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## Students' Mathematical Beliefs At School That Separate Gender Based On Students' Mathematical Autobiography

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### Abstarct

This study aims to find out the change in mathematical beliefs of students seventh grade in Junior High School through students' mathematical autobiography while at elementary school. The research design used in this study is qualitative descriptive. Instruments in this study are researchers as the main instrument, questionnaire about the identity of participants and 20 items of related statements about students' beliefs in mathematics, as well as interview guides as supporting instruments. The indicators of mathematical beliefs in this study are students have confidence in mathematics as a subject, have confidence in learning mathematics and problem solving, have confidence in learning mathematics in general. The results of this study showed that firstly, almost all students, both male, and female, have a decline of beliefs in mathematics learning at the junior high school level. Second, the factors that affect the decreasing level of students' belief in mathematics during the junior high school are the drastic changes in the subject that becomes more difficult and more formulas to be memorized, and many lessons do not use concrete objects. Further, the teachers' attitudes who are also very different from when they are in elementary school which are more comfortable, their social conditions are changed because they live in dorms that have many activities (must be followed) that makes them busy so that they are difficult to find free time to learn outside the school hours. Third, students' beliefs about mathematics learning have shifted from positive to negative or vice versa.

### Keywords:

*Education; Gender; Mathematical Autobiography; Mathematical Beliefs.*

### Introduction

Belief is one thing that forms one's view of something. According to McLeod, D.B., McLeod (2002), the definition of belief depends on its purpose and the definition is not single. Beliefs are conditions in which a person acknowledges a truth, although others do not necessarily acknowledge that truth (Borg, 2001). According to Chong et al (2004) beliefs

are formed by one's nature. Eleftherios & Theodosios (2007) write that belief is a person's subjective judgment of knowledge and does not need formal justification. Chapman (2008) argues that a person's beliefs are based on something that is considered to be true and that it can come from both real and imagined experiences.

Furthermore, students' belief in a lesson also contributes to the students' learning achievement (Eleftherios & Theodosios, 2007; House, 2006). Liviananda & Ekawati (2019) write that mathematical belief is the way the view of students who are considered correct in the world mathematics that can affect students' responses in learn math and respond to math problems which determines how he chooses the approach in solve the problem. The students' belief in mathematics positively correlates to mathematical performance (Abu-Hilal, 2000). One simple illustration, student experience in mathematics serves as a former of student attitudes in solving mathematics problems. Previous experience can be a reference for students in choosing relevant information and the right concept to solve the problem.

According to McDonough, A., & Sullivan (2014), belief in mathematics can affect student evaluation, for example in doing math assignment. Student's belief in mathematics impact on the students' attitudes and way of work in mathematics (Buehl, M. M., & Alexander, 2005; OECD, 2013). The opinion is in line with the definition states by Schoenfeld (1992) as the initial initiator of belief in mathematics that is, beliefs of mathematics is a person's understanding that forms the ways of conceptualizing mathematics including mathematical behavior. This confirms that mathematical beliefs consist of the subject of mathematics itself and the things that happen to the student's self and environment. Goldin (2002) states that the structure of individual beliefs is influenced by their

interaction with social groups. So, it appears that although the cognitive structures related to mathematical beliefs in each hidden individual, the symptoms can be seen when they perform mathematical activities or when given a stimulus regarding to mathematics.

Belief in mathematics and mathematics learning are interconnected by forming a circular process (Nurmi et al, 2003). The process of mathematics learning in the classroom is slowly affecting students' mathematical beliefs. In contrast, belief in mathematics affects the way students "receive" mathematics lessons. According to Eynde & Corte (2002), there are three things that simultaneously affect the students' belief in mathematics namely the object (mathematics education) and the student's self also the social context (class). These three aspects are illustrated in the following diagram.

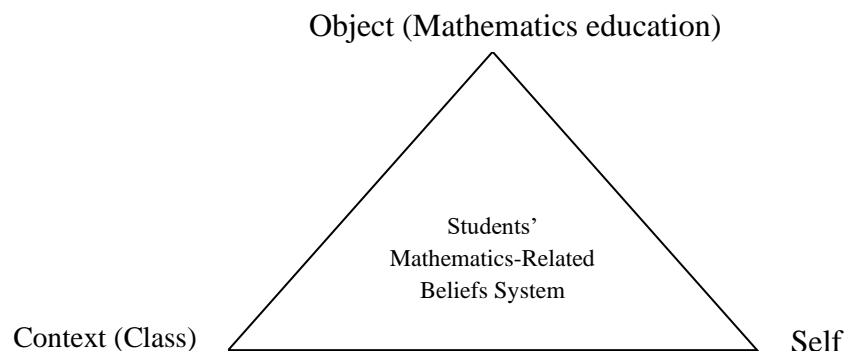


Figure 1. Aspects of students' belief systems in mathematics

Many studies have examined students' beliefs about mathematics from elementary school to college levels and associated with student learning achievement. One of the studies conducted by Taylor (2009) shows that a specially designed learning curriculum can change students' beliefs about mathematics and mathematics learning, and it can improve student performance in solving mathematics problems. The greatest change can be seen in students' beliefs about the importance of understanding concepts in

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mathematics learning. In addition, changes in the subject and social environment also affect students' beliefs in mathematics lessons.

The beginning of the seventh grade is a very significant transition for students both in mathematics and other subjects, this is due to changes in the learning and learning environment that are starting to not use concrete media. Changes in the learning environment during the beginning of junior high school are expected to produce a positive reaction to students' belief in mathematics. In addition, students are also expected to be able to reflect on the mathematical knowledge that has been obtained before, in this case in order that the students can use the mathematical knowledge maximally. One way to reflect on mathematical knowledge is to write an autobiography. Mathematical autobiography intends to help someone to reflect on their previous mathematical experience. According to King (2002), the cognitive-affective duality of autobiographical memory shows that significant emotional (positive or negative) memories of one's past can contribute to current and future views.

Mathematical autobiography is one way to search the experience of mathematics. Berry III (2003) examines the success of two high school male students in mathematics through mathematical autobiography. Participants were led to identify and write important events that they experienced in previous mathematics lessons. These important events include pleasant and unpleasant experiences in mathematics learning. In addition, mathematical autobiography can also show how the way participants participate and give a response in their mathematics environment.

Kurniasi (2016) states that men and women naturally have differences in physical condition, cognitive abilities, weaknesses, attitudes

and intuition towards problems. some students in learning have been widely researched, some state that girls are seen as successful in learning because of the hard work they do (Jussim, L., & Eccles, 1992; Siegle, D., & Reis, 1998; Tiedemann, 2000), while boys are successful in learning liked his talent (Jussim, L., & Eccles, 1992). LaLonde, D., Leedy, M.G., & Runk, (2003) reported that gender differences were found in affective relationships with mathematics. The problem of under-representation of women in mathematics and science-related careers has been a continuing concern despite societal efforts to facilitate women holding “male-dominated” jobs (Ceci, S. J., & Williams, 2011; Frome, P. M., Alfeld, C. J., Eccles, J. S., & Barber, 2006; Wang, M.-T., Eccles, J. S., & Kenny, 2013). Based on this problems, the researcher chose the title of students' mathematical beliefs at schools that separate gender based on students' mathematical autobiography.

## Methods

The research design used in this study is qualitative descriptive. This study intended to know the change of students' beliefs in mathematics from the experiences of mathematics learning while in elementary school (SD) and when studying mathematics in junior high school. The data were obtained by using questionnaires and interviews. Instruments in this study are researchers as the main instrument, questionnaire about the identity of participants and 20 items of related statements about students' beliefs in mathematics, as well as interview guides as supporting instruments. The statement in the questionnaire is divided into 10 positive statements and 10 negative statements related to mathematics. To see the change of students' belief in mathematics from the experience of mathematics learning while in elementary school and during studying mathematics in junior high school,

the questionnaire is also completed with a blank form for elementary school and junior high school.

The mathematical beliefs questionnaires was carried out based on a questionnaire made using Likert scale, namely: very high (ST), high (T), low (R), and very low (SR). This questionnaire was adapted from the Mathematics-Related Beliefs Questionnaire (MRBQ) by Eynde & Corte, (2003). This questionnaire is used to categorize students' mathematical beliefs, namely decline, decrease, stable, and increase mathematical beliefs. In addition, the questionnaire is also used as one reference interview to know the experiences experienced by students a much deeper. Finally, the analysis of interview data was carried out based on interview transcripts.

This study was conducted on the students of seventh grade Mts Al-Qodiri Jember and the students' mathematical autobiographies were recorded during interviews. This school is a school that separates classes between male and female students. From the collected questionnaires obtained data of female students who consist of 17 participants and from the male students who consist of 17 participants. Data obtained from the participants in the form of questionnaires and interviews. The interview was performed to confirm the participants' answers on the questionnaire and the reasons. The data obtained were analyzed qualitatively and reviewed based on the aspects of students' belief about mathematics.

Eynde & Corte (2002) formulated the students' beliefs related to mathematics as subjective conceptions that were considered correct and affected the learning of mathematics, either implicitly or explicitly. The students' mathematical beliefs are formed through three things, namely, first, beliefs regarding mathematics education, second, self-confidence and

then three, beliefs of the social context. The aspects and indicators of students' belief in mathematics can be seen in Table 1 below.

**Table 1. Aspects and indicators of students' beliefs in mathematics**

	Beliefs regarding Mathematics education	Self-confidence	Beliefs of the social context
Indicator	<p>a. The student has a belief related to mathematics as a subjects</p> <p>b. The student has a belief in mathematics learning and problem solving</p> <p>c. The student has a belief in a general mathematics lesson</p>	<p>a. The student has a self-beliefs in mathematics</p> <p>b. The student has a <i>control belief</i> to mathematics</p>	<p>The student has a belief and understands the function of the teacher in the class.</p>

## Results and Discussion

Based on the questionnaires of students' belief in Mathematics then conducted scoring according to the guide. The score in positive statements are 4 points for very agree, 3 points for agree, 2 points for disagree, and 1 point for very disagree, whereas in negative statements are apply otherwise 1 point for very agree, 2 points for agree, 3 points for disagree, and 4 points for very disagree. Based on the collected questionnaires of mathematical beliefs, there are 4 categories of students, namely, student who has a very high level of mathematical beliefs, student who has a high level of mathematical beliefs, student who has a low level of mathematical beliefs,

and student who has a very low level of mathematical beliefs. Of the study performed on 34 students seventh grade Mts Al-Qodiri Jember that divided into 17 female class students and 17 male class students obtained the following data :

**Table 2. Grouping of male class students based on the qualification of beliefs score results in mathematics on mathematics experience at the elementary school**

Aspects	ST		T		R		SR	
	$n_1$	%	$n_2$	%	$n_3$	%	$n_4$	%
1.	8	47,06%	5	29,41%	4	23,53%	0	0,00%
2.	8	47,06%	6	35,29%	3	17,65%	0	0,00%
3.	4	23,53%	6	35,29%	6	35,29%	1	5,89%

Information:

ST : Very high

T : High

R : Low

SR : Very low

n : Number of the students

Table 2 shows that in aspect 1 that is beliefs regarding mathematics education, most of the students have very high belief amounting to 8 students (47,06%). In aspect 2 self-confidence, most students have very high belief amounting to 8 students (47,06%), whereas in aspect 3 about beliefs of the social context, most students have high and low belief amounting to 6 students (35,29%). The following table 3 presents the grouping of female class students based on the qualification of beliefs scores results in mathematics on mathematics experience at the elementary school until of seventh grade in Junior High School.



**Table 3. Grouping of female class students based on the qualification of beliefs score results in mathematics on mathematics experience at the elementary school**

Aspects	ST		T		R		SR	
	$n_1$	%	$n_2$	%	$n_3$	%	$n_4$	%
1.	8	47,06%	4	23,53%	4	23,53%	1	5,89%
2.	8	47,06%	6	35,29%	3	17,65%	0	0,00%
3.	5	29,41%	8	47,06%	3	17,65%	1	5,89%

In table 3 can be seen that in aspect 1 and 2 related to the mathematics education and self-confidence, most of the students have very high belief amounting to 8 students (47,06%). Whereas in aspect 3 about the belief of the social context, most students have high belief amounting to 8 students (47,06%). The following table 4 presents the grouping of male class students based on the qualification of beliefs scores results in mathematics on mathematics experience at Junior High School.

**Table 4. Grouping of male class students based on the qualification of beliefs score results in mathematics on mathematics experience at the Junior High School**

Aspects	ST		T		R		SR	
	$n_1$	%	$n_2$	%	$n_3$	%	$n_4$	%
1.	4	23,53%	3	17,65%	4	23,53%	6	35,29%
2.	2	11,76%	5	29,41%	8	47,06%	2	11,76%
3.	2	11,76%	6	35,29%	8	47,06%	1	5,89%

Table 4 the grouping of male class students based on the qualification of beliefs score results in mathematics on mathematics experience at Junior High School, shows aspect 1 that is beliefs regarding mathematics education, most of the students have low belief amounting to 7 students (41,18%). In aspect 2 and 3 related to self-confidence and beliefs of the social

context, most students also have low belief amounting to 8 students (47,06%). The following table 5 presents the grouping of female class students based on the qualification of beliefs scores results in mathematics on mathematics experience at Junior High School.

**Table 5. Grouping of female class students based on the qualification of beliefs score results in mathematics on mathematics experience at Junior High School**

Aspects	ST		T		R		SR	
	$n_1$	%	$n_2$	%	$n_3$	%	$n_4$	%
1.	5	29,41%	5	29,41%	6	35,29%	1	5,89%
2.	4	23,53%	4	23,53%	7	41,18%	2	11,76%
3.	5	29,41%	5	29,41%	7	41,18%	0	0,00%

In table 5 can be seen that in aspect 1, beliefs regarding mathematics education most of the students have low belief amounting to 6 students (35,29%). In aspect 2 about self-confidence, most of the students have low belief amounting to 7 students (41,78%). Whereas in aspect 3 about the belief of the social context, most students have low belief amounting to 7 students (41,18%).

The changes of percentage that happen to the aspects associated with students' belief related to mathematics are very high, high, low, and very low. Each of the change, firstly, students' belief related to mathematics education in male class are 23,53% (decline), 11,76% (decrease), 0,00% (stable) and 35,29% (increase), whereas change in the female class is 17,65% (decline), 11,76% (decrease), 5,88% (increase), 11,76% (increase) and 0,00% (stable); (2) the aspect of self-confidence in male class is 35,3 (decline), 5,88% (decrease), 29,38% (increase) and 5,87% (increase), while the change in female class is 23,53% (decline), 11,76% (decrease), 23,53 % (increase) and

11,76% (increase); (3) the aspect of belief in social context in male class is 11,77% (decline), 0,00% (stable), 11,77% (increase) and 0,00% (stable), whereas change in female class is 0,00% (stable), 17,65% (decline), 23,53% (increase) and 5,89% (decline).

Through the grouping of students based on the qualification of beliefs score results in mathematics during at Elementary School and Junior High School above obtained the conclusion that almost all students have decreased belief in mathematics lesson in Junior High School level both in male class and female class. This is also supported by an interview that was carried out by the researcher to several students as follows:

Q: Please tell me what you remember about learning mathematics when you were in elementary school (SD) and what's the difference when you're in junior high school now?

S1: When I was in elementary school learning mathematics is fun, because we learn while there is also games, ma'am. The teacher also often brought props in the class, ma'am, and it makes me understand more about this subjects. But, currently, I feel that learning math is more difficult ma'am because of there a lot of formulas that must be memorized.

S2: Learning mathematics in elementary school, the problem that the teacher gives is not too difficult ma'am, so I enjoy doing the mathematics tasks. But now it (during junior high school) for example when the teacher explains I understand but when I try to do it, it makes me dizzy ma'am because the given problem is very different from the given example.

S3: During my elementary school experiences if there was a mathematics homework, I ask my parents to teach me ma'am,

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but now we live in the dorm so I just ask the dormitory leader or my friend even sometimes I do the homework in school before mathematics class begins. Besides, many activities must be followed in our dormitory so I rarely study outside the school hours, ma'am.

The most common student answers can be categorized into three, first, the students complain of drastic changes to the subjects that becomes more difficult and more formulas that must be memorized, and more learning does not use concrete objects. Second, the teachers' attitudes are also very different from when they were in elementary school which is more comfortable for the students. Third, their social conditions are changing because they live in dorms that have many activities (must be followed) that make them so busy so that they find it difficult to find free time to learn outside the school hours.

Some of the reasons presented above by the students can be categorized into two categories namely beliefs about mathematics lessons and students' beliefs about social conditions during mathematics learning. First, beliefs about mathematics learning are evident from students' perceptions that mathematics will be easier to learn when using concrete-shaped object and mathematics containing formulas that must be memorized. The beliefs in mathematics learning are also related to the lesson that the teacher conveys in the classroom. This is reinforced by the results of research by Muhtarom et al (2018) which found the fact that teachers have an important influence on what students believe. On the other hand, students' mathematical beliefs largely determine how successful students are in learning mathematics, and therefore teachers should find

out what students' beliefs about mathematics are before designing teaching plans.

Second, beliefs about social conditions during the time learning mathematics refers to students' perceptions of the role and function of teachers in the classroom, the roles, and functions of students, as well as the roles and functions of other adults around them when learning mathematics. In accordance with the findings of Gunderson, et al (2012) students' views about good teachers are teachers who are patient and persevering in giving explanations about a subject and their role only as recipients of what is given by teachers in the classroom. Also, other adults around them care about their mathematics achievements without judging.

It is known that students have experienced an interest in mathematics, in this case almost all students both male and female classes at the elementary school level. This is in accordance with the statement of the NCTM (2001) that most students start school enthusiastically and a shift in motivational orientation emerges at the age of about 8 years or around grade 3. Then, It can be concluded that students' beliefs about mathematics learning are shifting from positive to negative or vice versa.

### **Conclusions**

Based on the results and discussions, it can be concluded that, firstly, almost all students, both male, and female, have a decline of beliefs in mathematics learning at the junior high school level. Second, the factors that affect the decreasing level of students' belief in mathematics during the junior high school are the drastic changes in the subject that becomes more difficult and more formulas to be memorized, and many lessons do not use concrete objects. Further, the teachers' attitudes who are also very different from when they are in elementary school which are more comfortable, their

social conditions are changed because they live in dorms that have many activities (must be followed) that makes them busy so that they are difficult to find free time to learn outside the school hours. Third, students' beliefs about mathematics learning have shifted from positive to negative or vice versa.

Students who have beliefs about the importance of mathematics will lead to strong motivation, while students who have low beliefs, they do not learn in learning mathematics. Because affective abilities, namely mathematical beliefs, also affect student learning success, it is very important to do a similar research on students' mathematical beliefs in the hope that teachers can use learning methods that are suitable for students. In addition, similar research can also be used as an evaluation in learning mathematics. Suggestions for further research It is necessary to conduct similar research with more research subjects and with a longer research time to measure students' mathematical beliefs. And can relate the students' beliefs about mathematics with an understanding of concepts and solving student problems.

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