MS Word Export To Multiple PDF Files Software - Please purchase license.Mathematics Anxiety Questionnaire: Development and Validation

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Abstract

The purpose of present research was to develop the questionnaire that could measure middle and high school students' mathematics anxiety levels. Because mathematics anxiety is one of important components of mathematics classroom. In order to develop the questionnaire, a pretest form was developed through a literature survey and presented to experts for evaluation. After alterations based on their suggestions, a pilot study with 100 middle and high school students was held to revise the questionnaire. After the revision, a total of 69 items in the questionnaire was administered to 1015 students who were attending at middle and high school at Sivas city of Turkey. In order to realize the validity, exploratory factor analysis was performed. Exploratory factor analysis showed that the questionnaire included four factors and four-factor analysis of variance is 57.35%; for each factor, analysis of variance ranged 18.20 %, 16.32%, 12.41%, and 10.40% respectively. Cronbach Alpha Coefficient is also calculated for the entire questionnaire was as .867; for each factor, alpha ranged .832, .771, .754, and .609 respectively, for reliability of the questionnaire. In this way, a questionnaire consisting of 17 items has been developed. So, the questionnaire had satisfactory results on validity and reliability tests.

Anxiety is a situation which includes a multi-dimensional formation and in which backgrounds about different situations occur (Hembree, 1990). Lewis explains the concept of formation in the description above as an expression of emotions that are supported by fear and shock (1970, cited in Hembree, 1990). Spielberger divides the anxiety generally into two parts as trait anxiety and state anxiety (Cheng&Cheung, 2005; Rabalais, 1998). Trait anxiety shows an anxiety that doesn't appear with regard to a specific situation and time and is regardingly a permanent one. Individuals who have this kind of anxiety can be anxious in any situation and time. State anxiety is a kind of anxiety that shows itself in a specific situation and time and when it appears, it can show a harmful and dangerous situation potentially (Croft, 2000). Kennedy, Schwab, Morris, and Beldia (2001) consider the state anxiety as an emotional reaction against a stressful situation contains anxious thoughts and tension and unhappiness feelings. Spielberger makes an advanced division between these two kinds of anxiety as worry and emotionality. Here, worry points out the cognitive combination of anxiety. Thus, individuals perceives their deficiency of ability and they try to react against near danger within worry in order to destroy the threat they met. Emotionality shows a perceivable and awakening component of anxiety. Individuals can show other physical reactions such as sweating, headache, and nervousness. Although these two components indicates the same degree at the same, one of them is related the other partially. Also, behavioural results are different while worry is about performance, emotionality isn't almost about lack of performance (Schwarzer, 1997). According to Kazelskis and Kazelskis (1999), while the cognitive aspect of anxiety derives from neglecting the own performance of oneself

its affective aspect derives from the feelings of tension and irritation and the reactions against the situations met.

Mathematics Anxiety

Reynolds (2003) underlines that how many people suffers from mathematics anxiety and this couldn't be known well as there was no reliable records about it and in fact, mathematics teachers know and see what the mathematics anxiety is from the mimics and reactions of students everday. Hembree (1990) also points out that mathematics anxiety causes a decrease in mathematics achievement and an anxiety towards it such as avoiding oneself from. In fact, mathematics can be considered as an abstract discipline that depends on reasoning. But, mathematics awakens in many people a deep emotionality. It's so deep that, people either love it or hate it. Therefore, affective approach towards mathematics and mathematical thinking are integrated (Hannula, 2005). For this reason, anxiety is one of the most common problems which are related to mathematics in emotional field (Baloğlu&Koçak, 2006). When examining the information given about the general sorts of anxiety, mathematics anxiety can be identified within state anxiety (Brady&Bowd, 2005) and worry. As looking at literature, it is obvious that many descriptions of mathematics anxiety are made and so, there is no common description of it. Richardson and Suinn (1972) describe mathematics anxiety as a feeling of tension and anxiety which prevent the solutions of mathematical problems and manipulation of numbers in situations not depend on practise and in every life. Ashcraft and Faust (1994) also describe mathematics anxiety as mental disorder, terrify, desperation and tension feelings which happen when there is a need to make solution and manipulation of mathematical problems, figures and numbers. This description is essential as it proves that mathematics anxiety contains both cognitive and affective structures. Yet, at this point, Bessant (1995) also emphasizes the same thing and suggests that one should consider cognitive and affective components of mathematics anxiety together and he also describes mathematics anxiety as a combination of negative attitude towards mathematics teaching, the fear of failure, lack of self-confidence and pressure of examination. Ma and Hu (2004) see mathematics anxiety as a disturbing feeling appears when students have to do a mathematical work/task. They explains the former characteristics of this disturbance as specific behavioral indicators such as worry, mental disorder, desperation, disappoinment, tension, fear, dislike and thought. Cemen (1987) describes mathematics anxiety as a situation of reaction against the situations contain mathematics that were perceived as a threat for self-respect and presents it is an anxiety model which contains environmental, personal and state reasons. As for his model, anxiety is a reaction of these reasons that produce anxiety reaction together with is its psychological indicators. According to this, decisions are taken by struggling with anxiety during cognitive activities. If self-respect is basically strong and if there is a confidence related to question/task, the individual can handle with anxiety and canalize it into question/task. In such a situation, anxiety can asist performance. But, if the individual doesn't have enough ability to control anxiety, then this may decrease the performance (Ceman, 1987). Vinson (2001) and Vinson, Haynes and Sloan (1997) indicate that mathematics anxiety is far from disliking mathematics. As for Reynolds (2003), mathematics anxiety is a generally-known problem in education and it is an obstacle for many people to learn mathematics. According to him, mathematics anxiety isn't considered as a learning obstacle, but it gets people into irresistable troubles. Mathematics anxiety contains generally three kinds of anxiety dimensions as test, numeral and abstraction anxieties. While test anxiety is related to success in mathematics tests, numeral anxiety is related to the manipulation of numbers and abstraction anxiety is related to abstract

mathematical contents (Ma&Hu, 2004). Hadfield and McNeil classify the reason of mathematics anxiety as environmental, mental and individual (1994; cited in Ma&Hu, 2004). While environmental reasons contain the features of mathematics teachers and events experienced in math classes, mental reasons contain natural characteristics of mathematics that are quite abstract and based on reasoning. Individual reasons contain self-respect, psychological situation, attitudes and confidence towards mathematics, learning style of mathematics mathematical readiness. Baloglu and Koçak (2006) indicate that mathematics anxiety appears generally as a result of state, personality and environmental reasons at their literature scan findings. Here, while state reasons are related to the formation and education of mathematics, personality reasons are related to emotional, psychological and etc… features of an individual; in other words the individual itself. Environmental reasons are related to previous perception, attitudes, experiences and etc… of individual (Baloglu, 2001). So, gender and age of individual can be classified into this category (Baloğlu&Koçak, 2006). The process of mathematics anxiety is modelled by Mitchell. According to this model, the previous experiences of individuals in mathematics are seen as main reasons of mathematics anxieties. The previous experiences of individuals contain negative attitudes such as negative rumours about the mystery of mathematics, its difficulties, pains and contemplation. At the second step of the model, it is underlined that individuals may have a kind of relationship that can cause this negative attitude towards mathematics with themselves. The anxiety step of the model contain many fear factors such as failure, seeing as stupid, refusal and not reaching the goals. As a result of this, some physical indications can be seen such as the changes in sugar level of blood, in blood-pressure, sweating doubts and stretching of muscles. Model also points out that negative behaviours; such as the feeling of contemplation, deficiency of cognitive ability, failure and avoidance; can be observed in the individuals passing through these phases. In general meaning, as mentioned in this model, process prepares the ground for bringing up of individuals who have high mathematics anxiety (Truttschel, 1992).

Measurement of Mathematics Anxiety

Mathematics anxiety can measured in two different ways. Firstly, it can be measured by a developed anxiety questionnaire. By this way, mathematics anxiety can be divided into sub-categories such as high, medium and low levels of anxiety. The other way of measuring anxiety is to watch the psychological indications of anxiety and the actions combined with these indications. This method seems to be the most ideal one for especially psychiatrists and psychologists for diagnostic of a problem (Truttschel, 1992). In literature, it is obvious that there are some studies for developing anxiety questionnaire in order to determine mathematics anxiety (Alexander&Cobb, 1984; Bessant, 1995; Dreger&Aiken, 1957; Ferguson, 1986; Hopko, Mahadevan, Bare& Hunt, 2003; Richardson&Suinn, 1972). Some of these questionnaires try to measure mathematics anxiety as one-dimensional, some of them try to measure it as as two and others try to measure it as multi-dimensional. In this study, developing a multi-dimensional questionnaire is aimed to determine, mathematics anxiety levels of primary and high school graders. Because, it has been thought that anxiety questionnaires in Turkey aren't number well enough to determine mathematics anxiety levels of primary and high school graders (Baloglu, 2005; Bindak, 2005). Furthermore, the questionnaire developed by Baloglu (2005) is a Turkish version of "Mathematics Anxiety Rating Scale (MARS)" developed by Richardson and Suinn (1972) and it has one-dimensional structure that measures number anxiety. The questionnaire developed by Bindak (2005) is also one-dimensional and generally it tries to measure individual anxiety. Therefore, there is a need for developing a questionnaire (multi-dimensional) to explore mathematics

anxiety levels of particularly primary and high school graders. For this reason, it is aimed to developed a questionnaire by considering some factors such as family, peer, test and evaluation anxieties which are derived from the literature and thought to be the cause of mathematics anxiety. However, by the help of this questionnaire, the data; held by using genders, levels, mathematics achievement and etc… of students, are discussed together with the literature.

Method

Participants

Compulsory education was increased from 5 years to 8 years with an improvement in educational field at 1997 in Turkey. The first five years of this period are called as 1st stage of primary school and last three years are called as 2nd stage. 7-12 year old students go to 1st stage and 13-15 year-old students generally go 2nd stage of primary school. However, high school education also was increased from 3 years to 4 years with an improvement in educational field at 2006 and so, 15-18 year old students generally go to high school. This study was limited to develop the questionnaire that could measure middle and high school students' mathematics anxiety levels. For this purpose, the sample consisted of 1015 students (511 middle school and 504 high school) enrolled at middle and high schools in Sivas city of Turkey. Participants were randomly selected and attended at 6^{th}, 7^{th} and 8^{th} graders of 20 class at 10 primary schools and from 9^{th} to 12^{th} graders of 21 class at 10 high schools from different school districts in Sivas province in Turkey for inclusion in the research. Middle school students' age ranged from 11 to 15 and high school students' age ranged from 14 to 19. In terms of the study graders, the distribution of the students' were as follows: 210, 6th grades of primary schools, 161, 7th grades of primary schools; 140, 8th grades of primary schools; 82, 9th grades of high schools; 235 (125 mathematics branch and 110 science branch), 10th grades of high schools; 187 (102 mathematics branch and 85 science branch),11th grades of high schools. In terms of the study sexes, the distribution of the students' also were as follows: 535 female and 480 male.

Instrument Development

In this part, I proposes the process used for developing the questionnaire that could measure for middle and high school students' mathematics anxiety levels.

Structure of the MAQ

The MAQ primarly consisted of 69 items. Items for the MAQ were developed through the based on the related literature mentioned above. The MAQ was prepared as a five point-Likert type questionnaire and the students indicated how strongly they agreed with each item from 1 (strongly disagree) to 5 (strongly agree). High scores indicate to more fully convey anxiety toward mathematics. 18 items of the MAQ were negative, while 51 items were positive statements. Furthermore, negative statements were reversed according to the scores mentioned above.

Content Validity

Draft questionnaire was firstly presented with an evaluate checklist to the expert group, which included two people: one of whom has been teaching the mathematics teaching course, and the other person has been also teaching the Turkish language at Turkish department. The statements were evaluated for openness, fluency, appropriacy language, expression, mathematics anxiety statements writing form, and relevancy. Based on the expert opinions,

some statements were rewritten or rearranged. So, none of the statements was not deleted. For example; item 20 and item 48 were rewritten and they were the following:

20 I get bored of mathematics homework much.
20 I get bored of mathematics homework mostly (rewritten).
48 The interest of teacher towards me encourages me to study.
48 The interest of my teacher towards me incentives me to mathematics study (rewritten).

Preliminary Study

After alterations based on the expert suggestions, a pilot study with 100 middle and high school students was held to revise the MAQ. At the end of this pilot study, it was showed that it was not understand of some statements in the questionnaire by students. The MAQ was rearranged based on the expert opinions on these statements. It was formed with these applications. Items were alterationed according to the expert suggestions were the following:

33 I don't want to enter for mathematics exams.
33 If I have a chance, I won't enter for maths (rewritten).
45 I find mathematics meaningless.
45 I see mathematics as a combination of meaningless formulations and terms (rewritten).

Exploratory Factor Analysis

The MAQ was administered to1015 middle and high school students (511 middle school and 504 high school) according to the experts opinions and pilot study results. Exploratory factor analysis were employed to identify the sub-factors of the MAQ. It is a technique used to identify factors that statistically explain the variation and covariation among measures. It reduces a large number of overlapping measured variables to a much smaller set of factors. Hence, it can be viewed as a data-reduction technique (Gren, Salkind& Akey, 2000). All analyses were performed using SPSS 10.0 (Statical Package for the Social Sciences) version and it was used descriptive, one-way ANOVA, correlation statistics, independent samples t-tests, and multiple regression analysis for these analyses.

Results

Prior to any analyses, the questionnaire was screened for missing data. To clean the MAQ into a reliable and valid instrument, exploratory factor analysis, item analyses, and reliability analyses were performed on items and category subscales. Table 1 contains summary descriptive statistics for some items of the MAQ.

Table 1.

Summary Statistics for Some Items of the MAQ (N =1015)

Item	Mean	Std Dev.	Skewness	Kurtosis
1	1.83	1.09	1.35	1.13
2	2.09	1.23	.88	-.35
3	1.85	1.14	1.37	1.01
17	2.01	1.11	.96	.19
20	2.05	1.21	1.05	.14
21	2.01	1.23	1.04	.07
31	2.64	1.48	.34	-1.31
38	2.87	1.35	.15	-1.13
39	2.35	1.32	.66	-.71
46	2.66	1.35	.33	-1.05
49	2.00	1.26	1.15	.22
55	2.49	1.36	.47	-.1.06
57	2.59	1.44	.44	-1.15
58	2.28	1.37	.72	-.79
60	2.63	1.48	.34	-1.33
63	2.02	1.25	1.10	.11
67	2.88	1.31	.05	-1.05
69	2.19	1.24	.82	-.25

As will can be seen Table 1, most item distributions were negatively kurtotic which influenced correlations, which in turn influenced factor analysis results.

Analyses of the Kaiser-Mayer-Olkin (KMO) and the Barlett's Test of Sphericity (BTS)

Kaiser-Mayer-Olkin (KMO) and Barlett's Test of Sphericity (BTS) were employed to measure of sampling adequacy. According to Field (2002), the KMO measure should be greater than 0.5 if the sample is adequate. It varies between 0 and 1.A value close to 1 of the KMO for factor analysis should give reliable and distinct factors (Field, 2002). For the MAQ data the value .905 which falls into the range of being *superb*. Therefore, I should be confident that factor analysis is appropriate for these data. For the MAQ data, BTS test is also highly significant *(B=5354.33, p< .001)*, and so factor analysis is appropriate for them (Field, 2002).

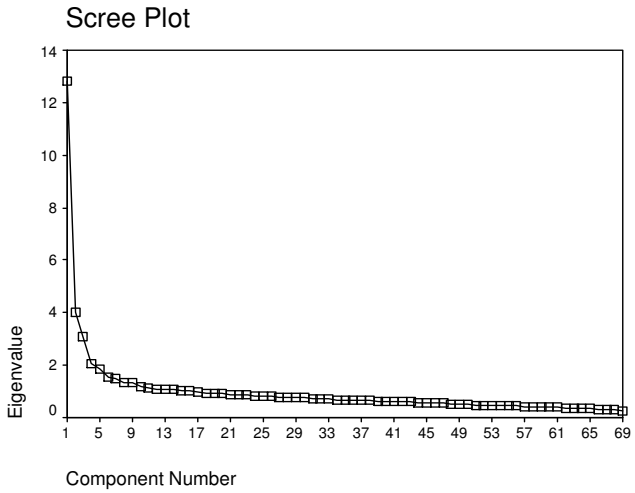

Figure 1. Scree Plot of Rotated Factor

Principal Components Factor Analysis

Principal components factor analysis was performed with an varimax rotation. It ensures that the factors remain uncorrelated (Field, 2002). It initially yielded 16 factors with eigenvalues greater than 1. Loadings less than .40 are not shown. Varianced explained for all of the factors were also 53.85%; for each scale, analysis of variance ranged from 6.59% to 1.78%. The factor loadings of these items vary between .701 to .402. However, the scree-plot is also shown in Figure 1 with a thunderbolt indicating the point of a break in size of eingevalues between the fourth and fifth factors on the curve. Hence, four or five factor solution appeared to be the best approximate simple structure.

Varimax rotation showed that the MAQ included four factors. Here, some items did not significantly load on any factor and thus were deleted from the MAQ. For example; item 1 and item 15 were deleted and they were the following:

2 I know that I can't succeed even if I work hard.
35 Time can pass by easily in mathematics exams.
57 I wish to have a good mark only for my family.

The first factor, named peer anxiety (PA), had 5 items with factor loadings ranging from .583 to .785. According to Table 4, it showed that factor loadings of 4 items are varies *excellent* and another item is varies *good* (Comrey& Lee, 1992). This factor seems to represent negative peer pressure towards mathematics learning.

The second factor, task anxiety (TA), had 6 items with factor loadings ranging from .465 to .707. Factor loadings of 2 items of the factor are varies *excellent*, 2 items are varies *very good*, 1 item is varies *good,* and 1 item is varies *fair* (Comrey&Lee, 1992). The factor includes task pressure towards mathematics learning.

The third factor, labeled individual anxiety (IA), had 3 items with factor loadings .718 and .817. This factor with together the following factor had the fewest items in the MAQ. However, factor loadings of 3 items of this factor are also varies *excellent* (Comrey&Lee, 1992). This factor includes self-confidence and attitude towards mathematics learning.

The last factor, labeled test anxiety (TEA), had 3 items with factor loadings .618 and .747. Factor loadings of 2 items of this factor are also varies *excellent* and 1 item is varies *good* (Comrey&Lee, 1992). This factor seems to represent test anxiety towards mathematics.

The rotated factor loading matrix, item-total correlations, communalities, means, and standart deviations for each item are presented in Table 2.

Table 2.

Rotated factor loading matrix, item-total correlations, communalities (h^2), item means, and standart deviations (SD) for the MAQ

MAQ/Item	Factor I	Factor II	Factor III	Factor IV	h^2	Item -Total Correlation	Mean	SD
PA1	.785				.653	.539	2.28	1.39
PA 2	.772				.659	.580	2.28	1.37
PA 3	.770				.641	.519	2.63	1.48
PA 4	.763				.606	.498	2.23	1.39
PA 5	.583				.469	.556	2.35	1.35
TA1		.707			.534	.408	2.06	1.28
TA2		.700			.511	.405	1.98	1.15
TA3		.687			.519	.450	2.03	1.23
TA4		.655			.556	.567	2.05	1.21
TA5		.582			.455	.505	2.23	1.29
TA6		.465			.380	.517	1.83	1.16
IA1*			.817		.713	.425	2.37	1.21
IA2*			.745		.696	.535	1.83	1.09
IA3*			.718		.616	.504	2.26	1.15
TEA1				.747	.642	.482	2.70	1.35
TEA2				.711	.642	.493	2.87	1.35
TEA3				.618	.467	.352	3.02	1.43

Note: All loadings smaller than .40 have been omitted.
* Reversed item

As can be seen Table 3 is given below, the results showed analysis of variance for the entire scale was 57.35%; for each scale, analysis of variance ranged 18.20%,16.32%, 12.41%, and 10.40% respectively. In this stage, the KMO value was calculated for the MAQ data as .905 which falls into the range of being *excellent*. For the MAQ data, BTS test is also highly significant *(B=5354.335, p<.001).*

Table 3.

Analysis of Variance for the sub-factors of the MAQ

Factor	Item No	Explained Variance (%)
Factor-1	59-58-60-61-61-11	18.20
Factor-2	26-23-21-20-25-50	16.32
Factor-3	5-1-10	12.41
Factor-4	37-38-29	10.40
Total	17	57.35

Internal Consistency (Cronbach alpha) for the MAQ

Table 4 presents means, standart deviations, skewness, kurtosis, variance, and internal consistency (Cronbach alpha) for the MAQ Questionnaire's and its sub-factors. As can be seen Table 4, Cronbach Alpha Coefficient is also calculated for the entire scale was as .867; for each factor, alpha ranged .832, .771, .754, and .609 respectively, for reliability of the questionnaire. These Cronbach alphas confirmed the satisfied internal consistence of the MAQ. In the light of these explanations about the MAQ, based on the reliability and validity analysis, it showed that there were satisfactory factor structure and reliability of the questionnaire.

Table 4.

Internal Consistency (Cronbach alpha), Means, Standart Deviations (SD), Skewness, and Kurtosis for the MAQ's Scales

Questionnaire	Number of Item	Mean	SD	Skewness	Kurtosis	Variance	Cronbach α
Entire Questionnaire	17	2.29	.73	.40	-.33	.53	.86
Factor-1	5	2.35	1.08	.47	-.71	1.17	.83
Factor-2	6	2.03	.83	.79	.14	.70	.77
Factor-3	3	2.15	.94	.70	-.08	.89	.75
Factor-4	3	2.86	1.03	.16	-.58	1.06	.60

Table 5 contains correlations between the MAQ factors. The results indicated that there was a positive and significant correlation among the MAQ factors. In general, the factors were moderately correlated.

Table 5.

Correlation between the MAQ Scales

Scale	Factor-1	Factor-2	Factor-3	Factor-4
Factor-1	-	.41*	.34*	.46*
Factor-2		-	.51*	.41*
Factor-3			-	.37*
Factor-4				-

Note: * refers to p<.01 level

In terms of the whether the MAQ could differentiate students with different mathematics anxieties. Therefore, I ranked students' anxieties towards mathematics learning into three categories, these were high anxiety levels, moderate anxiety levels, and low anxiety levels. For the high anxiety levels their scores ranged from mean score plus one standart deviation. For the moderate anxiety levels their scores equal to mean score. For the low anxiety levels their scores also ranged from mean score minus one standart deviation. One-way ANOVA analysis showed that there were significant difference among students with high, moderate, and low anxiety levels towards mathematics learning according to the entire questionnaire and its the factors, respectively

($F(2,1012) = 2320,44\, p < .001$; $F(2,1012) = 535,16\, p < .001$; $F(2,1012) = 581,49\, p < .001$; $F(2,1012) = 324.06\, p < .001$; $F(2,1012) = 343,03\, p < .001$). All of factors in the MAQ could distinguish among high, moderate, and low anxiety levels. So, this confirmed the construct validity of the MAQ. In addition, I also collected students' mathematics achievement scores on a 5.00 scale from the previous semester and used as variable of their performance in present study. Here, I grouped middle and high school students' mathematics achievement into three categories, these were high achievers, moderate achievers, and low achievers. For the high achievers their scores ranged from mean score plus one standart deviation. For the moderate achievers their scores equal to mean score. For the low achievers their scores also ranged from mean score minus one standart deviation. The univarate F-test followed MANOVA analysis results showed that that there were significant difference between students with high achievers, moderate achievers, and low achiewers according to the entire questionnaire and its the factors, respectively ($F(2,1012) = 28.49,\ p < .001$; ($F(2,1012) = 19.72,\ p < .001$; $F(2,1012) = 8.89,\ p < .001$; $F(2,1012) = 44.28,\ p < .001$; $F(2,1012) = 17.58,\ p < .001$)) . Consequently, students who had the highest mathematics achievement also had the lowest mathematics anxiety scores. So, a strong relationship between mathematics achievement and mathematics anxiety scores can be infered from these data. However, it has fixed that there was a significant and negative relationship (r = -.378, p<.01) between their mean scores of their mathematics anxiety scores got from the entire questionnaire and their mathematics achievement scores. Additionally, in the result of multiple regression analysis; which were performed to find out the effects of sub-factors of the questionnaire on students' mathematics achievements, the rank of relatively significant on students achievements is negative and it ranks from individual anxiety (IA), test anxiety (TEA), peer anxiety (PA) and task anxiety (TA) ($\beta = -.305; \beta = -.129; \beta = -.080; \beta = -.021$) . So, it can be said that the most important sub-factor that affects students mathematics achievements is individual anxiety. In this study, individual anxiety of students towards mathematics has been tried to determine in a scope of their attitudes mathematics and their self-efficacy. However, statistical analysis using independent samples t- tests indicated that there were significant difference between middle school students and high school students' mathematics anxiety levels ($t_{(1013)} = -2.23,\ p < .05$) . Clearly, high school students' mathematics anxiety levels (mean = 2.35) are significantly more likely than middle school students mathematics anxiety levels (mean = 2.24) for the entire questionnaire. However, it was determined that there was no meaningful relation towards the entire questionnaire for both primary and high school students according to their sexes, respectively ($t_{(509)} = .201,\ p > .05; t_{(502)} = -.269,\ p > .05$) .

Discussion

The purpose of the study were to develop a questionnaire that could measure middle and high school students' anxiety levels towards matematics. Items of the questionnaire were designed based on the related literature. In the present study were four factors generated in the MAQ, these were; peer anxiety (PA), task anxiety (TA), individual anxiety (IA), and test anxiety (TEA). However, Ma and Hu (2004) point out that mathematics anxiety consist of three anxiety dimensions as test, numeral and abstraction anxiety. Besides, Bessant (1995) sees mathematics anxiety as a combination of negative attitude, failure, deficiency of self-respect and exam pressure. When looking within of a frame of these two descriptions, it has been seen that MAQ is an effective and avaliable questionnaire to measure anxiety levels of

students towards mathematics. Similarly, Cates and Ryhmes (2003) point out that they related mathematics anxiety generally with performing of memory, age, self-competence, attitude towards mathematics, test anxiety and general anxiety. However, when looking at the literature, it is seen that mathematics anxiety has been investigated together with the subjects of teaching methods and strategies of mathematics (Gresham, Sloan&Vinson, 1997; Newstead, 1993; Newstead, 1998; Thiysse, 2002; Vinson, 2001), leadership behaviours and features of teachers (Bellows&Felicia, 1999), mathematics achievement of students/pre-service teachers (Clute, 1984; Kates&Ryhmes, 2003; Ma, 1999; Thiysse, 2002), mathematical ability (Lupkowski &Schumacker, 1991), gender (Baloğlu&Koçak, 2006; Bellows&Felicia, 1999; Campbell&Evans, 1997; Hembree, 1990; Ruben, 1998; Oxford&Wordick, 2006; Thomas, 1998), self-respect (Thiysse, 2002), psychologic situation, attitude and reliance towards mathematics (Allen, 2004), styles of teaching/learning mathematics (Vinson, Haynes&Sloan, 1997; Gavrielle, 1993; Sloan, Daane&Giesen, 2002), beliefs about mathematics (Ulusimaki& Nason, 2004a), mathematical readiness (Baloğlu&Koçak, 2006), and decreasing mathematics anxiety (Ulusimaki&Nason, 2004b). In this research, it is aimed to develop a questionnaire in order to explore mathematics anxiety levels of primary and high school graders and its aimed to determine whether this questionnaire diffirentiates significantly according to some variables (gender, mathematics achievement scores etc…) or not. At the end of research, it has been fixed that mathematics anxiety levels of both primary second stage and high school graders shows no significant difference according to gender. When looking at the literature, it has been seen that there are different results in studies carried out to explore gender factors on mathematics anxiety. So, in a study done by Thomas (1998) on university students, it has been determined that mathematics anxiety levels of male students are lower than those of female students. Hembree (1990) also fixes that preservice female mathematics teachers have greater anxiety levels than preservice male mathematics teachers. In a study executed by Ruben (1998) on university students, it has been determined that male students have less anxiety levels and need less help than female students. Similarly, Oxford and Wordick (2006) determine that female students at university have more mathematics anxiety in every age and grade levels than male ones. Cook (1997) also fixes that female students at universities have more mathematics anxiety than male ones and ages of students have no significant effect on mathematics anxiety. Hembree (1990) fixes that male students at universities have less mathematics anxiety than females, yet, before university mathematics anxiety plays more effective role and causes them to show poor mathematics performance and to refrain themselves from mathematics. Woodart (2004) fixes that female students at universities have more mathematics anxiety in significant level than male ones too. It has been explored that there is no significant difference between the mathematics anxiety who are 25 and up. Baloğlu and Koçak (2006) determine that female students have more significant anxiety levels in mathematics test anxiety and male students have more significant anxiety levels in numeral anxiety in their study with university students. Osborne (2001) finds out that female students have higher anxiety level than males in his study with high school graders. Lupkowski and Schumacker (1991) explore that university students having mathematical ability have lower anxiety and female students have higher anxiety levels even if this higher anxiety has no significant level statistically. Besides these researches; which show that gender has a significant effect on mathematics anxiety, there some researches; which prove that there is no significant difference between anxiety levels of female and male high school graders, just the same as the research done by Bellows and Felicia (1999). In the study carried out by Olson (1985) with university students, many variables such as mathematics

achievement and anxiety, achievement anxiety, trait anxiety, attitudes towards mathematics, reasoning ability, control focus, independent learning style, spatial aptitute and gender, have been examined and it has been fixed that there is no significant difference between mathematics anxiety levels of female and male students as one result of this study.However, the findings of the study done by Frary and Ling (1983) and Tapia (2004) point out that there is no significant difference between mathematics anxieties of female and male students at university. Campbell and Evans (1997) approach to relationship between gender and mathematics anxiety by a different perspective and find out that there is no significant difference between female students in co-education schools and single-sex education schools at mathematics anxiety.

In the literature, it can be seen that there are many researches of fixing and solving the state in order to cure the anxieties of students, preservice and in-service maths teachers towards mathematics by researchers, besides the researchers; which are gender-oriented and mentioned above. So, as a result of a study executed by Puteh (2002) with pre-service primary school teachers, it has been fixed that pre-service teachers consider the main factors of mathematics anxiety of students as peer-groups effects, family, test pressure, teaching methods of teachers and relationships between teacher-student, when examining their perceptions, perspectives, emotions towards mathematics and their behaviours while studying it. It has been seen that two ones in sub-factors of the questionnaire developed in this study are peer and test anxiety. On the other hand, in the present study, it has been determined that students with higher mathematics achievement have less mathematics anxiety. However, it's reported that there is a significant and negative relationship ($r = -.37$, $p<.01$) between mathematics achievement and anxiety. Asa result of a meta-analysis study of Ma (1999) that examines 26 studies on relationship between mathematics achievement and anxiety, it has been found that there is a significant and negative relationship ($r = -.27$, $p<.05$) between two variables. Results of the study done by Clute (1984) and Cates and Ryhmes (2003) about university students also support this situation. The findings of Clute's study show that students with higher mathematics anxiety have less mathematics achievements than the students with lower mathematics anxiety. Again as a result of the same study, it is determined that there is a significant relationship between teaching strategies and mathematics anxiety and also the students with higher mathematics anxiety use of expository teaching strategy mostly and students with lower mathematics anxiety use of discovery teaching strategy mostly. The findings of the study of Cates and Ryhmes (2003) also show that students with higher mathematics anxiety get significantly lower scores than students with lower mathematics anxiety in main mathematical tests (addition, substraction, multiply, division and linear equation). According to results of PISA 2003 project which explores the levels of mathematics anxiety of students in Turkey well, students at 15 age group in Turkey (last grade of primary school and first of high school) generally experience mathematics anxiety and mean scores of mathematics anxiety in Turkey is higher than those of mean scores of OECD countries in the project (Mean score: Turkey: 0.34, OECD-whole: 0.10, OECD-Mean score: 0.00). According to the results of the project, it is recorded that an important part of Turkish students get angry while solving mathematics problems and questions, feel themselves desperate, have an anxiety about getting bad marks and feel nervous while doing maths homeworks. However, it has been found out that female students at 15 age group have more mathematics anxiety than males in all all geographic regions (EARGED, Department of Education Research and Development-ERD, 2005:68- 69). Some precautions are determined to be taken by specific institutions in order to decrease the levels of Turkish students'

mathematics anxiety and as an obvious step, mathematics anxiety takes place in renewed Primary Mathematics Programme (Turkish Ministry of National Education-MONE, 2005) under the heading of affective domain with these expressions: "not having enough anxiety to affect their achievements and thoughts and feeling about mathematics, having patience while solving a problem and beliefing themselves in learning mathematics" (p.17) and under the heading of self-regulation with these expressions: "not feeling anxious and panic in maths exams" (p.18).

Consequently, the results of the present study provide support for the MAQ as a valid and reliable measure of the students' anxiety towards matematics. The MAQ appears to have a coherent factor structure for a sample of the students. It could also differantiate students with high, moderate, and low anxieties towards mathematics. Therefore, this questionnaire is thought to help for determining the relationships among many factors (learning style, socio-economic level, culture etc…) that can influence mathematics anxiety and together with teaching and learning mathematics.

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