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Parents' Mathematics Anxiety and Their Contribution to Mathematics Education

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ABSTRACT

This study aims to investigate the mathematics anxieties of primary and middle school parents and their contributions to the teaching of mathematics. The data of the research were collected using "Mathematics Anxiety Scale for Parents," "Parents' Contribution to the Mathematics Education Scale," and "Parent Form," developed by the researcher. This research was designed as a survey study, and obtained data were analyzed using SPSS 16. Some of the conclusions that are achieved in this investigation are as follows: mathematics anxiety of parents were found to be low whereas their participation in their children's mathematics education was high, there was no difference in the mathematics anxiety of the children in accordance with the grade level they were enrolled in, the participation of primary school parents in mathematics education was found to be higher than that of the middle school parents, there was no difference between mathematics anxiety of mothers and fathers, mothers participated in the mathematics education more than fathers did, mathematics anxiety of parents decreased as their graduation and mathematics knowledge increased, thus, their participation in mathematics education increased, there was a high and inverse relationship between mathematics anxiety and participation in mathematics education..

Keywords:
Mathematics, mathematics anxiety of parents, participation in mathematics education.

1. Introduction

Mathematics is a branch of science used in all areas of life. Mathematics anxiety is one of the factors restraining individuals to learn mathematics (Bai, 2011; Cates & Rhymer, 2003; Pajares& Miller, 1994). Mathematics anxiety is defined as a "feeling of tightness, helplessness, anxiety, panic, incompetence, paralysis and mental derangement that occur when an individual is required to make an operation by numbers or is solving a mathematics problem" (Ashcraft & Faust, 1994; Fiore, 1999). From past to present, mathematics anxiety has been a common problem for many primary, middle, high school, and even university students. This situation, which is a problem when being a student, may continue in adulthood. The mathematics anxiety of individuals is based on their prior experiences. It can be urged that the term named after spillover effect in psychology is functional in explaining the effect of parents' mathematics anxiety on that of their children's. In this respect, parents' mathematics anxiety may cause their children to develop mathematics anxiety (Mutlu et al., 2018). Thus, parents may transfer their mathematics anxiety to their children (Whyte & Anthony, 2012; Soni & Kumari, 2017; Şenol et. al., 2015). According to Bandura's (1971) Social Learning Theory,in observational learning, people can acquire general and integrated learning patterns without any need for trial and error. Children develop their behaviors by taking others as models and observing the behaviors of other people, including those of their parents, teachers, and friends (Soni & Kumari, 2017). Many parents are also role models of their children; thus, children are in a tendency to adopt

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their parent's beliefs, attitudes, values, and feelings (Soni&Kumari, 2017). For this reason, many studies discussed the fact that parents' mathematics anxiety is one of the factors contributing to the mathematics anxiety of children (Casad et al., 2015; He, 2007; Kesici, 2018; Maloney et al., 2015; Sarıgöl, 2019; Soni & Kumari, 2017; Yenilmezet al., 2007; Yenilmez & Midilli, 2006). Therefore, parents should be communicated in order to develop learning of students and to provide students with a better education (Price, 1997). As parents are one of the most important elements of the education and training process, they should participate in their children's education and training. Parent involvement in education increases their children's academic success (Anderson & Minke, 2007; Bean et al., 2003; Cai, 2003; Englund, et. al, 2004; Kotaman, 2008; Loomans, 2014; Mutlu et al., 2018; Schickedanz, 2003; Werf et al., 2001) and helps children learn mathematical concepts and how to perform mathematical operations (Pan et al., 2006).

When examining the related literature, many studies have been carried out on the mathematics anxiety of parents (Casadet al., 2015; Dahmer, 2001; Mutlu et al., 2018; Kesici, 2018; Öztop & Toptaş, 2019; Sarıgöl, 2019; Soni & Kumari, 2017; Yenilmez & Midilli, 2006) and the parents' participation in the education process (Akay, 2012; Aytekin, et. al, 2016; Cai, 2003; Civil, et. al., 2008; Deringöl, 2020; Nyabuto & Njoroge, 2014; Özcan, 2016; Yenilmez, 2006; Yenilmez et al., 2006). When we look at the studies done so far, there is no study that examines both the mathematics anxiety of parents and their children's mathematics education at the same time. As parents are significant factors in the children's success, this research aimed to investigate the mathematics anxiety of parents and their participation in mathematics education. Answers to the following research questions were sought in this regard:

1. How are parents' mathematics anxiety and their participation in their children's mathematics education?
2. Do parents' mathematics anxiety and their participation in mathematics education differ according to their children's grade level, their role as parents, their educational status, and their level of knowledge in mathematics, whether their children are successful in mathematics course, and whether they help their children adequately in mathematics?
3. Is there a significant relationship between parents' mathematics anxiety and their participation in their children's mathematics education?

2. Method

In terms of data, this research follows a quantitative approach. The study was conducted using a correlational survey model because the major goal was to evaluate parents' mathematical anxiety and participation in their children's mathematics education. The survey model, according to Karasar (2004), tries to "describe a scenario that existed in the past or lately as it is.

2.1. Sample

The sample of this study consisted of a total of 1071 (481 (44.9%) from primary school and 590 (55.1%) from middle school) parents (922 (86.1%) were mothers, and 149 of them (13.9%) were fathers) of students receiving education in Istanbul in 2019–2020, selected using a random sampling method. The distributions of the parents in the study group are as follows:

Table 1. *Parental Representation*

	Mother		Father		Total	
	n	%	n	%	n	%
Primary School	433	90.0	48	10.0	481	44.9
Middle School	489	82.9	101	17.1	590	55.1
Total	922	86.1	149	13.9	1071	100.0

The sample comprised of 1071 student parents, 481 (44.9%) primary school, 590 (55.1%) middle school 922 (86.1%) of the parents were mothers while 149 of them (13.9%) were fathers.

2.2. Data Collection Tools

In this study, the "Parent Form, "Mathematics Anxiety Scale for Parents" (MASP), and "Parents' Contribution to Mathematics Education Scale" (PCMES) were used as data collection tools.

Parent Form: The researcher came up with the Parent Form. This form asked about the parents'

demographics as well as their children's grade levels, their role as parents, their educational status, their level of mathematics knowledge, whether their children were successful in the mathematics course, and whether they adequately assisted their children in mathematics.

MASP: Developed by Öztop (2018), this scale has 27 items and 3 sub-scales. These sub-scales are as follows: "Mathematics anxiety in parents' academic life," "Mathematics anxiety in the parents' daily life," and "Parents' anxiety about their child's mathematics course." Developed to determine mathematics anxiety of parents, this scale is rated from 1 to 5: 1 "Never," 2 "Rarely," 3 "Sometimes," 4 "Generally," and 5 "Always." The scores obtained from this scale vary between 135 and 27 points. This scale has an internal consistency coefficient of.95, which is the same as in this study.

PCMES: Developed by Yenilmez et al. (2006), this scale consists of 22 items. It has 6 sub-headings: "in-Classroom," "homework," "exam," "out-of-class," "monitoring," and "assessment." A maximum of 110 and a minimum of 22 points are obtained from this scale. The internal consistency coefficient of this scale is .88, which was found to be .80 in this study.

2.3. Data Collection

In the parent meetings organized by the teachers in 2020, the measurement tools selected in accordance with the aims of the study were presented to the parents. They were sent online to some parents who filled them out. Incomplete forms were removed, and data entries were made for the remaining forms.

2.4. Data Analysis

SPSS 16.0 was used to conduct statistical analyses of the measuring tools. Before beginning the analyses, the Kolmogorov–Smirnov test was used to determine whether the data was suitable for normal distribution and to assess the Skewness–Kurtosis values of the scores. The level of significance was less than.05, and the Skewness–Kurtosis coefficient (.911,.526,.463,.036) was between +2.0 and 2.0, according to the Kolmogorov–Smirnov test findings.The data was found to have a normal distribution, according to George and Mallery (2010), and parametric tests were employed. Because it did not supply the one-way MANOVA assumptions, one-way analysis of variance was used in the data analysis. The Pearson moment correlation test and the independent-samples t-Test were also used.

3. Findings

Based on several variables, the results collected related parents' mathematical anxiety and participation in their children's maths education are presented below. Table 2 summarizes the findings linked to the first sub-problem.

Table 2. *Mean Scores Obtained from the Scales*

Scale	N	Mean	Ss
MASP	1071	2.04	.78
PCMES	1071	3.45	.54

Table 2 summarizes the results of the MASP and PCMES tests. The scores collected from the scales were calculated using the scale's range width, "array width/number of groups to be conducted" (4/5=0.80) calculation to determine their levels. The scale's arithmetic mean ranges were 1.00–1.79 for Very low, 1.80–2.59 for Low, 2.60–3.39 for Intermediate, 3.40–4.19 for High, and 4.20–5.00 for Extremely high. As a result, parents' mathematical anxiety was found to be low, while their participation in mathematics education was high.

Tables 3, 4, 5, 6, 7 and 8 present the findings of the second problem.

Table 3. *The Scores Obtained from the Scales According to the Grades of Children: Independent Sampling t-Test Results*

Scale	Grade	N	Mean	S	t	p
MASP	Primary School	481	2.03	.78	−.373	.709
	Middle School	590	2.05	.77		
PCMES	Primary School	481	3.69	.45	14.615	.000
	Middle School	590	3.25	.52		

A significant difference was not found between the MASP mean scores (t = 1.036, p >.05) and the grades of the children. There is a statistically significant difference between the mean PCMES score (t = −1.505, p <.01) and the grades of the children.In this respect, the primary school parents ($\bar{X}$ = 3.69) obtained higher scores than the middle school parents ($\bar{X}$ = 3.25) (Table 3).

Table 4. *The Scores Obtained from the Scales According to Role as Parents: Independent Sampling t-Test Results*

Scale	Parents	N	Mean	S	t	p
MASP	Mother	922	2.05	.78	1.415	.157
	Father	149	1.96	.72		
PCMES	Mother	922	3.47	.53	4.179	.000
	Father	149	3.28	.59		

While there was no significant difference between the MASP mean scores (t = 1.036, p >.05) and role as parents, a statistically significant difference was found between the PCMES mean scores (t = −1.505, p <.01) and role as parents in favor of mothers. Accordingly, mothers ($\bar{X}$ = 3.47) participated more in mathematics education than fathers did ($\bar{X}$ = 3.28) (Table 4).

Table 5. *One-Way Analysis of Variance (ANOVA) Results of the Educational Background of the Parents According to the Scale Scores*

Scales	Educational Background	N	Mean	Std. Deviation	Sum of squares	Mean square	F	p
MASP	Primary	157	2.18	.86	15.043	3.761	6.287	.000
	Middle	92	2.23	.85	637.626	.598		
	High	431	2.05	.72	652.669			
	Undergraduate	357	1.95	.78				
	Master's degree	34	1.63	.58				
	Total	1071	2.04	.78				
PCMES	Primary	157	3.38	.59	5.876	1.469	5.035	.001
	Middle	92	3.48	.61	311.062	.292		
	High	431	3.39	.58	316.938			
	Undergraduate	357	3.55	.44				
	Master's degree	34	3.41	.43				
	Total	1071	3.45	.54				

MASP [$F_{(4-1066)}$ = 6.287, p<.01] and PCMES [$F_{(4-1066)}$ = 5.035, p<.01]mean scoreswere found to have significant difference regarding the educational background of the parents (Table 5). The parents of primary ($\bar{X}$ = 2.18) and middle school ($\bar{X}$ = 2.23) students were specified to have higher mathematics anxiety compared with the parents of undergraduate ($\bar{X}$ = 1.95) and master's degree ($\bar{X}$ = 1.63) students. High school students also had higher mathematics anxiety than master's degree students. As to the participation of the parents in the mathematics education, it was concluded that the parents of undergraduates ($\bar{X}$=3.55) participated more in their children's education than the parents of primary ($\bar{X}$=3.38) and high school ($\bar{X}$ = 3.39) students.

Table 6. *One-Way Analysis of Variance (ANOVA) Results of the Parents' "Mathematics Knowledge Level" According to the Scale Scores*

Scales	Mathematics Knowledge Level	N	Mean	Std. Deviation	Sum of squares	Mean square	F	p
MASP	Low	130	2.61	.95	73.577	36.789	67.848	.000
	Intermediate	764	2.04	.72	579.091	.542		
	High	177	1.62	.60	652.669			
	Total	1071	2.04	.78				
PCMES	Low	130	3.16	.51	12.879	6.439	22.618	.000
	Intermediate	764	3.47	.54	304.059	.285		
	High	177	3.56	.50	316.938			
	Total	1071	3.45	.54				

MASP [$F_{(2-1068)} = 67.848$, $p < .01$]and PCMES [$F_{(2-1068)} = 22.618$, $p < .01$] mean scores were determined to have a statistically significant difference regarding the parents' level of knowledge in mathematics. The mathematics anxiety of the parents who considered their mathematics knowledge level to be low ($\bar{X} = 2.61$), was found to be higher than that of the parents who considered their mathematics knowledge level to be intermediate ($\bar{X} = 2.04$)' and high ($\bar{X} = 1.66$). In addition, the parents who considered their mathematics knowledge level to be intermediate ($\bar{X} = 2.04$) had a higher mathematics anxiety compared with the parents who considered their mathematics knowledge level to be high ($\bar{X} = 1.66$)'. Regarding their participation in the mathematics education, it was determined that the parents who considered their mathematics knowledge level to be intermediate ($\bar{X} = 3.47$) participated more in the mathematic education than the parents who considered their mathematics knowledge level to be low ($\bar{X} = 3.16$)'. It was also concluded that the parents who considered their mathematics knowledge level to be high ($\bar{X} = 3.56$)' participated more in the mathematics education than parents who considered their mathematics knowledge level to be low ($\bar{X} = 3.16$).

Table 7. *The Scores Obtained from the Scales: Independent Sampling t-Test Results "Is your child successful in the maths course?" asks the inquiry.*

Scale	Successful	N	Mean	S	t	p
MASP	Yes	784	1.92	.74	−8.199	.000
	No	287	2.35	.78		
PCMES	Yes	784	3.53	.50	8.126	.000
	No	287	3.23	.58		

There was a statistically significant difference between the MASP (t = −8.199, p<.01) and PCMES (t = 8.126, p <.01) scores in the answers provided for the question, "Is your child successful in the mathematics course?" Accordingly, the mathematics anxiety of the parents who considered their children successful in mathematics ($\bar{X} = 1.92$), was lower than that of the parents who considered their children unsuccessful in mathematics ($\bar{X} = 2.35$). In this regard, the participation of the parents who considered their children successful in mathematics ($\bar{X} = 3.53$) was specified to be higher than that of the parents who considered their children unsuccessful in mathematics ($\bar{X} = 3.23$).

Table 8. *The Scores Obtained from the Scales: Independent Sampling t-Test Results According to the question, 'Do you believe you are sufficiently assisting your child in mathematics?'*

Scale		N	Mean	S	t	p
MASP	Yes	764	1.92	.72	-8.328	.000
	No	307	2.34	.83		
PCMES	Yes	764	3.59	.49	14.481	.000
	No	307	3.10	.51		

There was a statistically significant difference between the MASP (t = −8.328, p <.01) and PCMES (t = 14.481, p <.01) scores in the answers provided for the question, "Do you think you help your child adequately in mathematics?" The mathematics anxiety of the parents who helped their children adequately in mathematics ($\bar{X} = 1.92$) were lower than that of the parents who did not provide adequate help to their children in mathematics ($\bar{X} = 2.34$). The participation of the parents who helped their children adequately in mathematics ($\bar{X} = 3.59$) was higher than that of the parents who did not provide adequate help to their children in mathematics ($\bar{X} = 3.10$).

The findings regarding the third problem are provided in Table 9.

Table 9. *Analysis of Pearson Product Moment Correlation The MASP and PCMES Scores are the results of the tests*

Scales	N	r	p
MASP PCMES	1071	-.097	.001

As can be understood in Table 9, an inverse and high relationship was specified between the MASP and PCMES ($r = -.097$; $p < .01$).

4. Discussion and Conclusion

After investigating the mathematics anxiety of the primary and middle school parents and their participation in the mathematics education, this research concludes that the parents with a low mathematics anxiety had a high participation in mathematics education. According to Kesici (2018), mathematics anxiety is transferred from parents to children, similar to a cultural inheritance. However, the low mathematics anxiety of the parents in this study may be considered a positive conclusion. In the investigation carried out by Metlilo (2017) who received the opinions of 300 teachers and 105 parents on participation in education, it was found that the participation of parents in education was high according to the teachers and was intermediate according to the parents.

The mathematics anxiety of parents was investigated in line with the grade level their children were enrolled in. Accordingly, there was no difference in the mathematics anxiety of parents of students from all grade levels, and primary school parents participated more in mathematics education than middle school parents did. It is considered that primary school parents participate in mathematics education more as they think that their children need more help in mathematics. Similar to this study, the research carried out by Metlilo (2017) also showed that the participation level of families in terms of their children's education was high in primary school and intermediate in middle school. Although the study conducted by Özcan (2016) specified that parents were mostly informed about what their children learned at school, this rate was low in middle school parents. The research performed by Yenilmez (2006) reported that the in-classroom participation level of families was higher in lower grade levels but decreased in the higher-grade levels. Many studies support this conclusion (Fa, et. al, 2017; Özcan, &Yıldız, 2016).

While there was no significant difference in parents' mathematics anxiety in their position as parents, it was found that mothers were more involved in their children's mathematical education than fathers. The higher participation of mothers can be due to the fact that they are more concerned about their children's homework. As found in this study, Yenilmez and Midilli (2006) reported that the mathematics anxiety of parents did not show a significant difference according to gender. In Dahmer's (2001) study of 66 parents, it was specified that the mathematics anxiety of parents did not have any significance in their role as parents. When examining another study investigating the participation of parents in mathematics education in their role as parents, Shumow and Miller (2001) concluded that the participation of mothers was higher than that of fathers. In a study by Deringöl (2020) who investigated the participation of families in mathematics education, mothers' attitude, interest regarding mathematics, and their participation in mathematics were higher than that of fathers. In the research conducted by Yenilmez (2006), it was determined that mothers participated in the mathematics education process more than fathers did, as in this study. In his study, Karan (2019) reported that there was a difference between mothers and fathers regarding their participation in their children's education process, and it was found that mothers were more involved in communicating with the school and teacher, supporting their children's homework and studies, participating in parents' self-development, voluntary active participation, communicating with their children, creating a home environment that supports learning, supporting their children's personality development, and participating in the educational process.

When examining the mathematics anxiety of parents regarding their educational background, it was concluded that the parents of primary school and middle school students had higher mathematics anxiety compared with that of the parents of undergraduate and master's degree students. The parents of high school students also had higher mathematics anxiety than the parents of master's degree students. As expected, the mathematics anxiety of parents decreases as their level of mathematics knowledge increases. This suggests that they consider themselves more competent in helping their children and are therefore more

able to help. Dahmer (2001) reported an inverse relationship between the parents' mathematics anxiety and their educational levels. In other words, as the educational levels of parents increase, their mathematics anxiety also decreases. Öztop&Toptaş (2019) determined that the mathematics anxiety of the parents with a lower educational degree was found to be higher compared with that of the parents with a higher educational degree. The parents with a university degree participated more in their children's education than the parents with primary school and high school degrees. This suggests that the higher their educational level, the more parents feel competent. Similar to the findings in this study, Şaban (2011) also reported that the parents with university degrees participated more in their children's education process than the parents with a primary school degree.

The mathematics anxiety of parents who considered their level of mathematics knowledge to be low were higher than that of the parents who considered their mathematics knowledge to be intermediate and high. In addition, the parents who considered their mathematics knowledge to be intermediate had higher mathematics anxiety than the parents who considered their mathematics knowledge to be high. According to Yenilmez&Midilli (2006), as the success of parents increase in their primary school years, their mathematics anxieties decrease. As to their participation in the mathematics education, the parents who considered their level of mathematics knowledge to be intermediate participated more in their children's mathematics education than the parents who considered their level of mathematics knowledge to be low. In addition, the parents who considered their level of mathematics knowledge to be high participated more in their children's mathematics education than the parents who considered their level of mathematics knowledge to below.

For the question, "Is your child successful in mathematics?," it was found that the parents who considered their children successful in mathematics had lower mathematics anxiety than those who considered their children unsuccessful in mathematics. Dahmer (2001) stated that parents' math anxiety has a negative relationship with their children's success in math. In a research of 595 students and their parents,carried out by Soni&Kumari (2017), they found that parents' mathematics anxiety affected their children's mathematics success, which is similar to the findings in this study. In this study, the participation of the parents who considered their children successful in mathematics was higher than those who considered their children unsuccessful in mathematics. Cruz (2012) reported that parental support and encouragement have a positive relationship with mathematics success. In the meta-analysis study carried out by Jeynes (2007) who examined 41 investigations on family participation, a positive relationship was found between the academic success of children and the participation of families in education. Shumow and Miller (2001) suggested that the parents of successful children participated more in school activities. In addition, in the research conducted by Caiet al. (1999) on the parents of 220 middle school students, they found that more supportive and participating parents affected their children's mathematics success and mathematics attitudes positively. To conclude, many studies have reported that the participation of parents in mathematics education is important in student success, as is also shown in this study (Dinç, 2017; Erbay, 2013; Fan & Chen, 2001; Voorhis, 2011; Vukovicet al., 2013; Yenilmez, 2006).

The mathematics anxiety of parents who helped their children adequately in mathematics is lower than that of the parents who did not help their children adequately in mathematics. The participation of the parents who helped their children adequately in mathematics is higher than that of parents who did not help their children adequately in mathematics. In a research conducted by Özcan&Yıldız (2016) who examined the opinions and participation of the parents in their children's mathematics homework, it was found that 59% of 206 parents supported their children properly, 37% partially supported their children, and 4% did not. It has been determined in many studies (Deringöl, 2019; Fantuzzoet al., 2004; Şaban, 2011) that parents showed a home-based participation, especially by helping their children with homework.

The purpose of this study was to see if there was a link between parents' math anxiety and their engagement in mathematics education. It was discovered that they have a high-level inverse connection.Accordingly, parents with a lower mathematics anxiety participated more in their children's mathematics education.

In conclusion, parents with a low mathematics anxiety are more willing to participate in their children's mathematics education, which is significant because parents have an important place in education. As carried out in this study, it is considered that the literature may be contributed by conducting the studies

determining not only the mathematics anxieties of parents but also specifying the mathematics anxieties of children. This research is a quantitative study on the mathematics anxiety of parents and their participation in their children's mathematics education. In this setting, qualitative research is believed to add to the discipline by allowing for a more comprehensive analysis.

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