

## Mathematical Beliefs of Teachers in Public High Schools

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**Abstract:** The study attempted to determine teachers' mathematical beliefs. Specifically, this study determined the respondents' age, sex and educational attainment; their mathematical beliefs on the process of learning Mathematics, use of Mathematics, and nature of Mathematics; the significant relationship of their age and mathematical beliefs; the significant difference between their mathematical beliefs according to their sex; and the significant relationship between their educational attainment and math beliefs.

Three hundred public high school mathematics teachers in Cotabato, Philippines were randomly selected. Beliefs about Mathematics Scale developed by Aksu, Engin, and Sumer (2002) was used as a data collection instrument. Data were analyzed using the mean, Pearson r moment correlation, independent t-test and one-way analysis of variance (ANOVA).

Based on the results of the study, teachers have a very high belief on how can students become good in learning mathematics where learning lessons makes them successful in mathematics and loving mathematics is necessary for being successful in mathematics. They indicated the highest level of agreement that mathematics increases practical intelligence. Teachers' mathematical beliefs are not affected by their age and mathematical beliefs among teachers are the same regardless of sex and educational attainment.

**Key Words:** Mathematical beliefs, teachers, public high schools

### Introduction

Mathematics is considered by many people, institutions, and employers of labor among others, as very important. Teachers have exhibited to have a big influence on the intellectual accomplishment of the students and they likewise play a significant duty in educational attainment because the teacher is ultimately responsible for transforming policy into conduct and principles in lined on practice through dealings with the students (Afe, 2001). Teaching and learning turns on teachers: no wonder an effective teacher has been conceptualized as one who creates desired results in the course of his imposition as a teacher (Uchefuna, 2001).

Teachers' knowledge has been a dominant theme in educational research for decades. The dominant approaches in mathematics education all draw on the composition of Shulman and his associates from the 1980's, in which they pointed to among other types of knowledge – to aspects particularly related to the contents. It is a continuous discussion how best to characterize

knowledge that is relevant and particular to the teaching of mathematics, and different approaches have been suggested but they adopt different approaches to characterizing the mathematical knowledge that is specific to the professional work that teachers do in the classroom.

The character, development, and possible impact of teachers' beliefs have been recurrent themes in research on and with teachers for decades, and they are also important in studies presented in Conference of European Research in Mathematics Education (CERME). In many papers, however, the notion of belief is used merely in passing and as an unproblematic reference to comments made by the teacher in question. In what follows, we focus the discussion of beliefs on the approach in papers with more explicit focus on beliefs or on one or more terms that are considered close proxies to one of beliefs, that is, the ones of conceptions, perceptions, values or orientations.

Beliefs play an essential part in learning and teaching mathematics. McLeod (1998) defined belief as the strongest thing which can affect significant cognitive foundation. Since mathematical beliefs were found to have impact in the learning abilities of the students, teachers try to enhance their personal feelings and abilities in learning math. But the main problem is that teachers sometimes forget to validly determine their mathematical beliefs, if they really have a healthy existing beliefs in themselves about mathematics for it will reflect on how they teach. It is good that teachers as well as parents know and help how to boost their own beliefs towards mathematics.

Determining teachers' mathematical beliefs is one way of making teaching-learning process between teachers and students a meaningful one. It influences the effort of teachers to learn mathematics with nice beliefs towards it or teachers influence their students with bad kind of mindset towards it. Students may imitate that kind of belief which results to academic progress or achievement in mathematics or students not giving so much attention with for it will not guarantee lifelong success.

Consequently, this research catered the need of determining the mathematical beliefs of teachers in public high schools in Cotabato, Philippines.

## **Methodology**

### **Research Design**

This study was a descriptive-correlation research. The descriptive method was used in the presentation of the teachers' profile and mathematical beliefs. Correlational design, on other hand, was utilized to determine if there exists a significant relationship between teachers' age and educational attainment to their mathematical beliefs.

## Instrument

This study utilized one set of instrument. The instrument was a survey questionnaire which has two sections: Personal Information of the respondents, and Mathematical Beliefs of Teachers. It a set of questionnaire of teachers as respondents. The first section requested personal information such as age, sex, and educational attainment. The second section dealt with the Mathematical beliefs of teachers. Beliefs About Mathematics Scale was developed by Aksu, Engin, Sümer (2002). It consisted of 20 likert type items. Their beliefs were evaluated following a Likert-scale with the following descriptions: 1- very low, 2- low, 3- high, 4-very high. This second part of the questionnaire contains beliefs about the nature of mathematics. This scale has three dimensions which connected to beliefs about process of learning mathematics, use of mathematics, and nature of mathematics. The reliability coefficient was attained by Aksu, Demir, and Sümer (2002) as .75 and internal consistencies of the scales as .75, .71, .66, for the beliefs about process of learning mathematics, use of mathematics, and nature of mathematics, respectively.

## Data Collection and Analysis

The researchers prepared a survey questionnaire for the data collection in quantitative research. They adopted a questionnaire for mathematical beliefs. They asked permission from the Schools Division Superintendent of the Department of Education – Cotabato Province Division to conduct this study. After his approval, they sent informed consent letters to the target respondents. Three hundred teachers coming from different public national high schools in the Province of Cotabato, Philippines were randomly selected to form part as samples of this study. Administration of the survey was conducted right after the teacher-respondent's agreement. The questionnaires were retrieved right away. The data from quantitative survey were extensively gathered and immediately encoded to come with an overview of the possible result. The teachers' Mathematical beliefs and their socio-demographic profile in terms of age, sex and educational attainment were analyzed using descriptive statistics indicating the mean and percentage distribution. Pearson r moment correlation was used in determining the significant relationship of the respondents' age and math beliefs; Independent t-test and One-way Analysis of Variance (ANOVA) were used in determining if there is a significant difference between the math beliefs and sex, educational attainment of the respondents. All the data were treated as confidential.

## Findings

### *Mathematical Beliefs of Mathematics Teachers*

Table 1 shows the beliefs of teachers about the process of learning mathematics. Presented in the data that the overall mean in this dimension is 2.51 described as high belief in all statements in

the process of learning mathematics. Data shows that the teachers have a very high belief on the statements on how can students become good in learning mathematics just like, learning lessons makes you successful in mathematics and loving mathematics is necessary for being successful in mathematics. Also, teachers have high level of belief that using calculator makes for learning mathematics easier and solving problems quickly and correctly are needed to be successful in mathematics. They tend to have a low belief that mathematics is only for geniuses and it is only learned by teachers. Further, they don't believe that student must focus upon the procedures set by the book in answering practices as indicated in their level of belief that math work exercises can be solved only in ways shown in the book and mathematics questions are solved using the teacher's method only.

Spangler (2001) pointed out that the goal of doing mathematics problems is to attain the correct answer in his study entitled "Assessing Students' Beliefs about Mathematics". His research has shown that it is one of the common beliefs and describes it as an unhealthy belief. He discussed that it is unhealthy since it is not conducive to the kind of mathematics learning.

Table 1. Teachers' Mathematical Beliefs about the Process of Learning Mathematics.

STATEMENT	MEAN	VERBAL DESCRIPTION
Learning lessons makes you successful in mathematics.	3.64	Very High
Mathematics is only for geniuses.	1.70	Low
To be successful in mathematics, finding the right answer is important.	3.29	High
Mathematics is only learned by teachers.	1.54	Low
Solving problems quickly and correctly are needed to be successful in mathematics.	2.88	High
Using calculator makes for learning mathematics easier.	2.62	High
Math work exercises can be solved only in ways shown in the book.	1.99	Low
Loving mathematics is necessary for being successful in mathematics.	3.51	Very High
Mathematics Questions are solved using the teacher's method only.	1.73	Low
In a mathematics course, you just need to know the topics that will be asked on the exam.	2.17	Low
<b>OVERALL MEAN</b>	<b>2.51</b>	<b>High</b>

Legend: 3.50 – 4.00 = Very High, 2.50 – 3.49 = High, 1.50 – 2.49 = Low, 1.00 – 1.49 = Very Low

Table 2 shows the mathematical beliefs of teachers about the use of mathematics based on their level of agreement. The data shows that teachers believed in all items towards the use of mathematical knowledge confirming a high belief on each statement with the overall mean of 3.38. They indicated the highest level of agreement that mathematics increases practical intelligence. They tend to believe that in any career in society today, there is a wide range of the utilization of mathematics. They also have a high level of agreement that mathematics is a universal language, that mathematics is a language for all. Moreover, they tend to believe that all people can understand mathematics.

Mathematics is considered to be an important part of people's life not just today but also for the future (New Zealand Numeracy Development Projects, 2005). Teachers believed that learning math is a key of elevating to a higher level of their education and in getting a decent job in the future. They basically see that higher level of education contains high math equations and concepts and every job involves bits of math.

Table 2. Teachers' Mathematical Beliefs about the Use of Mathematics

STATEMENTS	MEAN	VERBAL DESCRIPTION
Mathematics is required to be successful in other courses.	3.11	High
To know mathematics is important for every profession.	3.45	High
Mathematics increases practical intelligence.	3.58	Very High
Mathematics is used in each course.	3.39	High
Mathematics simplifies daily life.	3.46	High
Mathematics is mental gymnastics.	3.42	High
Mathematics is a universal language.	3.25	High
<b>OVERALL MEAN</b>	<b>3.36</b>	<b>High</b>

Legend: 3.50 – 4.00 = Very High, 2.50 – 3.49 = High, 1.50 – 2.49 = Low, 1.00 – 1.49 = Very Low

Table 3 shows the mathematical beliefs of teachers about the nature of Mathematics based on the level of agreement. The data shows that the overall mean in this dimension is 2.92 deliberated as high belief in all statements about the nature of mathematics. Data show that teachers have high level of belief about the nature of mathematics. They confirmed based on their high level of belief that Mathematics is performing computations, they tend to believe that math is all about doing calculations and doing mathematics means solving problems that requires a right solution and process and will finally come out with a correct answer. They also surely believed that Math discusses plenty of numbers confirming in their belief that mathematics is about numbers.

Teacher candidates who discovered the nature of mathematics, teaching and love mathematics will be easier. Researches pointed that, teachers' beliefs about the nature of mathematics and teaching mathematics influence significantly the way of their teaching mathematics (Clark & Peterson, 1986; Ma, 1999; Thompson, 1992).

Table 3. Mathematics Teachers Beliefs about the Nature of Mathematics

STATEMENTS	MEAN	VERBAL DESCRIPTION
Mathematics is about numbers.	2.81	High
Mathematics is performing computations.	2.93	High
Doing mathematics means solving problems.	3.03	High
<b>OVERALL MEAN</b>	<b>2.92</b>	<b>High</b>

Legend: 3.50 – 4.00 = Very High, 2.50 – 3.49 = High, 1.50 – 2.49 = Low, 1.00 – 1.49 = Very Low

### *Relationship between Respondent's Age and their Mathematics Belief*

Table 4 shows the relationship between the two variables, the respondents' age and their math beliefs scores. It can be perceived from the Pearson correlation  $r$  value = 0.154 that there is a low degree of correlation or there is small magnitude of association between the two variables. Therefore, there is a very low positive relationship according to Garrett interpretation of relationship that is if one variable increases, a very low level of relationship that the second variable also increases.

Table 4. Relationship between age and math beliefs of the respondents.

VARIABLES	CORRELATION R	p-VALUE
Age and Math Beliefs	0.154 <sup>ns</sup>	0.127

<sup>ns</sup>not significant at 0.05 level

However, presented in the table that the Pearson correlation  $r$  value of 0.154 with very low degree of relationship deliberated as not significant, for the probability value had found in the result of correlation coefficient is greater than the conventional level of significant of 0.05 ( $p > 0.127 > 0.05$ ). Consequently, there is no found existing significant relationship between the two variables, the age of the respondents and their mathematical belief score. This implies that when a math teacher becomes older, their beliefs towards mathematics will not go high.

In the study of Herrera and Carballo (2010) entitled "Teachers beliefs and teaching styles of mathematics teachers and their relationship with academic achievement", the results showed that differences between teachers of mathematics grouped by age over teachers' beliefs found no significant differences.

### *Difference between Respondent's Sex and their Mathematics Belief*

For the purpose of determining whether teachers' beliefs about mathematics showing a significant difference according to sex, independent t-test was applied to the data with 0.05

significance level. It has given analyzed results about the difference between male and female mathematics teachers' and their average of beliefs scores in Table 5.

Table 5. Test of difference between the math beliefs of the respondents according to their sex.

SEX	MEAN	t-VALUE	p-VALUE
Male	57.89	.454 <sup>ns</sup>	.651
Female	57.32		

<sup>ns</sup>not significant at 0.05 level

As seen from Table 5; female teachers' average of beliefs scores about mathematics is 57.32, while on the other hand, male mathematics teachers average of beliefs scores about mathematics is 57.89. Independent t-test results show that there is no significant statistical difference between the math beliefs of respondents in respect to their sexes. Thus, male and female math teachers have the same mathematical beliefs.

No substantial gender differences have been noticed in teachers' beliefs, even though some nuances appear according to Li (1999) in his the study entitled "Teachers' beliefs and gender differences in mathematics: a review". This leads us to believe that there are small, subtle, interactive and cumulative links between teachers' beliefs and gender differences in mathematics education.

### *Difference of the Respondents Educational Attainment and their Mathematics Belief*

In determining the significant relationship between the respondent's educational attainment and their math beliefs, Analysis of Variance (ANOVA) was applied to data with the level of significance of 0.05.

Table 6. Difference between the respondents' math beliefs according to their educational attainment.

	SUM OF SQUARES	MEAN SQUARES	F-VALUE	p-VALUE
Between Groups	116.359	29.090		
Within Groups	3858.551	20.616	.716 <sup>ns</sup>	.583
Total	3974.910			

<sup>ns</sup>not significant at 0.05 level

As seen from the table mean squares in between groups resulted 29.090 while in within groups 20.616. Analysis of variance test shows that there is no significant relationship between the educational attainment of the respondents and their math beliefs. This means that teachers with different educational attainment have the same mathematical beliefs.

## Conclusions

Based on the findings of this study, the following conclusions are drawn:

1. Teachers believe that being superior in Mathematics is a result of student's hard work in studying their lesson and Mathematics increases practical intelligence among learners;
2. Teachers' age does not influence their own beliefs in mathematics, therefore, as they age, it is not necessary that their belief increases or decreases;
3. Teacher's sex is not a factor that influences something their math beliefs indicating that there is no evidence that female teachers may have a strong or weak belief than male teachers in mathematics; and
4. Educational attainment is also not a factor that may influence teacher's beliefs about mathematics.

## Recommendations

On the basis of the results and conclusion of the study conducted, the researchers came up with the following recommendations:

1. Almost half of the respondents were young and didn't much have so much experience in the field of teaching, it is also nice to consider studying teacher's preparedness and cognitive and affective problems in teaching math subjects if there's a significant difference between those who already have gone so far in the field and those who were newly hired, it is also interesting to find out if there's a significant difference in both sex.
2. Mathematics teachers should have healthy existing beliefs about mathematics in themselves for students may imitate that belief as they teach and students will have healthy beliefs in mathematics too.
3. Teachers should practice reflecting and generalizing among students where students reflect on their answer and determine if their answer make sense and also extension where students explore on other perhaps even simpler or other way arriving at the same answer. It is good when teacher shares good beliefs about mathematics in their students.
4. For the future researchers who would find interest in doing a similar research may consider conducting it with other set of questionnaires or have an observation with the teacher if they really possess their existing beliefs as they teach.

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