

## **An Investigation of the Relationship between the Parents' Math Literacy Self-Efficacy and Their Math Anxieties\***

**Sümeýra AKKAYA<sup>1</sup>**

İnönü University

**Kübra POLAT<sup>2</sup>**

Sivas Cumhuriyet University

### **Abstract**

Mathematics anxiety can be defined as negative feelings towards mathematics and mathematical operations in general. Math anxiety is seen in many students, and even in parents. In fact, parents' own anxiety regarding mathematics may lead to their children experiencing angst over the subject as well. This can be a problem considering parents are considered one of the basic components of education and have important responsibilities to guide the education process of their children. Mathematical literacy is one of the research topics that have come into prominence in recent years due to PISA. Consequently, the purpose of this study is to determine the relationship between the parents' mathematical literacy self-efficacy and mathematics anxieties. Additionally, through examining the participation of parents in mathematic teaching during the COVID-19 pandemic, it is hoped to better understand their views and methodologies. All participants in this study are parents themselves. The study is designed with an explanatory sequential design among mixed method research designs. The grade in which the students are educated does not make any difference in the self-efficacy and anxiety perceptions of the parents regarding their mathematics literacy. Also, the parents' mathematical literacy self-efficacy and anxiety levels were high.

**Keywords:** Mathematics anxiety, self-efficacy of mathematical literacy, parents' participation, teaching, Covid-19

**DOI:** 10.29329/epasr.2022.442.11

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\* This paper was presented as an oral presentation at the XIII. International Congress of Educational Research on 03-06 September, 2020, Hatay, Turkey.

<sup>1</sup> Assoc. Prof. Dr. , Faculty of Education, Inonu University, Malatya, Turkey, ORCID: <https://orcid.org/0000-0002-9942-9848>

**Correspondence:** [sumeyra.akkaya@inonu.edu.tr](mailto:sumeyra.akkaya@inonu.edu.tr)

<sup>2</sup> Assist. Prof. Dr. , Faculty of Education, Sivas Cumhuriyet University, Sivas, Turkey, ORCID:, Email: <https://orcid.org/0000-0001-8060-0732>, [kubrapolaat@hotmail.com.tr](mailto:kubrapolaat@hotmail.com.tr)

## **Introduction**

Math anxiety is seen in many students and their parents. The reason for this concern may be derived from parents' lack of mathematical literacy or their own math anxiety. That being the case, it becomes important to investigate the relationship between mathematical literacy and math anxiety. Parents have been especially active in helping their children' math lessons during the COVID-19 pandemic. So, it is important to analyze this experience of parents who had to help their children in math lessons despite having math anxiety. In this context, the problem situation of the study is presented under the sub-headings of mathematics anxiety, mathematics literacy, and parents' contribution to teaching.

### **Mathematics Anxiety**

Mathematics anxiety can be defined as negative feelings towards mathematics and mathematical operations in general. As a matter of fact, mathematics anxiety is defined as an excessively emotional or physical reaction to a negative attitude towards mathematics (Nolting, 2012). Mathematics anxiety; is classified into three categories as mathematics test anxiety, numerical anxiety and abstraction anxiety (Nolting, 2012). There are many studies in the literature on children's mathematics anxiety (Cakir, 2015; Konca, 2008; Yildirim, 2017). The fact that such a wide array of studies have been conducted on the topic of math anxiety verifies the severity of the problem in students. Through examination of the different variables of math anxiety in Turkey, anxiety levels of teachers and students of mathematics, causes of math anxiety, math anxiety levels and studies about scale development, and its effect on mathematics anxiety of math topics important conclusions can be drawn (Baylan, 2020). Studies have indicated the factors that cause math anxiety are most often teachers, classmates, mathematics proficiency, negative experiences, and parents (Herts, Beilock & Levine, 2019; Mutlu, et al., 2018). In studies examining mathematics anxiety in terms of variables, a significant relationship was found between the educational status of the family and the child's mathematics anxiety (Konca, 2008; Saglam, 2019). On the other hand, there are not many studies on parents' math anxiety.

Math anxiety is seen in many students, but it is often evident in parents as well. As a matter of fact, Soni and Kumari (2017) state that parents can be more anxious regarding mathematics than children are, and the relationship between parents and children's math anxiety is significant. Nolting (2012) conducted a study that showed that parents who try to help with homework cause their children to experience math anxiety. As evidenced by the various studies, parents are among the primary factors that cause math anxiety in children. Accordingly, parents' anxiety about mathematics may cause their children to develop anxiety about mathematics (Mutlu et al., 2018; Oztop & Toptas, 2019). Therefore, when adults with math anxiety teach math to children, they unwittingly express their own angst on the topic. This, in turn, is likely to dissuade their children from enjoying math and

may actually lead them to avoid it altogether (Herts et al., 2019). Clearly, parents with math anxiety can unintentionally instill this anxiety in their children while trying to help them learn. On the other hand, families have to support their children both cognitively and affectively for mathematics lesson, especially during the distance education process.

Studies show that children of parents who experience fear or discomfort in mathematics tend to perform more poorly in mathematics achievement tests when compared to their peers (Arem, 2010; Herts, et al., 2019). It is important to analyze this through the lens of parents who had to help their children in math lessons despite having math anxiety. In addition, another factor that affects mathematics achievement is mathematics literacy (Efe Cetin & Mert Uyangor, 2019). Oguz Hacet and Demir (2019) in their research focus on, the effect of literacy education on literacy education, the relationship between access to information technology tools and mathematics literacy, the effect of literacy teaching on writing PISA questions, factors affecting the level of literacy, prediction skills and literacy relationship. They stated that adults' level of mathematical literacy, the effect of modeling on mathematics literacy, the relationship between arithmetic performance and mathematics literacy, the examination of mathematics curriculum programs in terms of mathematics literacy, the relationship between mathematics literacy and achievement, teacher candidates are subjects to develop mathematical literacy problems. In addition, many studies aimed at researching mathematics literacy of students (Aksu, 2019; Cilingir, 2015; Taskin, 2017), teachers (Genc, 2017), and prospective teachers (Kirmali, 2015) are present in the literature. When looking at the subjects, however, there are surprisingly few studies on parental literacy.

### **Self-efficacy of Mathematical Literacy**

The language of mathematics is complex and its relation to everyday language is far from simple (Solomon, 2009). However, individuals with mathematical literacy have the ability to relate mathematics to daily life, using it to make more sense out of the world around them. Self-efficacy beliefs of the students are related with mathematics achievement (Imer-Cetin, Timur & Timur, 2021). So, we can say that self-efficacy of mathematical literacy is important for overall achievement because it is related to the capacity of an individual to formulate, use, and interpret mathematics in various contexts and includes mathematical reasoning, using mathematical concepts, procedures, facts, and tools (OECD, 2013). We need mathematical thinking to solve the problems we encounter in daily life. It may be possible to ensure this occurs by raising "mathematical literate" individuals (Taskin, Ezentas & Altun, 2018).

Mathematical literacy is one of the research topics that have come into prominence in recent years due to PISA. As regards the PISA test results have demonstrated that related parents have led many researchers to basic math skills to adults and adults need to focus on arithmetic in Turkey (Atakli, 2011). The fact that lifelong learning has become one of the staples of developed countries

has revealed the importance of studies on adults' education. In addition, "New literacy studies" propose to consider literacy as a social practice rather than a technical skill (Yildiz, 2010). Therefore, conducting studies on math literacy in adults will help inform our understanding of it as a social practice. However, regarding the interpretation used and can be expressed as mathematical literacy mathematical knowledge can be said to be facing a lot of work to adults in Turkey. In Demir's (2019) study on adults' mathematical literacy, it was found that adults' self-efficacy beliefs were found to be at a good level, while Atakli's (2011) study found that adults' basic mathematics skills were low. There was no significant difference according to age, but there was to education. And it was determined that there was a difference in numerical and problem-solving skills in adults as well as students. Revealing adults mathematical literacy self-efficacy can contribute to adults use of mathematical skills in their daily lives and have an impact on their children's mathematical literacy. As a matter of fact, as stated in the previous sections, parents actively participated in their children's education during the distance education process and had to use the language of mathematics.

### **Parents' Participation in Teaching**

The education of most children starts in the family with parents as the first teachers. With the beginning of formal education, while the teacher takes the place of the parent, the child participates in a learning process that will continue at home, at school and in out-of-school learning environments. For this reason, parents are considered one of the basic components of education and have important responsibilities to guide the education process of their children (Sarigol, 2019).

The education process, which normally originates in the physical classroom environment, was forced to adapt to distance learning programs as of March 23, 2020, with the beginning of the COVID-19 pandemic. With this distance education process being implemented, the responsibilities of parents regarding their children's participation in the learning process have increased, and the education has turned into a triple-legged structure consisting of teacher-child-parent participation. As the responsibilities of teachers increased, the responsibilities of parents and of the child who continues his/her education at home have also increased. In fact, parents who began trying to make contributions to their children's homework have had to participate in the learning processes as well.

Math performance is adversely affected when parents cannot provide sufficient support to their children in homework (Herts, et al., 2019). Parents who have had to provide the bulk of the mathematics support during distance education often find that they are not well enough equipped to guarantee their child is learning, which certainly affects the potential for future mathematics achievement. Studies show that not only children have math anxiety, but their parents have math anxiety as well (Herts, et al., 2019); and math anxiety of the family can be transferred to the child as a fear of math. This condition in the child may be due to insufficient family support (Oztop & Toptas, 2019). Therefore, it is important to reveal the variables with which the parents' math anxiety is

associated. In examining the literature regarding these variables, there is no sign of any research examining the relationship between mathematics literacy and mathematics anxiety. Through this study, we hope to reveal the relationship between parents' mathematical literacy and mathematics anxiety and to answer the question of what can be done to prevent this negative development. Parent interviews will be the primary source of data. The relationship between the mathematics literacy and mathematics anxiety of the parents was examined; and a main goal for the interviews with the parents was to reveal their concerns and experiences in terms of their participation in the teaching process.

In this context, the purpose of this study is to determine the relationship between the parents' mathematical literacy self-efficacy and mathematics anxieties, and to determine the views of the parents regarding their participation in mathematics teaching during the COVID-19 pandemic. The aim is to reveal the effect of parents literacy self-efficacy related to mathematics on their children's mathematics anxiety and their parents' participation in the education process. We hope that presenting the views of parents who have had to be active participants in their children's ongoing education will contribute to future studies. Sub-problems determined for the purpose of this study are:

- What is the parents' level of mathematical literacy self-efficacy and mathematics anxiety?
- Is there a significant difference between parents' mathematical literacy self-efficacy and mathematics anxiety levels and their children's grade level variable?
- Is there a significant difference between the parents' mathematical literacy self-efficacy and mathematics anxiety levels and the variable of education levels?
- Is there a relationship between parents' mathematical literacy self-efficacy and mathematics anxiety levels?
- What are the effects of parents on their children's mathematics teaching during the pandemic? What are the parents' opinions regarding their children's concerns about mathematics teaching?
- What are the parents' views on their children's participation in mathematics education in the distance education process during the COVID-19 pandemic?
- What are the mathematics teaching resources that parents have benefited most from during the COVID-19 pandemic?

## **Method**

### **Research Design**

For quantitative data, the Parental Math Anxiety Scale and self-efficacy scale for mathematics literacy were applied to the participants. Then, semi-structured interviews were conducted with the participants to collect qualitative data. In this study both quantitative and qualitative data collection tools were used. The study is designed with explanatory sequential design among mixed method research designs.

In explanatory sequential design researchers collect the quantitative and qualitative data at different times. According to this design, quantitative data are obtained first, then qualitative data are ascertained to explain the results from the quantitative data more deeply (Creswell, 2007).

### **Participants**

Participants in this study are parents. According to the G power analysis, the number of samples was determined as 204. Data collection tools of the study were applied to 394 parents. According to G power analysis, this number is quite sufficient. In the quantitative part, scales were applied to parents whose children were at the grade of 1-4, and in the qualitative part, parents whose children were at the grade of 1-8 were interviewed.

### **Data Collection Tools**

#### ***Parental Math Anxiety Scale***

The Parental Math Anxiety Scale, one of the quantitative data collection tools utilized in the study, was developed by Mutlu et al. (2018). The scale is a five-point Likert-type scale and has three sub-dimensions: enjoyment, usefulness, and anxiety. It consists of a total of 16 items: 6 in the observed emotions regarding mathematics, 6 in the perception of inadequacy in mathematics, and 4 in the sense of difficulty in mathematics. Mutlu et al. (2018) found the reliability coefficients to be as follows: 0.75 for the observed emotions regarding mathematics dimension, 0.85 for the perception of inadequacy in mathematics dimension, and 0.88 for the sense of difficulty in mathematics dimension. In addition, the researchers calculated the reliability coefficient for the entire scale to be 0.90.

#### ***Self-Efficacy Scale for Mathematics Literacy***

The second quantitative data collection tool employed in the study was the Self-Efficacy Scale for Mathematics Literacy developed by Ozgen and Bindak (2008). The scale is a five-point Likert-type scale consisting of one dimension with 35 total items. Ozgen and Bindak (2008) calculated the reliability value of the scale as 0.942.

### ***Semi-structured Interview Form***

To obtain the quantitative data, a semi-structured interview form was prepared by the researchers. The interview form contained information belonging to the parents and their children (age, gender, education level, career, and grade level of their children). There were 8 open-ended questions and 17 follow up questions.

### **Validity and Reliability Data Collection Tools**

For the reliability of quantitative part of the study, the Croanbach alpha values obtained from the Attitude Towards Geometry Scale were examined. During the pre-test applications, the Croanbach alpha value obtained from the enjoyment dimension of the scale was 0.84. From the usefulness dimension the alpha value was 0.29, and from the anxiety dimension it was 0.54. On the other hand, the Croanbach alpha values obtained from the post-test application of the scale were 0.91 for the enjoyment dimension, 0.42 for the usefulness dimension, and 0.39 for the anxiety dimension. It is thought that the low reliability values obtained from the usefulness and anxiety dimensions of the scale were due to the low number of items in these dimensions. Research confirms that reliability values will be low in cases where the number of items is less than ten (Fraenkel & Wallen, 2006). The Croanbach alpha value of the whole scale, however, was calculated as 0.84 for the pre-test and 0.90 for the post-test. These values are at an acceptable level for reliability (Fraenkel & Wallen, 2006).

Furthermore, the Croanbach alpha values obtained from the Self-Efficacy Scale for Geometry were also examined. In the pre-test application of this study, the reliability coefficient value obtained for the positive self-efficacy beliefs dimension of the scale was 0.89; for the usefulness of geometrical knowledge dimension, it was 0.63; and for the negative self-efficacy dimension, the reliability coefficient value was 0.60. The whole scale scored 0.91 for its reliability coefficient value. When the values obtained from the post-test applications were examined, the reliability coefficient value obtained for the positive self-efficacy beliefs dimension was 0.86; the usefulness of geometrical knowledge was 0.82; the negative self-efficacy dimension was 0.89; and the whole scale was calculated as 0.94. These values are thought to be sufficient according to Fraenkel and Wallen (2006).

To confirm the validity of the inferences resulting from the qualitative data and the analysis process of the data were presented in detail. Since the coding was made by two different researchers, the reliability between these encoders was checked to make sure the inferences were consistent. As suggested by Miles and Huberman (1994), the percentage of agreement was checked. As a result, the agreement rate between the opinions of the two researchers was determined as 0.89.

### **Data Analysis**

In the study, parents' mathematical literacy self-efficacy levels and mathematics anxiety were considered dependent variables, and grade level and education level were considered independent

variables. Since the differentiation of two dependent variables according to the categories of independent variables was investigated, multivariate analysis of variance (MANOVA) was used to keep the amount of error at the lowest level.

Before starting the analysis, the data were examined in terms of missing and extreme values, and a normality test was performed. After editing the data, the assumptions required for MANOVA were tested and the results were reported.

No missing data was observed in the study. When the Z values for the extreme value were calculated, the value out of +3 and -3 was not observed. According to the Kolmogorov Smirnov test result applied for the normality test, mathematical literacy self-efficacy variable (MÖKS=.047,  $p < .05$ ) and mathematics anxiety variable (MKKS=.105,  $p < .05$ ) did not show normal distribution, but when the coefficients of skewness were examined, (self-efficacy; -.347, anxiety; -.562) it was observed that there was a distribution close to normal.

Mahalanobis distance values were calculated to test the assumption of multiple normality from the assumptions required for MANOVA (Pallant, 2005; Tabachnick & Fidell, 2007). Although Mahalanobis p value is less than .001, it is an extreme sign (De Maesschalck, Jouan-Rimbaud & Massart, 2000), as it was observed that all p values of variables are higher than .001. Multiple normality was provided for the variables in the study. When the Levene test was examined for the homogeneity of the variances, it was determined that the p values of the mathematical literacy self-efficacy and mathematics anxiety dependent variables were over .05 in the grade level and parental education level categories (Field, 2009). Box's M test, which is very sensitive for the homogeneity of another assumption, variance-covariance matrices, was examined. And .001 was taken as a significance criterion because it is a sensitive test (Tabachnick and Fidell 2012). It was noted that the covariance matrices, which is the H0 hypothesis, were equal ( $p < .001$ ) (Secer, 2015). The correlation between variables was examined for the multiple normality test. Tabachnick and Fidell (2012) stated that a relationship of less than .90 between variables provides the assumption of multiple linearity. Since the correlation coefficient between the two dependent variables was .36, the assumption was satisfied.

## Results

The dependent variables (Parental Mathematical Literacy Self-Efficacy Level and Mathematics Anxiety Level) in each category of the grade level and parental education level were examined in order to discern significant differences. It was aimed to keep the margin of error to a minimum by applying one-way MANOVA. Analysis results were reported to observe the change of dependent variables under each independent variable.



### MANOVA Results of Parents' Mathematical Literacy Self-efficacy and Mathematics Anxiety Levels and Grade Level Variable

First, the significance of the Wilks' Lambda value was analyzed in order to observe whether or not the dependent variables (Mathematical literacy self-efficacy and Mathematics anxiety) in the study differ according to the four-category grade level variable. In general, it is the most preferred index in the absence of small sample, unequal groups and assumption violations (Tabachnick & Fidell, 2012). The Wilks' Lamda index was interpreted due to the fact that the sample size between groups was very close and variations were provided in the study. The test result revealed that the parents' mathematical self-efficacy level and mathematics anxiety linear combinations did not show a significant difference in terms of grade level (Wilks' = .986,  $F(3, 370) = .886$ ,  $p = .505$ ). Moreover, it is said that mathematics literacy self-efficacy and mathematics anxiety behavior are similar among the parents of 1st grade, 2nd grade, 3rd grade and 4th grade students. Descriptive statistics and single-factor ANOVA results according to the class levels of the variables are presented in Table 1.

**Table 1. One-factor ANOVA results for parents' Math literacy self-efficacy and Math Anxiety Levels and grade level variable**

Dependent Variable	Class Level	n	$\bar{X}$	SS	Sd	F	p
Math Self-Efficacy	1st Grade	117	3.67	.57	3-370	1.435	.232
	2nd Grade	98	3.76	.64			
	3rd Grade	92	3.67	.66			
	4th Grade	87	3.64	.62			
Math Anxiety	1st Grade	117	3.77	.93	3-370	.713	.545
	2nd Grade	98	3.64	1.05			
	3rd Grade	92	3.61	1.00			
	4th Grade	87	3.54	.96			

As seen in Table 1, according to the results of one-factor ANOVA for Mathematics literacy self-efficacy and Math Anxiety Levels of the parents, self-efficacy ( $F_{3-370} = 1.435$ ,  $p > .05$ ) and anxiety ( $F_{1-370} = .713$ ,  $p > .05$ ) variables do not differ significantly between grade level categories. Since the difference is not significant, the effect size is not mentioned. It does not make a difference in parents' perceptions of self-efficacy and anxiety regarding mathematical literacy in the grade of students. Parents whose students attend primary school demonstrate similar anxiety and self-efficacy behaviors. When the average and standard deviation values according to the class level are examined, it can be said that the group mean and standard deviation values are similar. When the averages are examined on scales scored between 1 and 5, the mathematics literacy self-efficacy levels of the parents vary between 3.64 and 3.76. That is, they show a high level of self-efficacy behavior. Likewise, anxiety level average scores range between 3.54 and 3.77. In other words, the anxiety levels of the parents are also quite high.

According to qualitative findings, the reasons for parents' high anxiety levels are not only related to the level of self-efficacy, but also the inability to spare time for the child as a result of the increased workload during COVID-19. In addition, parents say they cannot get down to the level. Since the math program builds on the foundation one year at a time, parents do not struggle in the beginning, but they start to have problems towards high school.

Parents with mathematical competence state that they do not have any difficulties in terms of both mastering the subjects and supporting the child in mathematics. In this sense, we can say that parents with mathematical competence think their mathematical literacy self-efficacy is high.

### **MANOVA Results Regarding the Education Level Of Parents' Mathematics Self-Efficacy and Mathematics Anxiety Levels**

Parental education status was considered as primary school, secondary school, high school, associate degree, undergraduate and graduate; and Pillai's trace value was examined as a result of the MANOVA test, in which the significant difference was tested for the educational status variable. Pillai's trace is considered to be one of the most powerful statistics ranging from 0 to 1 (Olson, 1974). Unequal groups are preferred because of the small sample size and the fact that they are more resistant when variance homogeneity is violated (Tabachnick & Fidell, 2012). In the study, Pillai's trace value was examined because the parental education status was not evenly distributed among primary school, secondary school, high school, associate degree, undergraduate and graduate (58, 44, 84, 38, 147, 23, respectively) categories. It was observed that the linear combinations of mathematical literacy self-efficacy and anxiety variables differed significantly in terms of parental education level (Pillai = .222,  $F(5, 370) = 9.25$ ,  $p = .000$ ). The results of one-way ANOVA conducted to examine the differences of dependent variables according to education level are given in Table 2.

**Table 2. Differences of Dependent Variables according to Education Level**

Dependent Variable	Parental Educ. Lv.	n	$\bar{X}$	SS	Sd	F	p	h2	Difference
Mathematical Literacy Self-Efficacy	Primary S.	58	3.45	.74	5 - 370	10.51	.000	.124	Postgrad Primary, Secondary, High
	Secondary S	44	3.47	.66					
	High S.	84	3.52	.52					
	Assoc.Degree	38	3.75	.58					
	Undergrad	147	3.87	.56					
	Postgrad	23	4.04	.42					
Math Anxiety	Primary	58	2.95	1.02	5 - 370	15.85	.000	.176	Postgrad- Primary, Secondary, High
	Secondary	44	3.12	.96					
	High	84	3.48	.97					
	Associate Dg	38	3.89	.77					
	Undergrad	147	4.03	.81					
	Postgrad	23	4.16	.85					

As seen in Table 2, the differences observed in the educational status categories of mathematics literacy self-efficacy ( $F_{5-370} = 10.51, p < .05$ ) and mathematics anxiety ( $F_{5-370} = 15.85, p < .05$ ) are significant at .05 level. Furthermore, 12% of the mathematics self-efficacy variable ( $h^2 = .124$ ) and approximately 18% of the anxiety variable ( $h^2 = .176$ ) are explained by the educational status variable.

When the direction of the difference is examined, the mathematics literacy self-efficacy levels of the parents with graduate education ( $X = 4.04$ ) is higher than parents at the primary school ( $X = 3.45$ ), middle school ( $X = 3.47$ ) and high school ( $X = 3.52$ ) education levels. That is, parents with graduate degrees consider themselves more competent in terms of mathematics compared to primary, secondary and high school graduates. Likewise, parents whose educational background is undergraduate ( $X = 3.87$ ) have higher levels of mathematics literacy self-efficacy compared to parents with a primary school ( $X = 3.45$ ), middle school ( $X = 3.47$ ) or high school ( $X = 3.52$ ) education level. Self-efficacy levels of parents with associate degree education ( $X = 3.75$ ) do not differ from other groups. Postgraduate and graduate parents also have similar behavior in terms of mathematical literacy self-efficacy.

For the mathematics anxiety variable, parents whose education level is graduate ( $X = 4.16$ ); primary school ( $X = 2.95$ ), secondary school ( $X = 3.12$ ) and high school ( $X = 3.48$ ) education level is higher than parents. Parents with undergraduate education ( $X = 4.03$ ) have higher anxiety levels when compared to parents with primary school ( $X = 2.95$ ), middle school ( $X = 3.12$ ) and high school ( $X = 3.48$ ) education. Parents at associate degree education level ( $X = 3.89$ ) are more anxious than parents with primary school ( $X = 2.95$ ) and secondary school ( $X = 3.12$ ) education. While parents at graduate ( $X = 4.16$ ), undergraduate ( $X = 4.03$ ) and associate degree ( $X = 3.89$ ) levels have similar anxiety levels, parents of primary school ( $X = 2.95$ ), middle school ( $X = 3.12$ ) and high school ( $X = 3.48$ ) education levels also have similar math anxiety levels.

When the different education levels are examined, the data shows that as the education level increases, the mathematics literacy self-efficacy increases. On the other hand, parents with higher self-efficacy also have higher math anxiety levels.

The correlation coefficient between mathematics literacy self-efficacy, mathematics anxiety and parental education status is given in Table 3. While the Pearson correlation coefficient of mathematics literacy self-efficacy and mathematics anxiety are variable at the level of equal intervals and show normal distribution, the educational status was interpreted with Spearman's Rho correlation coefficient because it was at the level of the ranking scale.

**Table 3. Correlation Coefficient Results Regarding the Variables of Mathematics Self-efficacy, Mathematics Anxiety and Parental Education Level**

	Anxiety		Education Level	
	Pearson	p	Spearman's rho	p
Self-Efficacy	.404	.000	.295	.000
Education Level	-		.425	.000

As seen in Table 3, there is a meaningful medium-positive ( $r = .404$ ,  $p < .05$ ) relationship between mathematics literacy self-efficacy and mathematics anxiety levels. In other words, as the mathematics literacy self-efficacy of parents increases, a moderate increase is observed in their level of anxiety about mathematics. When this relationship is examined with educational status, there was a positive medium ( $\rho = .295$ ,  $p < .05$ ) relationship between educational status and self-efficacy and a positive medium ( $\rho = .425$ ,  $p < .05$ ) level relationship between anxiety. As the education level of the parents increases, their mathematics self-efficacy behaviors increase at a moderate level and their mathematics anxiety levels increase at a moderate level. The most feasible interpretation for this is that parents with high mathematics self-efficacy are more anxious as they possess a higher knowledge of mathematics subjects and, therefore, have higher awareness of the abstract and difficulty of teaching these subjects.

There is a requirement of mathematical competence in the calculation of verbal, equal weight and the numeric field in the ALES exam, which is a prerequisite for starting postgraduate education in Turkey. In this context, parents' graduate education is also an indicator of their math competence. As a matter of fact, according to qualitative findings, parents who have postgraduate education think that their mathematical self-efficacy is sufficient.

### **Findings Regarding Parents' Views On Their Children's Participation in Mathematics Teaching In The Distance Education Period During the COVID-19**

Ten parents were interviewed with questions related to their children's participation in mathematics education during the distance education process during the COVID-19 pandemic. As a result of the interviews, the themes of parental support, sources of anxiety of the child, mathematics sources used and parental influence were formed. The theme of parental support was analyzed under mathematical competence, parental division of labor, child's grade level, teacher support, anxiety and time codes. The theme of the sources of anxiety of the child was examined under the codes of not being anxious, anxieties originating from the child, anxieties originating from the parent, and concerns originating from the distance education process. The theme of mathematics resources which provided benefit was examined under platform, material, and course codes. The parental influence theme was examined under positive and negative codes.

**Table 4. Findings Regarding Children's Opinions on Participation in Mathematics Teaching in the Distance Education Process in the COVID-19 Period**

Theme	Code	Frequency	Sample Statement
Parental Support	Mathematical Competence	10	I guess I'm not good enough because of my education level. I do not have a grasp of the subjects that my child is dealing with in mathematics. (E4) Yes, I think I can be of sufficient support. I do my best with homework and school math. As a math educator, I know what a child can achieve. (E5)
	Parent division of labor	3	Since we usually solve the problems in distance education, my husband sometimes supports me either when I am available or because my wife is good at math. (E7)
	Child's grade level	6	I understand at this stage, but I don't think I can understand after 8th grade. There are subjects and concepts that I have been familiar with until now. However, I know that after 8th grade, there will be concepts that I am not very familiar with. (E8) I was familiar with the subjects at 1st grade. For instance, they had recently learned the whole concept of half-quarters. We practiced this with the items in the house. (E9)
Teacher support		9	I cannot say that I have contacted the teacher. I am a math educator, and I took care of the situation myself. If I couldn't find a solution, maybe I could have contacted the teacher. (E5) Sometimes there are wrong questions. In such cases, I contacted him. The teacher gives extra tests to aid the child, and we also contribute. That is parent-teacher collaboration. But we can help him advance to a the next level. (E10)
Anxiety		4	Not mathematically, but I'm worried about whether I can catch up to his level. I have difficulties because I do not receive any pedagogical formation and always learn advanced mathematics. (E6)
Time		5	We are currently running live classes at home and planning and organizing homework. Since these are the things that I have to control, there is inevitably no time to do other mathematical activities. (E5) I think I cannot support much due to my working hours. (E9)
Child's Sources of Anxiety	Absence of anxiety	7	Both of my children are very good at math. (E1)
	Anxiety of based-child	3	He had anxiety. Or rather, the level of anxiety increases as he moves on to different subjects, particularly subjects he does not know. (E5) He thought he couldn't do math. We go to a psychologist to work on this issue. (E8)
	Anxiety based-parents	3	Daily hustle and bustle and not being able to spare time led to anxiety for me. Actually, this is a very good process in terms of helping the child. But it doesn't always take place because we have other responsibilities. (E5)
	Concerns based from distance education	3	Mathematics is not a branch to be taken by distance education, especially for children at this age. When I explain the issues he encounters for the first time, the learning process takes longer. (E7)

Used Mathematical Resources	Platform	9	No. I'm not taking advantage of internet. They were exposed to computers due to an intensified distance education. (E3) I don't use it, but I'm searching (E6) Morpa Campus and EBA (E10)
	Materials	10	Until recently my son did not understand the concepts of whole and half. I use household materials, such as apples. (E1) Ruler, compass and meter (E2) There are many resource books and entertaining materials. (E8) Objects for counting, length measures, beads, meter, tape measure (E9)
	Courses	3	I can direct to private lessons or to his/her mother. (E2) Some of our relatives are math teachers. I contact them when needed. (E4)
Influence of Parents	Positive	10	I was emotionally relieved. Apart from that, I helped him with his homework when he did not understand. (E5) It has contributed positively. We do repetitions. I supported him because there was distance education where he was lacking. (E6)
	Negative	3	There were times when our patience as parents was inevitably weakened. Maybe I made him feel a little anxious when he struggled with things. I expected him to learn more easily. (E5) We may be overdoing it a little. (E9)

Table 4 shows that some of the parents consider themselves as mathematically competent, while others do not. Parents who consider themselves competent stated that they can support their children, but those who do not consider themselves as competent concluded that they cannot provide sufficient support to their children. Some of the parents said that they divide the work to provide support to their children.

There are parents who express that they can or cannot provide sufficient support according to the grade level of the child. Parents who think that they will not be able to master the subjects, especially in classes to come, think that they will have difficulty in providing support to their children.

Some parents contacted the teacher during the distance education process and others did not. Parents contact the teacher to get advice from the teacher for the resource book and to consult the erroneous questions. Parents who did not contact the teacher stated that they chose not to because they could handle the problems on their own.

It is also noted that some parents have difficulty supporting their children due to lack of time. In other words, the increased workload of parents throughout this process sometimes prevented them from providing adequate support to their children. It has also been observed that the sources of anxiety in the child may originate from the child himself, from the parent or from the distance education process. Parents who think that their children are not anxious stated that they are not anxious because their children love mathematics.

Parents who did not want to expose their children to more computer screens during the distance education process stated that they did not benefit from any platform in their children's education. Conversely, there are parents who use platforms such as MORPA, EBA, YouTube; or even if they do not use these applications themselves, they may consider them as suitable platforms for their children.

In the interviews, parents discussed positive and negative effects. Positive effects are generally stated as helping their children when they do not understand and applying repetition for further understanding. In addition, parents stated that motivating and emotionally supporting their children in this process was a positive effect. The negative effects were identified as the parents' decrease in patience, taking care of their children, and the child's inability to understand based off of the parent's explanation.

### **Related Qualitative and Quantitative Findings**

1. Parents demonstrated a high level of self-efficacy behavior (Table 1). When the difference between quantitative findings and educational status is examined, as the level of education increases, mathematical literacy self-efficacy increases. This was also confirmed in the qualitative interviews. Parents who study numeracy have an especially high self-efficacy in mathematics.
2. The quantitative part of the study was conducted among parents whose children attend primary school, and there was no significant difference according to grade level. In the qualitative findings, there was no anxiety related to support in parents whose children attend to primary school. However, the interview with parents (E4) whose child attends secondary school showed that there is a difference between primary and secondary school in terms of contribution.
3. According to quantitative findings, parents' anxiety levels are high (Table 1). In the qualitative portion of the study, it was observed that the parents of primary school children were not very concerned about this period, though they were concerned about the following periods.
4. According to quantitative findings, parents with higher self-efficacy tend to have higher math anxiety levels, though no inquiry was made regarding the fields of the parents. However, in the qualitative interviews, they stated that those who were in the numerical field had high self-efficacy in mathematics.

### **Discussion, Conclusion and Recommendations**

According to the quantitative findings, no significant difference has been found between the variables of mathematics literacy, self-efficacy and mathematics anxiety and grade level categories. That is, the grade in which the students are educated does not make any difference in the self-efficacy and anxiety perceptions of the parents regarding their mathematics literacy. Therefore, parents whose students attend primary school exhibit anxiety and self-efficacy behaviors. This result coincides with the result of Oztop & Toptas's (2019) study. One possible reason for this may be the absence of a centralized examination in the transition from primary school to secondary school. As a matter of fact, it has been seen in studies conducted with students that math anxiety is higher at grade levels with central exams (Dursun & Bindak, 2011; Oksal, Durmaz & Akin, 2013). In accordance with the qualitative findings of the study, parents have low anxiety and high self-efficacy at the primary school level because they do not expect difficulty in explaining the subjects. However, they expressed that this situation would change in the following grade levels. Actually, interviews with the parents who have a child at the secondary school level confirm this.

There are studies in the literature that show an adverse relationship between students' self-efficacy and anxiety (Ipek, 2019; Turkmenoğlu & Yurtal, 2020). As for the quantitative findings of this study, it has been observed that the parents' mathematical literacy self-efficacy and anxiety levels were high, and as the parents' mathematical literacy self-efficacy increased, there was a moderate increase in their math-related anxiety levels. In the results of PISA (2012), unlike other countries, Turkish students have high self-efficacy and self-confidence, despite the fact that their anxiety level is normally higher (Usta, 2016). One of the reasons for this may be that parents greatly affect their children's anxiety and self-efficacy. As a matter of fact, there are studies in the literature showing that anxiety is high in both parents and children and that parents' anxiety affects children's anxiety (Kesici, 2018; Sarigol, 2019; Soni & Kumari, 2017; Vukovic, Roberts & Green Wright, 2013). The qualitative findings have indicated that the reasons for the high levels of anxiety of the parents were not only related to the level of self-efficacy, but also the inability to spare time for the child due to the increased workload during the pandemic. However, it is also known that parental support is effective when it comes to children's academic success (Herts, et al., 2019; Vukovic, Roberts & Green Wright, 2013). Therefore, it can be recommended to analyze the difference in mathematics achievement of children who received and did not receive parental support during the distance education brought on by the spread of COVID-19. In addition, parents occasionally point out that they cannot get down to their children's level. The failure of parents to catch up to the math level of their children can cause anxiety and failure in the child. For this reason, studies should be carried out to provide pedagogical support to parents. Indeed, some parents have said that when they try to explain the subjects and their children do not understand, they are also negatively affected. Also, some parents want to benefit from various educational platforms to support their children.



In quantitative findings, the differences observed in the educational status categories of the variables of mathematical literacy, self-efficacy and mathematics anxiety are remarkable. In other words, postgraduate and graduate parents consider themselves more competent in mathematics than primary, secondary and high school graduates. When compared to parents with primary, secondary and high school education, parents with a bachelor's degree similarly have higher mathematical literacy self-efficacy levels. Self-efficacy levels of parents with an associate degree education do not differ from other groups. Besides, graduate and undergraduate parents also have similar behavior in terms of mathematical literacy self-efficacy. Qualitative findings support the quantitative data. As a matter of fact, the qualitative findings, especially parents with graduate education think that their mathematical self-efficacy is sufficient. The reason for this likely has to do with the mathematical proficiency requirement in the calculation of verbal, equal weight and numerical scores in the ALES exam, which is a prerequisite for starting graduate education. In this respect, having a postgraduate education is also an indicator of parents' mathematical competence. Parents with high mathematics proficiency state that they do not have any problems in terms of both mastering the subjects and supporting the child in mathematics. In this sense, we can say that parents with mathematical competence think that their mathematical literacy self-efficacy is high. It has been observed that parents who studied mathematics in particular were more confident in the field. Many studies have shown that the education level of parents has an effect on mathematics self-efficacy and anxiety (Demir, 2019; Konca, 2008; Ozgen & Bindak, 2011; Saglam, 2019).

As for the mathematics anxiety variable in the quantitative findings, parents with a graduate level of education; primary, secondary and high school education levels are higher than parents. Parents with an undergraduate education have higher levels of anxiety compared to parents with primary, secondary, and high school education. Parents at the associate degree education level are more anxious when compared to parents at primary, secondary, and educational level. While parents at graduate, undergraduate and associate degree levels had similar anxiety levels, primary, secondary and high school educated parents also have similar math anxiety levels. That is, when the difference of the education level is examined, as the education level increases, mathematical literacy self-efficacy increases. On the other hand, parents with higher self-efficacy also have higher math anxiety levels. The underlying reason is that parents with high mathematics self-efficacy are more aware of mathematics subjects, and so they are more aware of the difficulty of teaching these subjects. This demonstrates that they are more anxious. In addition, according to Vukovic, Roberts & Green Wright, (2013), parents do not cause anxiety in their children because they do not try to provide support in higher mathematics subjects. In other words, parents with high self-efficacy may be worried based off of their experience with these issues and may think that they need to explain to the children. On the other hand, according to Oztop and Toptas's (2019) study, parents who graduated from a lower educational level were more anxious than those who graduated from a higher one.

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