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MATHEMATICS ANXIETY AMONG 4th AND 5th GRADE TURKISH ELEMENTARY SCHOOL STUDENTS

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ABSTRACT. Using a sample of 4th and 5th graders, this study investigated whether students' mathematics anxiety differed significantly according to a group of variables. A total of 249 students participated in the study. "The Mathematics Anxiety Scale for Elementary School Students" and "The Personal Information Form" were used for data collection. Independent samples t-tests, Oneway Anova and Schefee test were used to analyze the data. Results showed that students' mathematics anxiety differed significantly according to gender, whether they liked mathematics class or not, whether they liked their mathematics teachers or not and the achievement level in mathematics. Female students reported significantly higher mathematics anxiety than males. Students who liked mathematics class and those who liked their mathematics teachers had lower anxiety. Students with higher achievement in mathematics reported lower degrees of mathematics anxiety. However, results did not show any significant difference in students' mathematics anxiety with respect to their grade level and gender-stereotypes about success in mathematics.

KEYWORDS. Mathematics Anxiety.

MATHEMATICS ANXIETY

Despite its importance, in daily life, mathematics is often viewed as a difficult topic. Such perception is in part, due to the nature of math. However, it also has to do with preconceived notions about mathematics (Umay, 1996) and the anxiety individuals have for mathematics (Yüksel-Şahin, 2004). A remarkable body of research has been accumulated on mathematics anxiety since the 1960s. There have been a variety of definitions of what constitutes mathematics anxiety. Richardson and Suinn view it as feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations (as cited in Gierl & Bisanz, 1995, p.140). Mathematics anxiety has to do with a sense of discomfort while required to work on mathematical problems (Hadfield & Trujillo, 1999; Ma, 2003) and with fear and apprehension to specific math-related situations (D'Ailly & Bergering, 1992).

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Studies point out a host of factors associated with mathematics anxiety. These variables range from environmental factors such as family pressure for higher achievement, to intellectual factors as learning styles or to personality factors such as low-self esteem (Uusimaki & Nason, 2004; Woodard, 2004). In other words, mathematics anxiety is a multifaceted construct with affective and cognitive dimensions. Personality, self-concept, self-esteem, learning style, parental attitudes, high expectation of parents, negative attitudes toward mathematics, avoidance of math, teachers' attitudes, ineffective teaching styles, negative school experiences and low degree of achievement in mathematics are among the concepts and constructs related to mathematics anxiety (Bursal & Paznokas, 2006; Cook, 1998; Hadfield & McNeil, 1994; Hopko et al., 2003; Ma & Xu, 2004; Norwood, 1994; Reynolds, 2001; Thomas & Furner, 1997; Williams, 1994; Woodard, 2004).

Mathematics anxiety in elementary school students indicates that its onset coincides with early years of schooling. This could in part be due to social learning from parents and teachers with mathematics anxiety or negative perceptions of math. Parents or teachers might give children mixed messages (Williams, 1988; as cited in Thomas & Furner, 1997) about mathematics. They might emphasize how highly difficult mathematics is and at the same time tell them how mathematics skills are of essential importance for their future achievements. Vann (1993) observed that mathematics anxiety in mothers was significantly predictive of mathematics anxiety in children. This could be so for excessive expectations as well. As pointed out by Geçtan (1995) children of parents with excessive expectations whose love and acceptance is conditional to how well children live up to these expectations have high degree of anxiety. These circumstances might lead to self-consciousness about one's performance and to anxiety arising from not living up high standards of parents. Children's excessive self-critical attitude might cause anxiety disproportionate to their failure in living up to these expectations. In fact, studies do show that low self-esteem, confidence and efficacy are closely related to mathematics anxiety (Uusimaki & Nason, 2004; Woodard, 2004).

Negative school experiences might also contribute to the development of mathematics anxiety (Bursal & Paznokas, 2006). For example, teachers' threatening and authoritarian attitudes could lead to fearsome classroom climate in which student might hesitate to ask questions or answer the teachers' questions. Furthermore, students fearing their mathematics teacher might have a conditioned reaction to mathematics as well. Observing teachers giving mathematics homework as punishment could also cause students perceive mathematics as unpleasant (Oberlin, 1982; as cited in Thomas & Furner, 1997). As punishment is inherently negative, extra

mathematics assignments as punishment could play a role in cultivating negative attitude toward mathematics in students who receive the punishment as well as those who witness it. Low grades or failure in mathematics could also lead to mathematics anxiety or exasperate students' existing levels of anxiety for mathematics (Ma & Xu, 2004; Norwood, 1994; Reynolds, 2001; Satake & Amato, 1995; Townsend, Moore, Tuck, & Wilton, 1998). Failure in mathematics, fear and anxiety about it could cause extreme feelings of dislike about mathematics. Indeed, Hopko et.al. (2003) observed that persons with mathematics anxiety make more mistakes in dealing with mathematics problems. Such mistakes lead to lower grades in mathematics which in turn increases anxiety about math. As such, the vicious cycle of anxiety, failure and anxiety is perpetuated.

Poor performance in mathematics has been linked to an increase in mathematics anxiety (Furner & Duffy, 2002; Hopko et.al., 2003). Belief and expectations to perform poorly on mathematics problems could also lead to mathematics anxiety (Özer, 1997; Reglin, 1990) or intensify students' existing anxiety. Mathematics anxiety can be experienced to such a degree that children might perceive their performance in mathematics as a measure of their self-worth and a reason for losing value in the eyes of parents and teachers. Thus, students with these excessive worries develop negative attitudes toward mathematics which are expressed as "I can't do mathematics" or "I hate mathematics." However, since they do have to deal with mathematics, these beliefs lead to a great deal of distress and unease (Gierl & Bisanz, 1995; Kazelskis, 1999; Townsend et. al., 1998).

Literature on mathematics anxiety often highlights adults' contribution to children's fears. Anxiety is a psychological state which consists of fear, worry, dread and tenseness (Parham, 1988). When faced with a situation, the individual might experience both fear and anxiety (Özer, 1997). Mathematics anxiety is a multi-sided structure and is intertwined with the terms of fear, worry and tenseness. As mentioned before, teachers and parents could do so by projecting their own fears of mathematics, giving mixed messages about mathematics, and by having high expectations for mathematics achievement from children. These factors might lead to overly sensitive attitudes toward mathematics. For instance, no one can solve every mathematics problem and it is quite normal that children would at times make mistakes while dealing with mathematics. However, children with such sensitivities might have more extreme reactions to such errors such believing that they can't do mathematics and thus they hate mathematics. Hence, researchers often recommend parents and teachers to set positive role models, have democratic attitudes, and be supportive of children in order to foster competence in mathematics. Effective

use of counseling and guidance services could have preventive functions by aiding children with effective study skills and helping them cope with feelings such as fear of failure.

A great deal of research has been accumulated particularly in the United States. However, much work is needed with Turkish samples. Recognition of mathematics anxiety in the Turkish educational system is quite new. Thus, part of the purpose of this study was to contribute to the literature on mathematics anxiety in Turkey. The study aimed at examining factor contributing to mathematics anxiety in 4^{th} and 5^{th} grade students. Results of the study could have implications for students, teachers, counselors and parents in handling mathematics anxiety. Morevoer, the results of this study conducted in Turkey together with the results of foreign studies are subjected to comparative analysis.

The purpose of this study was to investigate whether 4^{th} and 5^{th} graders' mathematics anxiety differed significantly to a group of variables such as gender, grade level, liking mathematics class, liking mathematics teacher whether or not students had gender stereotypes about success in mathematics and achievement level in mathematics.

METHOD

The current work is a descriptive study investigating if students' mathematics anxiety differed significantly to a group of variables such as gender, grade level, liking mathematics class, liking mathematics teacher, holding gender stereotypes about performance in mathematics and achievement in math.

Participants

In this study, participants were 249 persons (53.4 % of the n females, 46.6 % of the n males) who were 4^{th} graders (50.6 %) and 5^{th} graders (49.4 %).

Instruments

"The Mathematics Anxiety Scale for Elementary School Students" and "The Personal Information Form" were used for data collection.

The Mathematics Anxiety Scale for Elementary School Students: The scale was developed by Bindak (2005) to assess mathematics anxiety in elementary school students. It is a 5-point Likert type scale consisting of 10 items. Split half reliability coefficient to test the Scales'

reliability and found a Sperman-Brown correlation coefficient of .83, a Cronbach Alpha coefficient of .84. Factor analysis done for validity testing of the scale resulted in one factor.

The Personal Information Form: This form was developed by the researcher to obtain the following information: Gender, grade level, whether participants liked mathematics class or not, whether they liked their mathematics teacher, whether or not they believed success in mathematics is relevant to gender and mathematics achievement.

Data Analysis

Independent samples t-test, Oneway Anova and Schefee test were used for data analysis. A significant level of 0.05 was used for all analysis. These procedures were run in SPSS for windows.

RESULTS

Below is a summary of results obtained from data analytical procedures in answering the research questions. Students' mean scores on mathematic anxiety are illustrated in Table 1. The mean score on mathematics anxiety was $M = 20.31$ ($SD = 8.96$)

Table 1: Students' mathematics anxiety scores

n	Minimum	Maximum	M	SD
249	10	50	20.31	8.96

Independent sample t-test was used to determine if students' levels of mathematics anxiety differed significantly according to their gender, grade level, liking mathematics class, liking mathematics teacher. The results are illustrated in Table 2.

Table 2: Results of independent samples t-test; mathematics anxiety according to gender, grade level, liking or not liking mathematics class and liking or not liking mathematics teacher

Variable	n	M	SD	t	P
Gender					
Female	133	21.42	8.94	2.11*	.04
Male	116	19.03	8.84		
Grade Level					
4^{th}	126	20.26	8.81	.08	.93
5^{th}	123	20.36	9.14		
Liking Mathematics					
Liking	215	18.18	7.23	11.74*	.00
Not-Liking	34	33.76	6.94		
Liking Teacher					
Liking	224	18.87	7.70	8.67*	.00
Not-Liking	25	33.24	9.23		

As shown in Table 2, the results showed a significant difference between mathematics anxiety scores of males and females (df = 247, t = 2.11, p < .05). More specifically, female students scored significantly higher (M = 21.42, SD = 8.94) than males (M = 19.03, SD = 8.84). On the other hand, no significant difference was observed in the mathematics anxiety levels of 4th and 5th graders (df = 247, t = .08, p > .05). Concerning liking mathematics class, the results showed a significant difference between mathematics anxiety scores of those who liked their mathematics class and those who did not like (df = 247, t = 11.74, p < .05). Student who did not like mathematics class had higher mathematics anxiety (M = 33.76, SD = 6.94) than those who liked the class (M = 18.18, SD = 7.23). Likewise, the results showed a significant difference between mathematics anxiety scores of students who liked their mathematics teachers and those who did not like (df = 247, t = 8.67, p < .05). More specifically, the later group reported higher levels of mathematics anxiety (M = 33.24, SD = 9.23) than the former one (M = 18.87, SD = 7.70).

Oneway ANOVA was performed to inquire if students' levels of mathematics anxiety differed significantly according to whether or not they believed success in mathematics is gender dependent, and to their achievement level in mathematics (excellent, high, average, and low). The results are illustrated in Table 3.

Table 3: Results of oneway Anova; mathematics anxiety according to beliefs about gender and success in mathematics; and achievement level in mathematics

Variable	Sum of Squares	DF	Mean Square	F	P
Belief					
Between Groups	324.985	2	162.493	2.04	.13
Within Groups	19578.203	246	79.586		
Total	19903.189	248			
Achievement Level					
Between Groups	8653.832	3	2884.611	62.82*	.00
Within Groups	11249.357	245	45.916		
Total	19903.189	248			

As shown in Table 3, students' mathematics anxiety did not differ significantly according to their beliefs about success in mathematics being gender dependent. (df = 246, F = 2.04, p > .05). On the contrary, students' mathematics anxiety differed significantly according to their achievement levels in mathematics (excellent, high, average, and low) (df = 245, F = 62.82, p < .05). Schefee test was used to determine the direction of these differences. The results are illustrated in Table 4.

Table 4: Results of Schefee test; mathematics anxiety according to achievement level in mathematics

Achievement Level		M	SD	(1)	(2)	(3)	(4)
Excellent	(1)	13.65	5.14	-	6.54*	9.50*	20.11*
High	(2)	20.19	7.52		-	2.96	13.57*
Average	(3)	23.15	7.34			-	10.61*
Low	(4)	33.76	7.41				-

As shown in Table 4, students with excellent degree of achievement had significantly lower mean scores (M = 13.65, SD = 5.14) on mathematics anxiety than those with high, average and low mathematics achievement. Similarly, those with high mathematics achievement had significantly lower mean scores (M = 20.19, SD = 7.52) on mathematics anxiety than those with average and low achievement groups. Furthermore, students with average mathematics achievement had significantly lower mean scores (M = 23.15, SD = 7.34) on mathematics anxiety than those with low achievement (M = 33.76, SD = 7.41). In short, results showed that 4th and 5th graders' mathematics anxiety decreased as their achievement in mathematics increased.

DISCUSSION

The purpose of the study was to investigate influence of gender, grade level, liking mathematics class, liking mathematics teacher, whether or not students had gender stereotypes about success in mathematics and achievement level in mathematics on mathematics anxiety levels of Turkish elementary school students. Results showed that 4th and 5th grade elementary school students' mathematics anxiety differed significantly according to gender, liking mathematics class, liking mathematics teacher and achievement level in mathematics. Female students reported higher levels of mathematics anxiety than their male peers. Students who like their mathematics class reported significantly lower mathematics anxiety. Likewise, students who like their mathematics teachers had significantly lower mathematics anxiety. Student more successful in mathematics had lower degree of mathematics anxiety. On the other hand, students' mathematics anxiety did not differ significantly according to their grade level and their gender stereotypes regarding success in mathematics.

Results regarding gender and mathematics anxiety are parallel to those of Lafferty (1996) who found higher self-reported anxiety by females. However, they differ from findings of Rexses (1995) who did not detect any significant gender differences in mathematics anxiety among elementary school students. It is noteworthy that female participants in Rexses' sample did have higher means however not to a statistically significant degree. Likewise, working with a sample of elementary school students, Gierl and Bisanz (1995) also did not find any differences between mathematics anxiety scores of male and female students. In short, studies examining gender and mathematics anxiety have not always found higher anxiety in females and often report mixed results.

Results of this study did not find any significant difference in mathematics anxiety according to grade level. In other words, no significant difference was found between scores of 4th and 5th graders. This could in part be due to the fact that these two grade levels are consecutive.

One could expect that unless intervened, students' mathematics anxiety would worsen with time/grade. Part of the rational for this expectation is that factors contributing to mathematics anxiety (i.e., low self-confidence, low self-efficacy performance in math, low grades in math, negative attitudes toward math, negative attitudes of parents and teachers, learning styles and ineffective teaching strategies) might perpetuate one another and therefore cause higher mathematics anxiety as students go further in grade levels (Bursal & Paznokas, 2006; Cook, 1998; Hadfield & McNeil, 1994; Hopko et. al., 2003; Ma & Xu, 2004; Norwood, 1994; Reynolds, 2001; Thomas & Furner, 1997; Williams, 1994, Woodard, 2004). Another reason for this expectation could be the fact that subjects in mathematics get harder with each grade and thus the increased difficulty in the topics could lead to mathematics anxiety or exasperate existing levels apprehension toward math.

Results showed that students who like mathematics class had significantly lower mathematics anxiety. Perceiving a teacher's authoritarian and threatening attitudes might develop mathematics anxiety. In fact, students might continue to feel apprehensive about mathematics even if their mathematics teacher changes. As mentioned before, students' failure in mathematics can also lead to mathematics anxiety and even to hating math. Students who did not like mathematics class reported higher levels of mathematics anxiety which is consistent with finding of previous studies.

Results showed students who like their mathematics teachers scored significantly lower on mathematics anxiety. Perry (2004) states that mathematics anxiety begins at an early age. For example, young students can develop mathematics anxiety if they have rigid mathematics teachers. Mathematics teachers' positive, supportive and empowering approaches could help students develop positive attitudes toward mathematics. Altun (1995) recommends that fostering such attitudes in students should be part of the purpose of mathematics courses. Effective communication, consideration for individual difference and a positive attitude by the teacher (Sahin, 1998) can foster positive attitudes toward mathematics and thus counteract development of mathematics anxiety. Such class environment can be comforting for students and encourage them to express their skills as well as their questions and concerns (Ersever, 1992). This in turn could promote achievement which is antidote to developing fear and anxiety. In addition, tutoring (Miller & Mitchell, 1994), small group work (Furner & Duffy, 2002; Gresham, 2005; Gresham, Sloan & Vinson, 1997; Townsend et. al., 1998), comfortable class environment encouraging creativity without distressing students (Umay, 1996) and guidance programs geared toward strengthening study skills could add to preventive efforts against mathematics anxiety.

Results did not show significant difference in students' anxiety levels according to their beliefs about gender and mathematics. In other words, students' anxiety about dealing with mathematics did not differ depending on whether or not they believe that success in mathematics is related to one's gender. This finding is parallel to results by Senfeld (1996) who found a significant positive relationship between negative believes about mathematics and mathematics anxiety. Likewise, working with a sample of high school students and university students, Yüksel-Şahin (2004) also did not find any differ significantly according to this belief. Despite these findings, stereotypes could have powerful implications. Female students are believe that males are better equipped with mathematical abilities. On the contrary, even in the first grades of elementary education, male students perceive themselves more skillful in mathematics than their female peers. These beliefs could impact students' self-efficacy, expectations about their performance in mathematics and thus could have considerable influence on their achievement in mathematics in the long run (Casey, Nuttall & Pezaris, 1997; Tobias, 1978; as cited in Miller & Mitchell, 1994). Bruno (1999) recommends that parents and teachers should specifically point out that they expect similar degree of achievement from males and females alike.

Results showed that elementary school students' mathematics anxiety differed significantly according to their level of achievement in mathematics. The higher their achievement level the lower was their anxiety. Working with samples of elementary school students, Lafferty (1996) and Miller (1991) also found that those with higher achievement in mathematics had lower degrees of anxiety for mathematics. Norwood (1994), Ma and Xu (2004) and Yüksel-Şahin (2004), found confirming results with high school students and university students. Other studies also found parallel results (Reglin, 1990; Satake & Amato, 1995) indicating a negative relationship between achievement in mathematics and anxiety about math. Townsend et. al. (1998) reason that low achievement increases students fear and anxiety about mathematics which in turn negatively impacts achievement.

Results were overall in line with findings of previous studies on mathematics anxiety in elementary education students in Turkey and other countries. Review of the prior literature did not reveal any cross-cultural studies comparing Turkish students with international samples. However, the Program for International Student Assessment (PISA) conducted in 2003 by the OECD showed that participating Turkish students had difficulties with problem solving skills and reported higher mathematics anxiety than children from OECD membering countries. These findings were alarming about mathematics education in Turkey (Eğitim Reformu Girişimi, 2007). Thus, the Ministry of National Education decided to revise the curriculum and to improve quality

of education. The Ministry has been reviewing educational systems of various countries and examining reform efforts in other countries in order to renew the national education in ways that can live up to demands of the competitive global conditions of the present time (T.C. M.E.B., 2007). There is a universal effort toward reforming existing educational systems. Although nations strive to make changes congruent with the problems inherent in their national educational systems, in today's world incorporating approaches and experiences of other nations is worth consideration (Türkoğlu, 2005). Given the shortcomings of traditional approaches to education, fundamental changes in goals of educational policies, functions and organization of educational institutions and contents of curricula have become vital. Traditionally, schools were organized analogous to factories' functioning where neither the learners nor the teachers had control over the content and process of "the production" which encouraged memorization instead of learning (Arslan & Eraslan, 2003). The 1990s witnessed a great deal of focus in reforming educational systems from preschool to the end of university education in order to keep up with the fast-paced changes of the information age. A variety of national and international conferences have pointed out the need for change and attempted to identify new functions and roles of each of the educational phases (preschool, elementary, and the like). As Turkey strives toward membership to the European Union, revision of the goals and contents of mathematics, science, technology and other required courses is necessary. The vision of the Revised Mathematics Curriculum rests on the premise that each child can learn mathematics (Ersoy, 2006). As such, the mathematics teacher is no longer the holder of mathematics knowledge who merely transmits it to the students, he or she instead raises questions to promote mathematical thinking and communication, sets a positive role model and facilitates students' active participation in learning (Erbas, 2005). In this point of view, a teacher who sets a positive role model, establishes a good communication with his or her students and who provides a peaceful environment for them by trying to decrease anxiety will endear himself or herself and the lesson to his or her students. As a matter of fact, the results of the study also show that the mathematics anxiety degrees of students who like mathematics class and their mathematics teacher are lower. The students will get positively influenced if the teacher helps reducing the mathematics anxiety by adopting a cooperative and facilitative attitude keeping in mind individual differences. So; upon emergence of the need for a contemporary approach with realistic goals and quality educational programs (Ersoy, 2003), Turkish Ministry of National Education developed new elementary education programs in 2004. This new approach to education redefined the teacher's roles as; orchestrating learning environment, guiding students through learning activities, facilitating collaboration, easing students' difficulties, and planning the learning experiences. The new teacher is to be diligently

considerate about individual differences and be a life-long learner who also watches out for students' wellbeing and safety (Eğitim Reformu Girişimi, 2005). This approach is student and learning-centered and encourages active participation of students as well as collaborative small group/class work (Ersoy, 2006). In fact, studies show that group work and collaborative learning alleviate mathematics anxiety and have positive impact on students cognitively, emotional and socially (Gresham, Sloan & Vinson, 1997; Townsend, et al., 1998). As a part of reforms in Turkey, criteria for measurement of student achievement have also been redefined. Measurement is to focus on the process of learning as opposed to the outcomes (Yapıcı & Demirdelen, 2007). In other words, students will be evaluated based on their performance on tests, projects, participation in class and performance homework (Eğitimevi Online, 2007). These changes will be particularly helpful for students with mathematics anxiety. In addition to traditional exams, using group assessments, group observation (Thomas & Furner, 1997); homework and comparing performances on in-class problem solving (Miller & Mitchell, 1994) will eliminate stress, provide opportunities for creativity, and allow more comfortable test taking which in turn will minimize existing problems in teaching mathematics (Umay, 1996). Such approaches will decrease the anxiety degrees of the students and increase the achievement level in mathematics. As a matter of fact, the results of the study also show that the achievement level in mathematics increases as the mathematics anxiety level decreases. These reform efforts in Turkey appear promising from a mathematics anxiety standpoint.

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