.21			
	Female	74	2.62	1.17			

From Table 4, although the mean of mathematics characteristics for male students (2.90) was lower than for female students (3.02), there was no statistically significant difference between both genders in their beliefs about mathematics characteristics. The findings in Table 4, also indicated that although there are unequal means, there were no statistically significant differences between male and female students' self-confidence as a mathematician, teacher's role, and mathematics in a social context. This result is in agreement with the findings of Ayele and Dadi (2016). They also find that even though there are some differences between the mean scores of male and female students, there is no significant difference between all aspects of their mathematical belief.

Then, based on the result of the survey researcher conducted interviews and observations for each student on their specific gender and mathematical belief levels. Therefore, there is one student from each category. There are 24 students from 24 categories.

In the aspect of students' beliefs in mathematics characteristics, male students who have a high level of mathematical belief can see that mathematics is not just arithmetic. They give examples of simple mathematical logic. In addition, they also do not hesitate in demonstrating the use of symbols in mathematics. They also consider that memory is one of the determinants of success in mathematics. While female students who are at a high level of mathematical belief indicate that they understand how mathematics continues to develop. The use of symbols and understanding how mathematics is not only memorizing but memorizing is also something important. They feel that mathematics is a developing science. They also do not hesitate to provide examples of the benefits of mathematics in the real world.

Male students who have a moderate level of mathematical belief think mathematics is a science full of symbols. They also feel that mathematics is the science of counting. In addition, their memory is dependent on the given material. If they like the material then they will remember it. Female students who have a moderate level of mathematical belief indicate that they understand that mathematics is not just numbers and counting. The use of symbols in mathematics helps them to make analogies in conversation. However, they argue that memorizing is most important in mathematics and depends on the material being studied. Meanwhile, male students who have a low level of mathematical belief think that mathematics is a collection of formulas and symbols. This causes them to feel that mathematics is mostly just memorizing. They assume that a math problem has only one way to solve it. This results in when they have difficulty remembering the formula, they feel they have failed and give up. They feel mathematics is a science that is too abstract so their abilities cannot be achieved. They also prefer to avoid math in the future and reduce math lessons. Female students who have a low level of mathematical belief assume that it depends on the material. They have a better understanding of the questions if they like the material. Even so, they feel that the use of symbols in mathematics is sometimes difficult to understand. In addition, when the math material requires them to draw or imagine a picture they have difficulty doing so. They find it difficult to convert instruction words into drawings so they feel that mathematics is an abstract science.

In the aspect of students' self-confidence as

mathematicians, male students who have a high level of mathematical belief show confidence in their answers. Even so, they still experience nervousness when asked to explain their answers in front of the class. However, they do not hesitate to explain their work to teachers and other students. They show that they are capable of doing their work. In addition, they see mistakes as normal and can be fixed again. However, there is a tendency for them to be overconfident about their abilities so that they do not re-check their work. Female students who have a high level of mathematical belief show high confidence in their answers. They are confident enough to come forward to explain the answer but show nervousness when asked a question. They also assume that mistakes in mathematics are normal. They are confident in their abilities and are careful about answering questions independently.

Male students who have a moderate mathematical belief level indicate that they are still unsure of their answers. They keep asking other students if there is a different answer they will immediately feel nervous. If they like the given material, they show confidence to work on it but they are still unsure of the answer. They show a resigned attitude when talking about their math scores. They feel that their abilities are sufficient and can still be developed. Female students who have a moderate mathematical belief level show their doubts when answering. They were seen asking other students how to do something. They feel that mathematics is not their strength, but their ability is sufficient. They showed hesitancy to answer, but after explanations from other students, they showed enthusiasm to do their work. Their enthusiasm depends on the material being studied.

Male students who have a low level of mathematical belief show a dislike attitude towards mathematics. They even feel that if they could, they would avoid learning mathematics. Some of them indicated that they prefer outside activities, such as sports, and find math boring. They feel math is their weakness in school, and when they are helped in doing the problems they show a nonchalant attitude. They tend to look for friends who fail exams so they feel satisfied because they are not alone. Female students who have a low level of mathematical belief show a dislike attitude towards mathematics. They feel that mathematics is not for them. They feel that no matter how much they learn their abilities will not develop. When assisted in doing a math problem, they easily give up. They have a fixed mindset that feels they can't grow. They stated that they were ashamed to show their poor grades.

In the aspect of student confidence in the teacher's role, male students who had a high level of mathematical belief indicated they believed that their teacher would help them. They feel comfortable when the teacher communicates with them. They show respect for the teacher, but they are still hesitant to ask questions about learning. They can follow every explanation from the teacher about the material. Female students who have a high level of mathematical belief show confidence in their teacher. They feel comfortable when the teacher communicates with them. They show respect for the teacher and do not hesitate to ask questions related to learning. They can follow every explanation from the teacher about the material.

Male students who had a moderate mathematical belief level indicated that when they doubted their answers, they asked their peers more often. They tend to be neutral towards their teacher, but they also feel that sometimes they have difficulty understanding the teacher's explanations. They feel that the teacher still does not provide variety in learning so it seems boring. Female students who have a moderate mathematical belief level indicate that they ask other students more often. However, if the other students also do not understand they do not hesitate to ask the teacher. They also feel that the teacher's explanation of the material they like is easy to follow, but the material they don't like becomes difficult. They feel that learning in class is still monotonous so it is sometimes boring.

Male students who have a low level of mathematical belief show a dislike attitude towards mathematics. Even so, they show respect for their teacher. It's just that they feel that the teacher's way of teaching is boring. Even so, some students think that the teacher prefers smart students when answering questions. Teachers will pay more attention to smart students and tend to ignore less intelligent students. This resulted in sometimes these students becoming indifferent to the teacher. In addition, there are some teachers whose voices are less loud, making it difficult for students to hear them. Female students who have a low level of mathematical belief show a dislike attitude towards mathematics. They feel that learning in class is boring. They tend to close themselves off

and avoid teachers. They also feel that there are teachers who are picky about smart students. This causes them to lose motivation to be better. They still want to listen to the teacher's explanation, but when asked to do it themselves they are less motivated.

The teacher's role is very important in learning mathematics, both in the classroom and outside the classroom (Munna & Kalam, 2021). In fact, for student-centered learning, the teacher's role is vital (Keiler, 2018). According to Yukhymenko et al. (2014), teachers are not information givers or class controllers. On the other hand, teachers facilitate, train, and model good problem-solving skills for their students. This is because the teacher becomes a facilitator and motivator for students in learning mathematics. The facilitator keeps the focus on learning, guides the process, measures challenges, and provides appropriate feedback for each student and the entire group (Gordon, Rogers, Comfort, Gavula, & McGee, 2001). In addition, teachers are also expected to be managers of students' mathematics learning (Masih, 2020). The teacher needs to be a good example so that students will follow the teacher.

In the aspect of mathematics in a social context, male students who have a high level of mathematical belief understand the importance of mathematics for themselves, and they do not hesitate to show that at a later stage they will use mathematics. They confidently show real-world examples of how mathematics works in the real world. Female students who have a high mathematical belief level understand the importance of mathematics. They also provide concrete examples of how mathematics affects the learning of others. They also show a love for mathematics and do not hesitate to continue to the next level. Male students who had a moderate mathematical belief level indicated the importance of mathematics, but they felt that if they could choose they would avoid mathematics. They hesitate when explaining how mathematics affects learning other than economics. Female students who have a moderate mathematical belief level show a neutral attitude. They don't hate math but they don't like math either. They show that they understand how mathematics affects the classroom and the real world. However, they have not been able to provide tangible examples of its benefits other than in the economic field. They also reveal the benefits of mathematics to the world depending on the material. There are some materials that they feel are of no use to the real world.

Male students who have a low level of mathematical belief tend to dislike mathematics. They are aware that mathematics exists in the real world, but apart from arithmetic or economics, they have difficulty providing other examples. They give examples of shaped buildings, but they have not been able to demonstrate the need for mathematics there. They feel that once they graduate, they don't need math anymore. This is because they will avoid mathematics. They feel that learning outcomes and arithmetic are the main goals of learning mathematics. Female students who have a low level of mathematical belief show a dislike of mathematics. They feel that mathematics exists in the real world, but only provide examples of economics. They also show that learning mathematics is learning to find learning outcomes, not processes. They are aware that mathematics is useful for human life, but they are unable to provide examples other than the usual things, namely economics and trade.

CONCLUSION

The findings of this study show that male students who have a high level of mathematical belief indicate that they like mathematics. They believe in their abilities but are still hesitant to explain in front of the class. They also showed them that they were able to solve mathematical problems independently. However, there is a tendency of overconfident. This causes them to often make mistakes because they do not check again. In addition, they also feel that their teacher helps them in understanding the material. Then, they believe in the benefits of mathematics and can provide examples. Female students who have a high level of mathematical belief show that they like mathematics. They independently complete the work, but they still ask their colleagues or teachers to confirm. They show an attitude of hard work and caution when working on a problem independently. In addition, they feel that the teacher helps them to understand the material. Then, they believe in the benefits of mathematics and can provide examples.

Male students who have a moderate mathematical belief level indicate that they feel neutral about mathematics. They do math because there is a math lesson, but they find the learning in class quite impressive. They are hesitant to work independently so they tend to

keep asking other students. However, they are willing to do the work themselves. They are aware of the benefits of mathematics but have not been able to provide examples other than economics and trade. Female students who have a moderate mathematical belief level show a neutral attitude toward mathematics. They understand that mathematics is important and must be learned. However, they are still not able to show the benefits of mathematics with confidence. They like math if they like the material being taught. They feel that learning in the classroom also depends on the material. If they can understand the material being taught they will feel confident and able to understand the teacher. They are aware of the benefits of mathematics but have not been able to provide examples other than economics and trade.

Male students who have a low level of mathematical belief show a dislike of mathematics. They feel that mathematics is not for them. They feel that the teacher shows favoritism to smart students. In the future, they will try to avoid math. They show an indifferent attitude toward learning and want fewer math lessons. Female students who have a low level of mathematical belief show a dislike of mathematics. However, they understand the importance of mathematics. They also feel that teachers show favoritism to smart students. In class, they show a resigned attitude and feel that they can no longer develop their math skills. They still pay attention to learning in class, but they easily give up when working on math problems. They have a fixed mindset.

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