

Gender Related Differences in Mathematics Teaching Anxiety

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Abstract: The purpose of this study was to investigate the gender-related differences in mathematics teaching anxiety. There were a total of 368 pre-service mathematics teachers, 199 middle and 169 high school pre-service mathematics teachers involved in this study. The researchers gave the participants a Likert-type questionnaire, the Mathematics Teaching Anxiety Scale (MATAS) that included 23 statements. After the collection of the data, the researchers used the independent samples t-test with $\alpha = 0.05$ in the analysis of the data. The study revealed that there was no statistically significant gender-related difference in mathematics teaching anxiety between pre-service male and female mathematics teachers, and that there was also no gender difference found in terms of mathematics teaching anxiety between pre-service male and female middle, and high school mathematics teachers.

Key words: Teaching Anxiety; Gender; Mathematics; Pre-service mathematics teachers

Introduction

Research has documented that many students have learning difficulties in mathematics (e.g. Gutierrez, Jaime, & Fortuny, 1991; Halat, 2007). There are many variables, such as teacher-beliefs, instruction, gender, environment, task-difficulties, lack of parental support, lack of self-confidence, learning styles, mathematics anxiety, mathematics teaching anxiety and helplessness appearing to affect students mathematics learning (c.f., Vinson, 2001; Sloan, Daane, and Giesen, 2002; Uusimaki & Nason, 2004; Brady & Bowd, 2005; Peker, 2005; Iossi, 2007). Some of the factors mentioned above are included in the major factors of mathematics anxiety that can be classified into three categories, intellectual, environmental and personality factors (Trujillo & Hadfield, 1999). The intellectual factors consist of

students' attitudes, lack of self-confidence in mathematical skills, mismatched teaching and learning styles. The environmental factors include use of traditional teaching method, conventional classroom environment, parental demands, feeling helpless, and negative teaching and learning classroom experiences. Personality factors involve being reluctant to ask questions in the classroom by reason of low self-esteem, shyness and for females perceiving mathematics as a male domain (i.e., Trujillo & Hadfield, 1999).

According to Fennema and Hart (1994), Altermatt and Kim (2004), and Halat (2006), gender is an important factor in the learning of mathematics. Furthermore, Forgasız (2005) for whom gender is still a matter of concern in mathematics education argued that it is significantly important to include gender as a variable in research analysis even if it is not the main focus of a study. Especially, sex differences in academic achievement and math anxiety in mathematics have been the subjects of extensive examination over the last two decades (e.g., Hembree, 1990; Meece, Wigfield, and Eccles, 1990; Fan & Chen, 1997; Malinsky, Ross, Pannells, and McJunkin 2006; Yüksel-Şahin, 2008). It is clear that gender plays prominent roles in students' math anxiety. In this study we investigated whether gender is an effective factor in mathematics teaching anxiety.

Mathematics Anxiety & Mathematics Teaching Anxiety

Today mathematics anxiety is a vital common phenomenon from elementary through university students. According to Baloğlu (1999/2001), mathematics anxiety comes first among the most crucial problems in teaching mathematics. In other words, it is one of the most prevalent emotional problems associated with mathematics (Baloğlu & Koçak, 2006). In order to understand mathematics anxiety, one should initially find the complexity of this concept (Uusimaki & Nason, 2004). Smith and Smith (1998) stated that "maths- anxiety is a feeling of intense frustration or helplessness about one's ability to the mathematics, and can be described as a learned emotional response to participating in a math class, listening to a lecture, working through problems, and /or discussing mathematics" (Uusimaki & Nason, 2004, p.370).

The research has shown that there were many studies done on the anxiety about mathematics with the pre-service teachers (Vinson, Haynes, Brasher, Sloan & Gresham, 1997; Sloan, Vinson, Haynes, & Gresham, 1997; Tooke & Lindstrom, 1998; Newstead, 1998; Trujillo & Hadfield, 1999; Vinson, 2001; Uusimaki & Nason, 2004; Brady & Bowd, 2005; Idris, 2006). For example, according to Levine (1996), Uusimaki and Nason (2004), and Malinsky et al. (2006), the origin of the pre-service teachers' negative beliefs and anxiety about mathematics could be attributable to prior school experiences, such as their experiences as a mathematics

student, the effect of prior teachers and of teacher preparation programs. Teachers' previous experiences, including those in elementary school, contributed to teachers' ideas about how mathematics is taught (Austin, Wadlington, and Bitner, 1992). Brown, McNamara, Hanley, and Jones (1999), on the other hand, claimed that the pre-service teachers originated their negative experiences and anxiety about mathematics related to the secondary school years, the pre-service primary school teachers stated that they originated their negative beliefs and anxiety about mathematics related to the early and middle school years (Levine, 1996; Uusimaki & Nason, 2004). Moreover, Uusimaki and Nason (2004) found that pre-service primary school teachers' negative experience and anxiety about mathematics are attributed to the teacher rather than to other factors, such as mathematical concepts, or to social factors such as parents and peers. They also claimed, "Situations which caused most anxiety for the participants included communicating one's mathematical knowledge, whether in a test situation or in the teaching of mathematics such as that required on practicum" (p. 374).

In addition to mathematics anxiety, the pre-service teachers also have teaching anxiety in mathematics (Levine, 1993; Peker, 2006/2009a/2009b). According to Levine (1993), anxiety for teaching mathematics is a frequent fear of pre-service teachers. It is associated with teaching mathematics. It may reflect real or perceived knowledge deficits in mathematics content as well as in mathematics teaching skills, and memories of past occurrences of mathematics failure or mathematics anxiety (Levine 1993). Gardner and Leak (1994) conceptualized teaching anxiety as anxiety experienced in relation to teaching activities that involve the preparation and execution of classroom activities. Mathematics teaching anxiety can be defined as teachers' feelings of tension and anxiety which occurs during teaching of mathematical concepts, theories and formulas or during problem solving (Peker, 2006).

In last two decades, many studies done on the mathematics teaching anxiety with the pre-service teachers (Levine, 1993/1996; Peker, 2006/2008/2009a/2009b/2009c; Peker & Halat 2008/2009) have been documented. Levine (1996), for example, claimed that pre-service elementary school teachers usually experience anxiety for teaching mathematics and show feeling of mathematics anxiety. According to Levine (1996), abstract discussions regarding mathematical concepts increased the teaching anxiety of the pre-service elementary teachers who had high level of anxiety for teaching mathematics, but using manipulative materials, getting familiar with developing creative teaching strategies for teaching mathematics and learning to design lesson plans for teaching mathematical concepts reduced the teaching anxiety level of the pre-service elementary school teachers. Moreover, Peker (2008) reported that there was a positive correlation between the need for concretization of

the subject to be taught and the pre-service teachers' mathematics teaching anxiety. Several studies also showed that there were prominent factors, such as teaching techniques, learning styles and so forth related to the pre-service teachers' mathematics teaching anxiety (Levine, 1996; Peker, 2009a/2009b/2009c; Peker & Halat, 2009). For instance, Levine (1996) and Peker (2009b) found that the teaching techniques they had learned during their undergraduate education and their learning styles (Peker, 2009c) had positive impacts on the pre-service teachers' mathematics teaching anxiety.

Shortly, there are several factors mentioned above affecting mathematics teaching anxiety but, there are some factors such as, content knowledge, attitudes towards mathematics and self confidence appearing to have influence on the pre-service teachers' mathematics anxiety and mathematics teaching anxiety (e.g. Peker, 2006).

Gender Related Differences and Mathematics

"During the past 30 years, the lower performance and the lower participation of girls and women in mathematics have been of major concern among policy makers and educational researchers in the USA and in most western European countries" (Van de gear, Pustjens, Van Damme, & De Munter, 2008, p.568). Research has showed that the findings regarding gender issue are varied. Over the past two decades, research has documented that although there is a difference between the achievement of males and females in mathematics, (e.g., Hembree, 1990; Ashcraft & Faust, 1994; Ayalon, 2003), recently a considerable decrease can be seen in the gender gap between male and female students (e.g., Lloyd, Walsh, & Yailagh, 2005). Several researches (Cooper & Robinson, 1989; Zettle & Houghton, 1998; Marso & Pigge, 1998; Ameen, Guffey, & Jackson 2002; Haynes, Mullins, & Stein, 2004; Dane, 2005) found that there were no gender differences in terms of mathematics anxiety between pre-service male and female teachers. For instance, Dane (2005) who studied with 363 university students stated that gender was not a factor in mathematics anxiety. Similarly, according to Haynes, Mullins, and Stein (2004), no significant difference about mathematics anxiety was found between the male and female college students.

Marso and Pigge (1998), and Ameen, Guffey, and Jackson (2002) also found no gender difference in terms of teaching anxiety between male and female educators, and between pre-service male and female teachers. On the other hand, there were also several of them (Hembree, 1990; Ashcraft & Faust, 1994; Lussier, 1996; Fish & Fraser, 2001; Bowd & Brady, 2003; Altermatt & Kim, 2004; Nasser & Birenbaum, 2005; Malinsky et al., 2006) who stated that there were gender differences in reference to mathematics anxiety between pre-service male and female teachers favoring females. Malinsky et al. (2006) conducted a study with

481 pre-service elementary school teachers and investigated the mathematics anxiety. They found that the pre-service female teachers' mathematics anxiety level were higher than that of males. In other words, they claimed that there was a statistically significant difference in regard to mathematics anxiety between pre-service male and female teachers. That was in favor of the pre-service female teachers. Likewise, Bowd and Brady (2003) studied with 357 final-year pre-service teachers at a small Canadian University. They found that male and female participants did not differ in mathematics achievement, but pre-service female teachers had significantly greater mathematics anxiety than that of male. With regard to teaching at the university level, Fish and Fraser (2001) stated that among the university professors surveyed about teaching anxiety, gender was a factor, with female faculty reporting more teaching anxiety than males.

The Purpose of this Study

The purpose of this study was to examine the gender differences in mathematics teaching anxiety. The following questions guided this study:

- Q1: Is there a significant difference in regard to mathematics teaching anxiety between pre-service female and male middle, and high school mathematics teachers?
- Q2: Is there a significant difference in reference to mathematics teaching anxiety between pre-service female and male mathematics teachers?

Method

Participants

The study included 368 pre-service mathematics teachers. One hundred ninety nine of them were pre-service middle school mathematics teachers from the department of Elementary Mathematics Teacher Education and one hundred sixty nine were pre-service high school mathematics teachers from the department of Secondary Mathematics Teacher Education. The participants involved in this study were from three different universities in Turkey. All of them volunteered for this study. The percentage of the pre-service elementary mathematics teachers in the study was 54.1 and the percentage of the high school mathematics teachers was 45.9. Moreover, 58.3 % of the pre-service elementary mathematics teachers were females and 41.7 of them were males, while 54.4 % of the pre-service high school mathematics teachers were females and 45.6 % of them were males.

Data Sources

The researchers used a Likert-type questionnaire, Mathematics Teaching Anxiety Scale (MATAS), consisting of 23 items. This was designed to find one's mathematics teaching anxiety. The MATAS was developed by Peker (2006). Factor analyses revealed four factors. These are below: Content knowledge – 10 items (factor loading ranging from 0.53 to 0.86), Self-confidence – 6 items (factor loading ranging from 0.57 to 0.76), Attitude towards mathematics teaching – 4 items (factor loading ranging from 0.61 to 0.70), and Teaching knowledge – 3 items (factor loading ranging from 0.68 to 0.78). Reliability estimates of the MATAS were obtained by using Cronbach's alpha measure for each subscale. They were "Content knowledge": 0.90, "Self-confidence": 0.83, "Attitude towards mathematics teaching": 0.71, "Teaching knowledge": 0.61, Total Scale: 0.91.

The followings are some of the statements from the MATAS: "I got anxious when it comes to the point of teaching some mathematical topics", "It is very easy for me to teach mathematics", "I like answering questions about the topic I am teaching", "Throughout my career as a teacher, I think I can make use of the different views and theories about teaching mathematics". The highest point a person can make on the MATAS is 115 (23x5), and the lowest point is 23 (23x1). The pre-service teachers' teaching anxiety in mathematics is calculated based on the score in the above 23-item scale.

Data Analysis

The pre-service middle and high school mathematics teachers took the MATAS and completed it in 15 minutes. While gender was independent variable in this study, the teaching anxiety level in mathematics was dependent variable. Therefore, after the collection of the data, the researchers employed the independent samples t-test with $\alpha = 0.05$ to analyze the quantitative data. The results of the statistical analysis were reported below.

Results

Q1: Is there a significant difference in regard to mathematics teaching anxiety between pre-service female and male middle, and high school mathematics teachers?

Table 1 presents the descriptive statistics for pre-service female and male middle, and high school mathematics teachers' mathematics teaching anxiety based on the

MATAS, and shows that the pre-service female middle school mathematics teachers' mean score (43.71) is numerically higher than that of males (43.15). On the contrary, the pre-service female high school mathematics teachers' mean score (42.98) is numerically lower than that of males (43.23). However, Independents Samples t-test as shown in table 1 below indicates that these differences are not statistically significant with reference to the level of mathematics teaching anxiety between pre-service male and female middle, and high school mathematics teachers, [$t_{(197)} = .324$, $p = .746 > .05$] and [$t_{(167)} = -.132$, $p = .895 > .05$], respectively. In other words, the hypothesis that gender is a factor with regard to mathematics teaching anxiety is rejected at .05 level of significance for both middle and high school pre-service mathematics teachers.

Table 1
The Level of Pre-service Middle & High School Mathematics Teachers' Teaching Anxiety in Mathematics

	Pre-service Middle School Mathematics Teachers				Pre-service High School Mathematics Teachers			
	N	\bar{x}	sd	<i>t</i>	N	\bar{x}	sd	<i>t</i>
Female	116	43.71	11.22	.324	92	42.98	10.54	-.132
Male	83	43.15	13.19		77	43.23	14.64	
Total	199				169			

Q2: Is there a significant difference in reference to mathematics teaching anxiety between pre-service female and male mathematics teachers?

Table 2, the descriptive statistics for pre-service male and female mathematics teachers' mathematics teaching anxiety based on the MATAS, indicates that the pre-service male mathematics teachers' mean score (43.19) is numerically lower than that of females (43.39). But, the independent samples t-test in table 2 below demonstrates that this difference between males and females is not statistically significant, [$t_{(366)} = .153$, $p = .879 > .05$]. In other words, the hypothesis that gender is a factor with reference to mathematics teaching anxiety is rejected at .05 level of significance for the pre-service mathematics teachers in this current study.

Table 2
The Level of the Pre-service Mathematics Teachers' Teaching Anxiety in Mathematics

	N	\bar{X}	sd	<i>t</i>	p
Female	208	43.39	10.90	.153	.879
Male	160	43.19	13.86		
Total	368				

Discussion and Conclusion

This current study showed that the mean score of mathematics teaching anxiety level of the pre-service middle school female mathematics teachers is slightly higher than that of pre-service male mathematics teachers. However, the mean score of mathematics teaching anxiety level of the pre-service high school male mathematics teachers is numerically higher than that of pre-service female mathematics teachers. But, these differences were not statistically significant. In other words, there appeared to be no gender related differences found in mathematics teaching anxiety between pre-service male and female middle, and high school mathematics teachers.

Furthermore, in general the mean score of mathematics teaching anxiety level of the pre-service female mathematics teachers is almost equal to the pre-service male mathematics teachers' mean score of mathematics teaching anxiety. That is, this study found that gender was not a factor in mathematics teaching anxiety for the pre-service middle and high school mathematics teachers. These results support the research findings of Marso and Pigge (1998), and Ameen, Guffey, and Jackson (2002), who expressed that there was no gender related difference in teaching anxiety between the pre-service male and female teacher candidates, and between male and female educators.

However, these findings of the study were not consistent with the claim of the research such as that of Fish and Fraser (2001), which stated that gender was a factor in teaching anxiety. In other words, they found that the teaching anxiety level of the pre-service female teachers was significantly higher than that of males.

There might be several variables, such as lack of content knowledge, self-confidence, lack of pedagogical content knowledge, use of manipulative materials, lack of school experience and teaching practicum, test anxiety, fear of success, instruction, negative attitudes of teacher, and perceiving mathematics as a male domain seeming to cause one's mathematics anxiety and teaching anxiety (c.f., Vinson, 2001; Uusimaki & Nason, 2004; Brady & Bowd, 2005; Iossi, 2007). Some of these factors mentioned above are also major factors in mathematics teaching anxiety. Levine (1996), Vinson (2001), and Peker (2006), for instance, found both content and pedagogical content knowledge, self-confidence, using manipulative materials, and teaching practicum to be prominent factors in mathematics teaching anxiety.

In the current study, the researchers studied with pre-service middle and high school mathematics teachers. And, in the study gender appeared not a factor in mathematic teaching anxiety. What might be the reasons behind the finding of this study? In Elementary and Secondary School Mathematics Teacher Education Programs in Turkey, the pre-service teachers are required to take courses related the content knowledge, pedagogical course, school experience, and teaching practicum. Therefore, the participants must have had strong mathematical content knowledge and pedagogical content knowledge because they successfully completed all required mathematics courses and pedagogy courses in which they were taught how to teach mathematics in different ways and how to use manipulative materials in teaching of specific mathematical contents. Moreover, they could have gained self-confidence because they completed their teaching practicum course. They had three semesters of school experiences. In short, these variables were under controlled and it may not cause to gender differences.

Moreover, according to the result of the OECD's Programme for International Student Assessment (PISA) (2006) that assesses the knowledge and skills in science, mathematics and reading at age 15 of students from 57 countries, the female students of six countries (Iceland, Azerbaijan, Bulgaria, Jordan, Qatar, and Thailand) performed better in mathematics than male students of the rest of the participant countries did. On the other hand, among the 30 OECD countries, the mean scores of male students were numerically higher than that of female students except Iceland. Likewise, Turkey, one of the participating countries to the PISA, also witnessed the mean score of the male students being higher than that of their female counterparts in mathematics. However, in recent years in Turkey there is a considerable decrease in the difference of the mean scores between male and female students' achievement and motivation in mathematics (Celik & Bindak, 2005; Halat 2008). Leder (2005) expressed that females' mathematics performance is somehow insufficient, but they can reach the achievement of males with stronger effort,

different practices or better interventions. Furthermore, Fennema and Hart (1994) mentioned that interventions could achieve equity in learning mathematics. For example, reform-based curricula may cause changes in females' attitudes towards mathematics courses (Halat, 2006; Lapan, Reys, Barnes & Reys, 1998).

There can be seen many important reform movements taking place in Turkey after the year of 2000. For example, health, education, and human rights are some of them. This is particularly so in education with the Ministry of National Education continued the revision of the curricula from grades 1 through 12 based on the new educational theories and strategies, such as constructivism, multiple representation, and the use of technology. New Elementary School Curriculum has already been completed and implemented in the classrooms while studies on middle and secondary school curricula are work in progress. Therefore, reform movements in education may result in narrowing the gender gap in Turkey. In fact, Lapan, Reys, Barnes, and Reys (1998) and Halat (2008) claimed that reform-based curricula had positive effects on students' motivation and achievement in mathematics and they added that gender was not a factor in mathematics achievement. Moreover, according to the reports of 2008 Nationwide University Entrance Exam in Turkey, the percentage of girls who qualified for entry into a university was higher than that of boys (OSYM 2008).

The Ministry of National Education and United Nations Children's Fund (UNICEF) have also started the girls' education campaign 2001-2005 in Turkey. It was called "Let's go to school, girls!". This campaign mobilized various organizations, agencies and individuals in a drive to increase enrolment rates for girls and achieve gender equity in primary education attendance by 2005. Although this campaign was targeted at primary school students, also it affected many teenagers and adults. Furthermore, there were other similar campaigns by several organizations. For example, Mother Child Education Foundation about the functional adult literacy and women's support program were some of them. These campaigns focused on the areas such as, basic literacy and mathematical skills, citizenship as well as health and human rights. Therefore, these educational activities may have made teachers, teacher educators, families, and others to become conscious about the importance of girls' education.

As a conclusion, the study indicated that there were no gender differences found in mathematics teaching anxiety between pre-service male and female middle, and high school mathematics teachers, and that there was also no gender difference detected in terms of mathematics teaching anxiety between pre-service male and female mathematics teachers. In other words, gender was not a factor in mathematics teaching anxiety.

Recommendations, Limitations, and Future Research

As Levine (1996) stated, the use of manipulatives played an important role in the acquisition of mathematical concepts, which may help to reduce teaching anxiety. Besides, implementing alternative teaching techniques and problem solving strategies may also help the pre-service mathematics teachers to gain self-confidence and so may reduce teaching anxiety in mathematics. Gender related differences in mathematics teaching anxiety may be equaled if teacher educators pay attention to the importance of the use of manipulatives, alternative teaching techniques and problem solving approaches.

The findings may not be generalized to other pre-service mathematics teachers as not only mathematics teacher preparation programs might be different, cultural differences might also limit the results in other countries.

Similar studies with pre-service mathematics teachers can be conducted in order to see the effect of different teacher preparation programs and cultural differences regarding gender issue in teaching anxiety.

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