Pegem Journal of Education and Instruction, Vol. 11, No. 4, 2021 (pp. 177-184)

RESEARCH ARTICLE WWW.PEGEGOG.NET

Development and implementation of mathematics attitudes scale for the primary and secondary students

Mehmet GÜLBURNU[1*], Kenan YILDIRIM[2]

[1]Ministry of Education, Mersin, Turkey

[2]Ministry of Education, Gaziantep, Turkey

Abstract

This study was aimed to develop an instrument to measure primary and secondary school students' attitudes toward mathematics and to find the underlying dimensions that comprise the attitudes toward mathematics. In addition, it was aimed to examine students' attitudes towards mathematics in terms of gender and grade level variables. For this purpose, a five-point Likert-type instrument consisting of 27 items to measure students' attitudes towards mathematics was prepared and applied. The validity and reliability of the instrument were made on the data obtained from 328 students selected by random sampling method among primary and secondary school students. As a result of the factor analysis performed to determine the construct validity of the instrument, it was seen that the factor loads of the scale items ranged from 0.44 to 0.75, the Kaiser-Meyer Olkin (KMO) value was .89, and the internal consistency coefficient (Cronbach alpha) value calculated for the reliability study was α=.88. In addition, principal components factor analysis with varimax (orthogonal) rotation applied to find the sub-dimensions of the instrument revealed five factors: (1) in-class; (2) the nature of mathematics; (3) problem solving; (4) understanding and (5) self-efficacy. Findings related to validity and reliability studies show that the instrument has a valid and reliable structure. In addition, as a result of the application of the instrument, it was concluded that the mathematics attitudes of the students did not differ according to gender, but there was a significant difference in terms of grade level.

Keywords: Primary school, secondary school, mathematics attitude, attitude scale

Introduction

Mathematical knowledge includes the skills of counting, calculating, measuring, which are used to solve problems encountered in daily life, and the ability to open up to the world with logical thinking and expand the horizon of life. Therefore, mathematics, which has a wide application area from preschool to higher education, is of great importance in education. However, mathematics is one of the areas that students are most afraid of or have problems within their education life (Tıraş, 1999; Taşdemir, 2009). It can be thought that the effect of mathematics attitude, which started to form especially in primary and secondary school years, played a role in the formation of this perception in students. As a matter of fact, mathematics depends not only on cognitive abilities but also on emotional factors and attitudes (Dowker, Bennett & Smith, 2012). Every person has thoughts and attitudes about mathematics. Attitude can be defined as the tendency of individuals to react positively or negatively towards a certain object. Attitude towards mathematics is explained as the individual's positive or negative reaction to mathematics (Papanastasiou, 2000).

Researchers who participated in the development of an attitude scale towards mathematics were mostly concerned with pleasure or anxiety (Aiken, 1974; Michaels & Forsyth, 1978; Shashaani, 1995). Different psychometric procedures were applied in the creation of attitude measures used in such studies. The aspect of attitude evaluated with these tools usually includes only one of the effective goals of mathematics teaching (McCallon & Brown, 1971; Aiken, 1974). Therefore, when the scales used to measure mathematics attitudes are examined, it can be said that only certain sub-dimensions (such as anxiety, etc.) come to the fore (Tapia, 1996; Tapia & Marsh, 2004). Considering that attitude is a cognitive, affective, and behavioral reaction that an individual organizes based on his or her experience, motivation, and knowledge towards any social subject, object, or event around him (Saracoğlu et. al., 2004), there is a need for more up-to-date and comprehensive sub-dimensions in determining attitudes towards mathematics. Indeed, studies show that there are more significant relationships between mathematics attitude and students' self-evaluation scores than anxiety (Dowker, Bennett & Smith, 2012). In this context, it can be said that the scale developed in the current study will contribute to the emergence of more comprehensive sub-dimensions related to mathematics attitudes.

Corresponding Author e-mail: mehmet_gulburnu@hotmail.com
https://orcid.org/0000-0001-6270-8619

How to cite this article: GÜLBURNU M, YILDIRIM K, (2021). Development and implementation of mathematics attitudes scale for the primary and secondary students. Pegem Journal of Education and Instruction, Vol. 11, No. 4, 2021, 177-184

Source of support: Nil

Conflict of interest: None.

DOI: 10.47750/pegegog.11.04.17

Received: 03.04.2021

Accepted: 09.08.2021 **Publication:** 01.10.2021

It can be said that emotional factors such as attitude also play a big role in mathematical performance (Baloğlu & Koçak 2006; Miller & Bichsel, 2004). Therefore, students' attitudes towards mathematics are also important in terms of students' mathematics experiences, academic achievements, and daily lives (Başer & Yavuz, 2003). However, most of the studies on performance and attitude towards mathematics are mostly directed towards adults (Çoban, 1989). It is therefore particularly important to explore the early development of attitudes towards mathematics if we are to understand the relationships between actual mathematical performance and attitudes and, if possible, to prevent the development of negative attitudes. For this reason, the present study aimed to determine the mathematics attitudes of primary school (9-10 years) and secondary school (11-12 years) students with the developed scale. Relatively few studies examining young children's attitudes towards math have generally shown positive attitudes, with most children claiming to love math (Blatchford, 1996; Tizard et. al., 1988). However, studies suggest that attitudes may deteriorate with age, especially in the primary school age group (Wigfield & Meece, 1988; Dowker, 2005). Therefore, another aim of the present study is to investigate the change between primary and secondary school students. Undoubtedly, it can be predicted that older children may exhibit more negative attitudes. This prediction is based on the assumption that children's experiences of success and failure can influence their attitudes and confidence in mathematics, and that such experiences and their effects will become increasingly evident in later school years. The present study also aims to examine gender differences in students' attitudes towards mathematics. Studies suggest that women do not underperform at math, but tend to have lower self-evaluation and more anxiety (Devine, et. al., 2012; Else-Quest, Hyde & Linn, 2010). The present study aims to investigate whether such gender differences can also be present in primary and secondary school students.

In summary, although attitudes alone are not a sign of success in mathematics, it can be said that student's personality traits, gender, and grade level are among the variables that affect their attitudes towards mathematics. For this reason, there is a need for further studies to measure students' attitudes towards mathematics from an early age and to examine the relationship between variables affecting mathematics attitudes. This study, it was aimed to develop a scale to determine the mathematics attitudes of primary and secondary school students, and as a result of the application of the scale, the relationship of students' attitudes towards mathematics in terms of various variables was examined. In line with the stated purposes, the sub-problems of the research are as follows;

- Does the developed Mathematical Attitude Scale (MAS) have a valid and reliable structure?
- Do primary and secondary school students' attitudes towards mathematics differ in terms of gender and grade level variables?

In this context, the present study is important in terms of shedding light on the attitudes of primary and secondary school students towards mathematics and whether their attitudes differ according to certain variables.

Method

Researach Design

The survey model was used in this study, which aims to develop a scale that can be used to measure the attitudes of primary and secondary school students towards mathematics. In this section, the study group of the research, the development of the scale, and the techniques used in the analysis of the data are mentioned.

Population and Sample

Primary and secondary school students were chosen as the population of the study. A random sampling method was used in sampling methods. The sample of the study consists of a total of 328 students, 170 (52%) girls and 158 (48%) boys, who are studying in a primary school and a secondary school in the Southeastern Anatolia Region. The distribution of students according to their grade levels is shown in Table 1.

Data Collection Tools and Developing the Scale

In the first stage of the development of the scale, a literature review on the subject was made and sentences that could express the mathematical attitude were formed. The sentences formed were evaluated by two lecturers who are experts in the field of mathematics education. In addition, the opinions of experts working in Turkish education were consulted so that these sentences do not contain any expression disorders in terms of grammar. Afterward, a 27-item 5-point Likert-type scale was prepared to express students' attitudes towards mathematics. Three of these items are negative items for attitude. Each student responds to each item on the scale in five subscales. These; “Strongly agree, Agree, Undecided, Disagree, Strongly disagree”. The scale was finalized by scoring positive items as 5-4-3-2-1 and negative items as 1-2-3-4-5 for attitude.

Tablo 1.: Grade levels of students

Grade Levels	*f*	*%*
4th grade	70	21
5th grade	61	19
6th grade	56	17
7th grade	88	27
8th grade	53	16
Total	328	100

The created scale consists of five factors: (1) in-class; (2) the nature of mathematics; (3) problem solving; (4) comprehension and (5) self-efficacy.

Data Analysis

Within the scope of the validity studies of the developed scale, the Kaiser–Meyer–Olkin (KMO) value was calculated and the Bartlett Sphericity test was applied. The process of determining the factor structure of the scale was done by using Principal Component Analysis, which is a factor analysis technique. In the reliability studies of the scale, the item-total correlations were examined and the Cronbach Alpha internal consistency coefficient was calculated. Besides, as a result of the application of the scale, the independent group t-test was applied in the whole scale and in the subscales for the mean attitude of the students according to the gender variable. In addition, the scores of the students from the whole attitude scale and its subscales according to their grade levels were analyzed with a one-way analysis of variance and the Duncan test.

Findings

In this section, findings of the validity and reliability of the scale and the findings of the examination of students' mathematical attitudes in terms of various variables are included.

Findings Regarding the Validity and Reliability of the Scale

While determining the items to be included in the scale, the correlation between the answers given to each item and the total score obtained from the answers given to all of the items was calculated. Findings of item-total test correlations obtained here are shown in Table 2.

Items 4 and 22, which had a low correlation value according to Table 2 and lowered the Cronbach Alpha reliability coefficient of the draft scale, were removed from the draft scale. Kaiser-Meyer-Olkin (KMO) value and Bartlett's Test of Sphericity were applied to the data remaining after the extracted items within the scope of validity studies. The KMO value shows that it is excellent between 1.00-0.90, very good between 0.89-0.80, good between 0.79-0.70, a medium between 0.69-0.60, weak between 0.59-0.50, and unacceptable for values less than 0.49 (Büyüköztürk, 2005; Tavşancıl, 2005). The KMO value of the remaining 27-item scale was found to be (.888), indicating that this sample was very good. Also, Bartlett's test of sphericity has a significance value (.000) [X2 = 2550,101, p <.001]. This shows that the data come from a multivariate normal distribution. These results show that there is sufficient correlation between the items of the scale and factor analysis can be performed (Çokluk, Şekercioğlu & Büyüköztürk, 2010).

Factor analysis is a statistical technique that aims to measure variables that measure the same structure or quality by collecting them together and explaining them with a small number of factors (Büyüköztürk, 2005). While deciding on the number of factors in the scale, the eigenvalues being greater than 1 and the Scree-Plot chart were taken into account. The Scree-Plot graph is shown in Figure 1.

Taking advantage of the eigenvalues in Figure 1, it was decided that the scale consists of 5 factors. Rotated Component

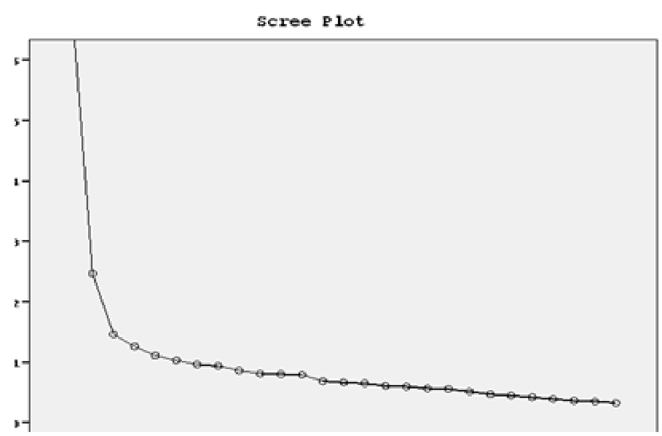

Figure 1: The Scree-Plot

Table 2: Findings regarding item-total test correlations

Item	*Item Total Correlation*	*Item*	*Item Total Correlation*	*Item*	*Item Total Correlation*
S1	,272	S11	,569	S21	,458
S2	,281	S12	,526	S22*	,066
S3	,531	S13	,591	S23	,394
S4*	-,081	S14	,303	S24	,426
S5	,453	S15	,265	S25	,413
S6	,445	S16	,496	S26	,511
S7	,459	S17	,567	S27	,527
S8	,506	S18	,429	S28	,500
S9	,545	S19	,322	S29	,387
S10	,440	S20	,306		

* Extracted ıtems

Matrix analysis was conducted to determine how to group 27 items in the scale according to 5 factors. The Maximum Variability (Varimax) orthogonal rotation technique was used to obtain more clear information about the nature of the factors found as a result of the factor analysis. While evaluating the factors, items with factor load values of .40 and above were taken into consideration (Stevens, 2002), but the 14th item with a factor load value above .40 in factor 3 and factor 5 was found to be factor 5 with a higher load value by taking expert opinion. (see Table 3).

According to Table 3, items 6, 8, 10, 11, 13, 16, 17, 26 and 27 under factor 1, items 3, 9, 19, 21, 23 and 28 under factor 2, 1 under factor 3, Items no 5, 7, 12, and 18, items no 15, 24 and 29 under factor 4, and items no 2, 14, 20, and 25 under factor 5 were determined.

According to Table 4, the 1st factor explained 25,790% of the total variance, the 2nd factor explained 9,129%, the 3rd factor explained 5,408%, the 4th factor 4,663%, and the 5th factor 4,103%. These five factors explained 49.093% of the total variance. Since the explained variance percentage is over 30, it is sufficient for the scale (Büyüköztürk, 2005). The factors were named "In-Class", "Nature of Mathematics", "Problem Solving", "Understanding", "Self-efficacy", respectively.

To reveal the reliability of the scale, the Cronbach Alpha internal consistency coefficient was calculated. The Cronbach Alpha coefficient was found to be .880 for all items. Cronbach's alpha values were calculated in its sub-factors and shown in Table 5. Since these values are greater than the suggested value of .7, the scale is reliable (Nunnally, 1978).

Findings of Examining Students' Mathematical Attitudes in Terms of Various Variables

In this section, there are findings to test whether students' mathematics attitudes differ statistically according to gender and grade variables.

Table 3: Factor load values of the items of MAS

Item	*Factor 1*	*Factor 2*	*Factor 3*	*Factor 4*	*Factor 5*
S10	,717				
S11	,699				
S16	,656				
S17	,654				
S27	,549				
S6	,541				
S8	,532				
S26	,505				
S13	,447				
S19		,661			
S28		,572			
S9		,557			
S3		,530			
S23		,525			
S21		,463			
S5			,691		
S1			,628		
S7			,624		
S12			,585		
S18			,549		
S15				,716	
S29				,694	
S24				,553	
S20					,598
S14					,549
S25					,500
S2					-,425

Table 4: Factors and load values in the results of the rotated principal component analysis

Factor	*Eigenvalue*	*Variance Percentage*	*Total Variance Percentage*
1	6,963	25,790	25,790
2	2,465	9,129	34,918
3	1,460	5,408	40,327
4	1,259	4,663	44,990
5	1,108	4,103	49,093

Table 5: Findings of the Cronbach Alpha internal consistency coefficient

Sub-Factors	*Item Numbers*	*Cronbach's Alpha Coefficient*
In-Class	9	,837
The Nature of Mathematics	6	,735
Problem Solving	5	,742
Understanding	3	,712
Self-Efficacy	4	,787
Total	27	,880

Table 6: Scale options weights and limits

Weight	*Option*	*Limits*
1	Strongly agree	1,00-1,79
2	I agree	1,80-2,59
3	I am indecisive	2,60-3,39
4	I disagree	3,40-4,19
5	Strongly disagree	4,20-5,00

Table 7: Students' mathematics attitude scores (n = 328)

	In-Class	*Nature of Mathematics*	*Problem Solving*	*Understanding*	*Self-efficacy*	*Total*
2,2937	2,3252	2,1902	2,2957	2,2188	2,2707	
ss	,87154	,86613	,90051	,97937	,76425	,65058

Table 8: Independent group t-test findings (female = 170, boy = 158) applied to the scores of the students obtained from the whole scale and subscales according to their gender

Sub-Factors	*Gender*	$\overline{X}$	*ss*	*p*
In-Class	Female	2,26	,88	,580
	Male	2,32	,85	
Nature of Mathematics	Female	2,31	,86	,804
	Male	2,33	,86	
Problem Solving	Female	2,15	,92	,452
	Male	2,22	,87	
Understanding	Female	2,25	,94	,391
	Male	2,34	1,01	
Self-efficacy	Female	2,18	,70	,433
	Male	2,25	,82	
Total	Female	2,24	,64	,428
	Male	2,30	,65	

In the questionnaire, which was scaled in a five-point Likert type, the students were asked to indicate the items by giving a score between 1 and 5. The interval width of the scale (string width/number of groups to be made) was calculated with the formula, and the options and limits of the scale are shown in Table 6.

Based on the answers given by the students to the MAS, the mathematics attitude scores they got on the whole scale and in the sub-scales are shown in Table 7.

Based on the answers given by the students to the MAS in Table 7, it was seen that the attitudes of the students were positive and they agreed with the statements in the whole scale and the sub-scales.

Table 8 shows the data regarding the independent group t-test applied to the average scores of the students in the scale and sub-scales according to their gender.

When Table 8 is analyzed, no statistically significant difference at $p < 0.05$ level was found in the independent group t-test for the mean attitude according to the gender variable in the whole scale and its subscales. Besides, girls' averages of attitude are more positive than boys on the whole scale and in subscales.

In Table 9, the one-way analysis of variance applied to the average scores of the students from the scale and subscales according to their classes, and the findings of the Duncan test to determine which groups caused the difference as a result of this analysis.

Table) 9: Findings of one-way analysis of variance and Duncan test of the scores of the students from the whole attitude scale and its subscales according to their classes

	4th grade	5th grade	6th grade	7th grade	8th grade	P value
In-Class	2.21	2.14	2.24	2.45	2.37	0.188
Nature of Mathematics	2.52^{c}	2.00^{a}	$2.17^{a,b}$	$2.43^{b,c}$	$2.41^{b,c}$	0.003
Problem Solving	1.77^{a}	1.95^{a}	1.90^{a}	2.61^{b}	2.63^{b}	0.000
Understanding	2.05^{a}	1.89^{a}	2.18^{a}	2.69^{b}	2.54^{b}	0.000
Self-efficacy	2.15	2.23	2.03	2.28	2.39	0.119
Total	2.17^{a}	2.06^{a}	2.13^{a}	2.48^{b}	2.45^{b}	0.000

abc: Letters on the same line indicate group differences ($P < 0.05$)

As seen in Table 9, there was no significant difference in the in-class and self-efficacy subscales. However, a significant difference was found between the classes on the whole scale and in other subscales. Classes were divided into 3 groups according to the answers given by the students like the mathematics subscale. There are 5th and 6th grades in the first group, 6th, 7th and 8th grades in the second, and 4th, 7th and 8th grades in the third group. As can be seen, it was seen that the 6th grade was associated with both the first and the second groups, while the 7th and 8th graders were associated with the second and third groups. Also, a significant difference was found between these 3 groups. In the problem-solving subscale, the answers given by the students formed more meaningful groups based on classes. 4th, 5th, and 6th grades constituted the first group, 7th and 8th grades constituted the second group. Besides, a significant difference was found between the groups. Attitude scores of 4th, 5th and 6th grades are more positive than 7th and 8th grades. In the comprehension subscale, the answers given by the students divided the classes into 2 subgroups, and a difference was found between these groups. Parallel to the problem-solving subscale, 4th, 5th and 6th graders constituted the first group, 7th and 8th graders constituted the second group. It was observed that the 4th, 5th and 6th grades had a more positive attitude towards understanding mathematics. In the whole of the scale, the classes are again divided into 2 subgroups and a difference was found between these groups. 4th, 5th, and 6th grades constituted the first group, 7th and 8th grades constituted the second group. It was observed that 4th, 5th, and 6th graders had more positive attitudes than 7th and 8th graders.

Discussion

In this study, 5-grade Likert-type MAS was developed to determine the attitudes of primary and secondary school students towards mathematics. The MAS, which initially consisted of 29 items, was made up of 27 items after two items were removed after the analysis. The KMO value of the scale was calculated as (.888), and the Cronbach Alpha coefficient was found to be .880 for all items and over 0.7 for the subscales. As a result of the factor analysis, it was seen that the items of the scale reflected the dimensions of "In-Class, The Nature of Mathematics, Problem Solving, Understanding, and Self-Efficacy". According to the findings, it was concluded that the MAS has a reliable structure that measures the attitudes of primary and secondary school students towards mathematics and has a measurement validity consisting of five sub-dimensions. This result, unlike the mathematics attitude scales in the literatüre (Yenilmez, 2007; Ganley & Vasilyeva, 2011), provided a broader perspective in determining students' attitudes towards mathematics with more comprehensive and up-to-date sub-dimensions. In addition, the validity and reliability studies of the developed MAS in its use at different times will help the measurement tool to have a more valid and reliable structure.

According to the results obtained by applying the scale, it can be said that students' mathematics attitudes, in general, show a positive trend in the whole scale and the subscales. This result is in line with the results of the study by Dowker, Bennett & Smith (2012). However, it was revealed that the mathematics attitudes of the students did not differ significantly in terms of gender variable. Tocci & Engelhard (1991) suggested that there is a significant relationship between mathematics attitude and gender variables in their study in which they investigated the relationship of mathematics attitudes with mathematics achievement, parental support, and gender. They stated that the idea that mathematics is a male job played a major role in the formation of this difference. In the current study, the fact that the students were smaller individuals might have prevented them from displaying a sexist attitude in their perspective on mathematics. Therefore, this result supports the importance of younger ages for the formation of mathematical attitudes in a healthy way. In addition, it was observed that the mean attitude of girls was more positive than boys in the whole scale and its subscales. Similarly, studies have shown that female students have more positive attitudes towards mathematics than male students (Yenilmez, 2007; Ganley & Vasilyeva, 2011).

Another result that emerged with the application of the scale is that students' mathematics attitudes do not differ in class level in terms of in-class and self-efficacy subscales, but there is a significant difference in other subscales and the entire scale. The fact that there is no significant difference between class levels in terms of in-class attitude and self-efficacy may indicate that primary and secondary school students' perceptions of mathematics are similar. The difference revealed in the dimension of the nature of mathematics may be because mathematics is a product of the human mind due to its nature and because it is a science-based on the discovery, the lower students' feelings of curiosity prevail and they are more open to exploration. It can be said that the most important reason for the significant difference between classes in terms of class level in problem-solving and comprehension sub-dimensions is the mathematics curriculum. The 7th and 8th-grade mathematics curriculum deals with solving equations and algebraic expressions in more detail. For this reason, the mathematics attitudes of the students in upper grades are more negative than the students in lower grades. Similarly, it can be interpreted that after the 6th grade, the subjects in the 7th and 8th-grade mathematics curriculum consist of difficult to understand and more abstract subjects, negatively affecting the attitudes of 7th and 8th-grade students. The reason for the significant difference occurring in the whole scale is that the mathematics curriculum is heavier and more abstract after the 6th grade, as stated in other subscales. Also, it can be interpreted that the 7th and 8th-grade mathematics curriculum is not compatible with the mental development of the students. In similar studies, it was observed that with the increase in grade level, a decrease was observed in the attitude scores of students studying in the second grade of primary education towards mathematics (Taşdemir, 2009). A study by Baykul (1990); reveals that students' attitudes towards mathematics and science lessons constantly change negatively in the fifth grade of the primary school towards the last grades of high school and equivalent schools. Altun (1995), in his research on 3rd, 4th, and 5th-grade primary school students, states that there is a decrease in attitudes towards mathematics as the grade level increases. As a result of the comparison between grade levels, it was found that 5th-grade students have a more positive attitude towards mathematics than 8th-grade students. This result can be attributed to the fact that the curriculum of mathematics lessons in the second level of primary education is more complex and at a level that may be difficult (Yenilmez, 2007). As a result, the secondary school mathematics curriculum can be simplified considering that there is a significant difference in students' mathematics attitudes in terms of grade level.

References

Aiken, L. R. (1974). Two scale of attitude toward mathematics. Journal for Research in Mathematics Education, 5, 67-71.

Altun, M. (1995). İlkokul 3, 4 ve 5. sınıf öğrencilerinin problem çözme davranışları üzerine bir çalışma. Unpublished doctorate dissertation, Hacettepe Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Baloğlu, M. & Koçak, R. (2006). A multivariate investigation of the differences in mathematics anxiety. Personality and Individual Differences, 40 (7), 1325–1335.

Başer, N. & Yavuz, G. (2003). Öğretmen adaylarının matematik dersine yönelik tutumları. Retrieved July 29, 2021, from http://www.matder.org.tr/ogretmen-adaylarinin-matematik-dersine-yonelik-tutumlari/

Baykul, Y. (1990). İlkokul beşinci sınıftan lise ve dengi okulların son sınıflarına kadar matematik ve fen derslerine karşı tutumda görülen değişmeler ve öğrenci seçme sınavındaki başarı ile ilişkili olduğu düşünülen bazı faktörler. Ankara: ÖSYM Yayınları.

Blatchford, P. (1996). Pupils' views on school work and school from 7 to 16 years. Research Papers in Education, 11 (3), 263–288.

Büyüköztürk, Ş. (2005). Sosyal bilimler için veri analizi el kitabı. Ankara: Pegema Yayıncılık.

Çoban, A. (1989). Ankara, merkez ortaokullarındaki son sınıf öğrencilerinin matematik dersine ilişkin tutumları. Unpublished master's thesis, Gazi Üniversitesi Sosyal Bilimler Enstitüsü, Ankara.

Çokluk, Ö., Şekercioğlu, G. & Büyüköztürk, Ş. (2010). Sosyal bilimler için çok değişkenli istatistik. Ankara: Pegem Yayıncılık.

Devine, A., Fawcett, K., Szucs, D. & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. Behavioral and Brain Functions, 8 (33).

Dowker, A. (2005). Individual differences in arithmetic: ımplications for psychology, neuroscience and education. New York, USA: Psychology Press.

Dowker, A., Bennett, K. & Smith, L. (2012). Attitudes to mathematics in primary school children. Child Development Research, 2012.

Else-Quest, N. M., Hyde, J. S. & Linn, M. C. (2010). Crossnational patterns of gender differences in mathematics: a meta-analysis. Psychological Bulletin, 136 (1), 103– 127.

Ganley, C. M. & Vasilyeva, M. (2011). Sex differences in the relation between math performance, spatial skills, and attitudes. Journal of Applied Developmental Psychology, 32 (4), 235–242.

McCallon, E. & Brown, J. (1971). A semantic differential instrument for measuring attitude toward mathematics. The Journal of Experimental Education, 39, 5-8.

Michaels, L. A. & Forsyth, RA. (1978). Measuring attitudes toward mathematics? some questions to consider. Arithmetic Teacher, 26, 22-25.

Miller H. & Bichsel, J. (2004). Anxiety, working memory, gender, and math performance. Personality and Individual Differences, 37 (3), 591–606.

Nunnally, J. O. (1978). Pyschometric theory. New York: McGraw-Hill.

Papanastasiou, C. (2000). Effects of attitudes and beliefs on mathematics achievement. Studies in Educational Evaluation, 26, 27-42.

Saracoğlu, A. S., Başer, N., Yavuz, G. & Narlı, S. (2004). Öğretmen adaylarının matematiğe yönelik tutumları, öğrenme ve ders çalışma stratejileri ile başarıları arasındaki ilişki. Ege Eğitim Dergisi, 5 (2), 53-64.

Shashaani, L. (1995). Gender differences in mathematics experience and attitude and their relation to computer attitude. Educational Technology, 35 (3), 32-38.

Stevens, J. (2002). Applied multivariate statistics for the social sciences (4th Edition). Mahwah, NJ: Lawrence Erlbaum Associates.

Tapia, M. & Marsh, G.E. (2004). An instrument to measure mathematics attitudes. Academic Exchange Quarterly, 8, 16-22.

Tapia, M. (1996). The Attitudes Toward Mathematics Instrument. Paper presented at the Annual Meeting of the Mid-South Educational Research Association (Tuscaloosa, AL, November 6-8, 1996). Retrieved from https://eric.ed.gov/?id=ED404165

Taşdemir, C. (2009). İlköğretim ikinci kademe öğrencilerinin matematik dersine karşı tutumları: Bitlis ili örneği. Dicle Üniversitesi Ziya Gökalp Eğitim Fakültesi Dergisi, 12 (2009), 89-96.

Tavşancıl, E. (2005). Tutumların ölçülmesi ve spss ile veri analizi. Ankara: Nobel Yayıncılık.

Tıraş, Ş. (1999). Öğrenme-öğretme açısından matematik öğretmenlerinin yeterliliği ve etkili olma düzeyleri. D.E.Ü. Buca Eğitim Fakültesi Dergisi, 11.

Tizard, B., Blatchford, P., Burke, J., Farquhar, C. & Plewis, I. F. (1988). Young children at school in the inner city. London, UK: Erlbaum Press.

Tocci, C. M. & Engelhard, G. (1991). Achievement, parental support and gender differences in attitudes toward mathematics. Journal of Educational Research, 84 (5), 280-287.

Wigfield A. & Meece, J. L. (1988). Math anxiety in elementary and secondary school students. Journal of Educational Psychology, 80 (2), 210–216.

Yenilmez, K. (2007). İlköğretim öğrencilerinin matematik dersine yönelik tutumları. On Dokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi, 23 (2007), 51-59.

Sınıfınız: **Cinsiyetiniz:** Kız ( ) Erkek ( ) Aşağıdaki ankette matematik dersi ile ilgili kaygılarınızı anlatan cümleler verilmiştir. Cümleleri dikkatlice okuyarak yanındaki kutucuklara 'X' işareti koyunuz.	Kesinlikle katılıyorum	Katılıyorum	Fikrim yok	Katılmıyorum	Kesinlikle katılmıyorum
1. Matematik kendimi rahat hissetmemi sağlar.					
2. Matematik benim için en korkunç derstir.					
3. Matematik dersine girmeden önce üzgün oluyorum.					
4. Matematik en sevdiğim derstir.					
5. Matematik sınavlarından her zaman korkarım.					
6. Matematik problemi çözmek beni her zaman memnun eder.					
7. Evde matematik ödevimi yaparken sıkılıyorum.					
8. Matematik benim için baş ağrısıdır.					
9. Matematik dersinde soru sormaktan korkarım.					
10. Öğretmen matematik sorusu sorduğunda aklım duruyor.					
11. Matematik öğrenmekten zevk alıyorum.					
12. Matematik bana sıkıcı geliyor.					
13. Matematiği ileriki yaşantımda kullanacağımı düşünüyorum					
14. Matematik kafamı karıştırıyor.					
15. Matematik konularını anlamada sıkıntı yaşarım.					
16. Bir arkadaşımın bana matematik ile ilgili bir soru sorması beni korkutur.					
17. Matematik ile ilgili bir oyuna katılmaya istekliyim.					
18. Matematik ile ilgili sohbetin yapıldığı ortamlara girmek istemem.					
19. Başkalarının yanında zihinden işlem yapmaktan korkmam.					
20. Arkadaşıma matematikle ilgili bir şeyler anlatmaktan çekinirim.					
21. Bir matematik problemini denklem kurarak çözmekten nefret ederim.					
22. Dört işlem gerektiren matematik sorularını severim					
23. Bir matematik problemi çözdükten sonra kendimi rahatlamış hissederim.					
24. Matematik kelimesini duymak bile beni korkutur.					
25. Matematik derslerinde tahtaya kalkmaktan nefret ederim					
26. Matematik derslerinde sınıf dışında olmak isterim.					
27. Matematik derslerinin bitmesini istemem.					