Ümmet, D.& Korban, İ. (2023). Predictive role of cognitive distortions and motivation regulation on math anxiety among Turkish high school students. *International Online Journal of Education and Teaching (IOJET), 10*(2). 764-777.

Received : 03.10.2022
Revised version received : 16.01.2023
Accepted : 20.01.2023

PREDICTIVE ROLE OF COGNITIVE DISTORTIONS AND MOTIVATION REGULATION ON MATH ANXIETY AMONG TURKISH HIGH SCHOOL STUDENTS

(Research article)

Correspondence

Durmuş Ümmet - https://orcid.org/0000-0002-8318-9026
Marmara University, İstanbul, Turkey
dummet@marmara.edu.tr

İrfan Korban - https://orcid.org/0000-0002-2320-1556
Ministry of National Education, Şanlıurfa, Turkey
irfankorban@hotmail.com

Biodata(s):

Durmuş Ümmet is a full time Associate Professor at Marmara University Faculty of Education, Department of Psychological Counseling and Guidance. His research interests are psychological services in education, psychological counselor education, school counseling and positive psychology.

İrfan Korban is a school counselor at Ministry of National Education in Şanlıurfa. He has completed her MA thesis at İstanbul Sabahattin Zaim Üniversitesi in 2018. His research interests are psychological services in education and multicultural psychological counseling.

PREDICTIVE ROLE OF COGNITIVE DISTORTIONS AND MOTIVATION REGULATION ON MATH ANXIETY AMONG TURKISH HIGH SCHOOL STUDENTS

Durmuş Ümmet
dummet@marmara.edu.tr

İrfan Korban
irfankorban@hotmail.com

Abstract

The aim of this study is to examine mathematics anxiety in high school students according to cognitive distortions and motivation regulation variables related to academic anxiety. The sample of the study consists of a total of 436 students (283 girls and 153 boys) studying at different high schools in Turkey in the 9th, 10th, 11th and 12th grades. Mathematics Anxiety Scale (MAS), Cognitive Distortions Scale Related to Academic Achievement (CDS-AA) and Motivation Regulation Scale-Short Form (MRS-SF) were used to collect the data of the research. According to the findings obtained; a significant negative correlation was found between high school students' math anxiety and motivation regulation skills. In addition, it was determined that there were positive significant relationships between students' math anxiety and both the total scores of cognitive distortions related to academic achievement and the sub-dimension scores of catastrophizing, perfectionism, self-value, and outer attribution. According to the results of the regression analysis, it was determined that motivation regulation and cognitive distortions scores were a significant predictor of students' math anxiety. The findings were discussed with other studies in the field and some suggestions were made.

Keywords: Math anxiety; motivation regulation; cognitive distortions; high school students

1. Introduction

Anxiety is one of the most common used words in these days and is associated with three of the following six symptoms: restlessness, being easily fatigued, difficult concentrating, irritability, muscle tension and sleep disturbance (American Psychiatric Association, 2014). In this research, we shall investigate the predictive role of math anxiety, which is one of the types of anxiety, on students' cognitive distortions and motivational regulations. Math anxiety is one of the most prevalence topics in school and everyday life that can affect individuals' academic performance and career throughout their lives and, is defined as a general fear or tension to math and math-related situations and associated with negative reactions to math (Ashcraft 2002; Campbell 2005; Legg & Locker, 2009). According to the Harper & Daane (1998), Factors causing the main math anxiety centered on word problems, right answers, timed tests, confidence level and fear of making mistakes.

Basic numerical skills are important for achievement in school and everyday life and, are compulsory in many countries' education systems. However, many people experience anxiety when dealing with numerical information, and those with high levels of math anxiety underperform in math relative to those with low math-anxious counterparts and, they tend to avoid math and math related situations (Ashcraft 2002; Lyons & Beilock 2012; Maloney &

Beilock 2012). Similarly, low performance in math is related to negative attitudes toward math and consequently, math anxiety (Núñez-Peña, Suárez-Pellicioni & Bono, 2013). Individuals with avoidance tendency and high math anxiety have less math competence and success compared those with low math anxiety and when they become less anxious and more confident about their abilities to do math, their standardized test scores will improve (Ascraft, 2002; Furner & Berman, 2003). There are several components that can trigger individuals' math anxiety throughout their lives. Teachers can have a significant impact on students' math anxiety and numerical performance – particularly female students might be affected from their female teachers and, it is therefore suggested that teachers should recognize their own math anxiety and seek new strategies for those with math anxiety (Beilock, Gunderson, Ramirez & Levine, 2010; Geist, 2010; Harper & Daane, 1998; Martinez, 1987). According to Demir & Durmaz (2018), math teachers have limited knowledge about reasons and definition of math anxiety and consequently, they confuse the math anxiety with fear. Parents are also one of the components of students' math anxiety. A study showed that when the parents were more math anxious; their children may learn significantly less math over the school year and have more math anxiety (Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015). In addition to low academic performance, math anxiety also may affect students' social life (Krinzinger, Kaufmann, & Willmes, 2009). According to National Scarpello (2007), reports that approximately 75 percent of Americans stop studying math and, they tend to take minimum number of required math courses due to their confidence in math, which limits their career options.

The educational and personal aspects of math anxiety have been satisfactorily investigated and are well known. However, cognitive consequences have been discussed recently (Campbell, 2005). Ashcraft and Faust (1994) defined math anxiety as mental disorder, horror, helplessness and tension that occurs when it is necessary to solve mathematical problems and manipulate figures and numbers. This definition is important because it shows that math anxiety includes both emotional and cognitive structures. As it is seen in all psychological cases and dysfunctional behaviors, math anxiety is also regarded along with the cognitive distortions that affect individuals' confidence levels and coping skills. Studies in this field have revealed that cognitive distortions constitute an essential component of youth psychopathology and are classified as either overgeneralization or pseudo-discrimination (Barriga, Gibbs, Landau, Liau, Stinson, 2000; Dawes, 1964). Moreover, cognitive distortions significantly predict adolescents' academic performances to a high degree (64%), and that are critical for this age group in terms of their social acceptance at school (Usen, Eneh & Udom, 2016; Mcgrath, 2002). On the other hand, findings have shown that academic domain irrational beliefs (cognitive distortions) mediate the relationship between academic achievement and test anxiety, and students with higher levels of irrational beliefs have higher level of test anxiety which is increasing along with the irrational beliefs and intrusive images (Boyacioglu & Kucuk, 2011; Putwain, Connors, & Symes, 2010).

Overall, math anxiety is not only related to individuals' academic performance, career and confidence levels, but is it also acting an important role of the ones' motivational regulation strategies that may affect ones' academic achievement directly or indirectly. There are several studies concerning effects of the motivational regulation strategies on language learning, GPA, affective/cognitive well-being and consequently academic achievement (Grunschel, Schwinger, Steinmayr & Fries, 2016; Li, 2017; Schwinger & Stiensmeier-Pelster, 2012; Schwinger, Spinath & Steinmayr 2012). It is understood that motivation regulation is a concept related to mathematics anxiety. Motivation regulation can be expressed as the sustainability of motivation or the awareness of motivation and the willpower of the individual to maintain it. Whether students are motivated or not affects their educational life. In this context, the high

level of motivation ensures success in the lessons in the education life and the next school provides a positive situation and continuity in the education life of the student, while the low motivation provides a negative situation and interruption in the education life of the student, which leads to not being successful in the lessons and leaving the school (Beaudoin, 2006; Pintrich & Schunk, 2002; Vallerand & Bissonnette, 1992). A study showed that motivation and anxiety are concepts that interact to facilitate self-regulation over the course of developing expertise in a domain, such as math (Shores & Shannon, 2007). On the other hand, findings underlined those definite relationships between test anxiety and students' motivation regulation strategies were found (Bembenutty, Karabenick, Lin & McKeachie, 1998). Teachers and other significant adults sometimes model that math is difficult and something to fear, while at the same time claiming that mathematical skills are very important for one's future success (Hébert & Furner, 1997). It is thought that examining cognitive distortions and motivational regulation as predictors of math anxiety in high school students will provide important information to school counselors, teachers and parents.

Therefore, this study seeks the answers of the following questions:

i. Are there relationships between high school students' math anxiety and motivational regulation and cognitive distortions?

ii. To what extent the motivation regulation and cognitive distortions predict high school students' math anxiety?

2. Method

1.1. Research Method

This research is a correlational survey model prepared to examine the mathematics anxiety of high school students in the context of cognitive distortions and motivation regulation variables towards academic success. The Correlational survey model is defined as a research model that aims to determine the existence and degree of changes between two or more variables. In correlational studies, on the other hand, it aims to explain the relationship between the variables without any intervention in the study process (Babbie, 2010; Karasar, 2016).

1.2. Participants

The sample of the study consists of 436 students (283 girls and 153 boys) studying at various high schools in the 9th, 10th, 11th and 12th grades. The number of students studying in private school is 104, and the public school is 332. The sample was determined by the convenient sampling method. Convenient sampling method is the selection of the sample from units, which are easily accessible and applicable, due to the limitations in terms of time, money, and labor. (Büyüköztürk, 2012).

1.3. Data Collection Tools

1.3.1. Mathematics Anxiety Scale (MAS)

The original form of the scale was developed by Bai vd. (2009), and its Turkish adaptation was made by Akçakın, Cebesoy and İnel (2015). According to the explanatory and confirmatory factor analyzes, it was seen that the scale was compatible with the original form. The internal consistency coefficient of the scale was found to be .91. The item-total test correlations calculated for the item validity and homogeneity of the scale are ranged from .46 to .77. Based on these findings, it was concluded that (MAS) is a valid and reliable scale that can be used to measure the mathematics anxiety of university students. High scores on the total

score scale indicate high math anxiety. The Cronbach Alpha value for this study was calculated as α=.891.

1.3.2. Cognitive Distortions Scale Related to Academic Achievement (CDS-AA)

The scale was developed by Kaya (2018) to measure the cognitive distortions of high school students regarding academic achievement. The form with 52 items was created in the development process of the scale based on interviews with students, literature and expert opinions. Explanatory factor analysis (EFA) was first applied on the obtained form. In light of the EFA and expert opinions, 27 items were removed from the tool and a form with 25 items, which explain %50.87 of the total variance, were obtained. To examine the coherence of the model of the four-factor structure, confirmatory factor analysis (CFA) was performed with a different study group and the results obtained (X2 /sd= 2.29; RMSEA= .08; CFI= .95; NNFI= .95; SRMR= .08) showed that the coherence of the model-data of the scale was at a good level. The Cronbach's Alpha internal consistency coefficient (.89), test-retest reliability (.89) and structural reliability (.94) were calculated as a result of the reliability analyzes of the scale. The scale consists of 25 items and various sub-dimensions such as catastrophizing, self-worth, attribution, and perfectionism. The findings showed that it is a valid and reliable measurement tool in evaluating high school students' cognitive distortions related to academic achievement. Coronbach Alpha value for this study was calculated as α=.917.

1.3.3. Motivation Regulation Scale-Short Form (MRS-SF)

The Turkish adaptation of the Motivation Regulation Scale (MRS-K), developed by Kim, Brady, and Wolters (2018), was carried out by Sarıçam and Erdemir (2019). Statistically, high level of correlation was found between the Turkish Form and the English Form in the linguistic equivalence study. KMO sample coherence coefficient was calculated as .92, and Bartlett sphericity test score was calculated as $\chi 2 = 2885.51$ ($p< .001$, sd =66). As a result of the explanatory factor analysis, it was observed that 12 items were under 2 factors with eigenvalues higher than 1, and item factor loading values were between .55 and .81. In the confirmatory factor analysis, which was applied consistently with the original form for the construct validity of the scale, it was determined that the goodness of coherence values of the 12 items and 2 sub-dimension model were at a good level. Cronbach's alpha internal consistency reliability coefficient was calculated as α=.92. The corrected item-total correlation coefficients of the scale ranged from .61 to .74. High scores on the total score scale indicate high motivational regulation skills. Coronbach Alpha value for this study was calculated as α=.874.

1.3. Procedure

Participation in this research is on the voluntary basis; the purpose and method of this research were explained to all participants, and the research was conducted by following the confidentiality principle. Ethics committee approval was also obtained for the study (from a Marmara University dated 14.08.2020 and numbered 2000310356). The data were analyzed with SPSS 21. The relationships between math anxiety scores and cognitive distortions for academic achievement and motivation regulation skills were examined using Pearson Product-Moment Correlation Analysis, while the predictive mathematics anxiety of cognitive distortions for academic success and motivation regulation scores were examined using Hierarchical Regression Analysis.

2. Result

In this section, the findings regarding the statistical analyzes obtained as a result of the analysis of the research data are given in tables.

Table 1. *Correlation Analysis Results between Participants' Math Anxiety, Motivation Regulation and Cognitive Distortions Scores*

Variables	1	2	3	4	5	6	7
1. Math Anxiety	1	-,213**	,194**	,176**	,191**	,149**	,177**
2. Motivation Regulation		1	,008	,082	-,022	-,072	,018
3. Total CDS-AA			1	,861**	,928**	,854**	,941**
4. Catastrophizing				1	,644**	,744**	,686**
5. Attribution					1	,684**	,988**
6. Self-worth						1	,683**
7. Perfectionism							1
Mean ($\bar{X}$)	43,33	39,38	90,76	25,21	23,95	14,09	27,50
Standard Deviation (SD)	12,51	9,95	25,95	7,86	7,19	6,07	7,78

**p<.050*

Table 1; there is a significant negative correlation between math anxiety scores and motivation regulation (r=-.213; p<.050). According to this finding, as students' motivation regulation skills increase, their math anxiety decreases. According to the table; there was a positive correlation between students' math anxiety scores and total cognitive distortion scores (r=.194; p<.050), and sub-dimensions such as catastrophizing (r=.176; p<.050), external attribution (r=.191; p<.050). .050), self-worth (r=.149; p<.050) and perfectionism (r=.177; p<.050) scores were also found to be positively significantly correlated. According to these findings, as students' cognitive distortion and sub-dimension scores increase, their math anxiety scores also increase.

Table 1. *Regression Analysis for Motivation Regulation and Cognitive Distortions as Predictors of Math Anxiety*

Predictive Variable		Math Anxiety				
		R^2	R^2 *change*	β	*t*	*F*
Step 1	Motivation Regulation	,045	,043	-,213*	-4,531	20,527*
Step 2	Motivation Regulation	,098	,095	-,215*	-4,497	6,357*
	Catastrophizing			,233*	2,883	
	Attribution			,670*	2,010	
	Self-worth			-,114	-1,472	
	Perfectionism			-,564	-1,640	

**p<.050*

As a result of the regression analysis, it was seen that motivation regulation scores significantly predicted high school students' math anxiety scores. (F=20,527, p<,050). As a result of the Hierarchical Regression Analysis, it was seen that sub-dimension scores of cognitive distortions towards academic achievement and motivation regulation scores predicted mathematics anxiety scores at a statistically significant level (F=6, 357, p>.050). When the model was examined, it was seen that motivation regulation scores were a significant predictor of students' math anxiety and that scores explained 4% of the total variance. In the

second step, when sub-dimension scores of cognitive distortions scale was included in the regression equation, catastrophizing and attribution dimensions were found to be significant predictors. However, perfectionism and self-worth scores were not found to be significant predictors. When cognitive distortion scores were included in the equation, the variance explanation value increased to approximately 10%. In other words, motivation regulation and cognitive distortion scores were found to be similarly significant predictors of students' math anxiety scores.

2. Discussion and Conclusion

In this study, it was aimed to examine mathematics anxiety in high school students according to cognitive distortions and motivation regulation variables. For this purpose, initially, the relationship between variables were examined. A significant negative correlation was found between students' math anxiety scores and their motivation regulations. According to this finding, as students' motivation regulation skills increase, their math anxiety decreases. As a result of the regression analysis, it was seen that motivation regulation scores significantly predicted high school students' math anxiety scores. Motivation is a student's willingness to put in the effort necessary to learn a subject (Avcı, 2020). Motivation, as a concept that determines a student's insistence on learning a lesson or his/her indifference towards the lesson, appears as the key concept of education. Mathematics is a lesson that many students perceive as a difficult and incomprehensible lesson in schools. For this reason, studies that improve self-regulation skills and increase motivation are needed in order to be able to change these perceptions of students in math lessons (Clearly & Chen, 2009; Peker & Mirasyedioğlu, 2003; Pintrich, 1999). Many studies examining the background of students' math anxiety show that motivation is one of the factors that shape students' negative perceptions about the lesson (Berkant & Gençoğlu, 2015; Savaş et all., 2010; Tatar & Dikici, 2008). From this point of view, it is clear that motivational regulation skills are essential in overcoming students' anxiety about the mathematics lesson. Kuzu & Çalışkan (2018) reported that while there is a negative relationship between math anxiety and intrinsic motivation, there is not a significant relationship found between extrinsic motivation and math anxiety. Motivation regulation is a concept closely related to intrinsic motivation. Intrinsic motivation is the type of motivation in which the sense of learning and achievement develop in natural environments and behaviors are done not for reward but for happiness. (Ryan & Deci, 2000). Other studies (Kesici & Aşılıoğlu, 2017; Külünk Akyurt, 2019; Yıldırım, 2011) report that as students' math motivation increases, their math anxiety decreases. These studies also show the relationship between math anxiety and motivation. All these explanations and other research results support the results obtained from this study.

Another finding of the study is that there are positive significant relationships between students' math anxiety scores and total CDS-AA and sub-dimensions (catastrophizing, external attribution, self-worth and perfectionism) scores. According to these findings, as students' cognitive distortion total and sub-dimension scores increase, their math anxiety scores also increase. The results of the Regression Analysis showed that the sub-dimensions of the cognitive distortions scale, catastrophizing and attribution, were significant predictors. Cognitive distortion can be expressed as a person's often erroneous way of thinking and perceiving a particular situation. A very large proportions of people accept these thought-forms as they are without testing their authenticity and obtaining sufficient proof of their correctness (Beck, 2006; Dryden, David and Ellis, 2010; Ellis, 1976). Considering the nature of cognitive distortions, it can be considered a situation that is expected to be a concept closely related to math anxiety. Studies on anxiety often draw attention to the cognitive component of anxiety.

The person who feels anxiety identifies cognitive processes as inadequacy, catastrophizing, and externalizing the source of the problem in order to be able to eliminate the threat. When cognitive structures have negative content, anxiety increases, while if thoughts are positive, such as thinking about competence, anxiety decreases (Cemen, 1987; Kazelskis ve Kazelskis, 1999; Schwarzer, 1997). Students may be going through similar processes when they experience anxiety in the face of a stimulus related to mathematics. Cognitive distortions are the processes that involve internal conversations used while reaching irrational, negative inferences and evaluations, and the cognitive, emotional and behavioral problems associated with it (Bonner & Rich,1998; Fair, 1986). When students with math anxiety encounter a relevant stimulus, they start to talk to themselves such as "I can't do it", "I look stupid", "if I can't do it, it would be very bad." It is clear that there is a significant relationship between these cognitive structures and anxiety (Baloğlu, 1999; Esen-Aygün, 2022; Mitchell & George, 2022). There are also effects of families on the increase in students' math anxiety. Some parents emphasize that mathematics is quite difficult for their children and also say that success is directly related to mathematics (Fraser & Honeyford, 2000). The student who is exposed to this also develops catastrophic and perfectionist thoughts about mathematics and this is one of the reasons for mathematics anxiety. Senol and et al. (2015) reported a similar finding in their research on the causes of math anxiety. Studies show that there is a relationship between childhood and adolescence psychological problems and cognitive distortions. Many unhealthy behaviors such as anxiety, test anxiety, eating disorders, and suicidal tendencies are accompanied by typical cognitive distortions such as perfectionism, exaggeration and personalization (Clack & Beck,1999; Jager- Hyman et all, 2014). Research findings revealing the relationship between cognitive distortions and problem-solving, decision-making, critical thinking skills, which have undeniable importance in individuals' education and working lives, draw attention to the negative effects of cognitive distortions (Nezu & Nezu, 2001; Limón, 2001). Negative mental explanations of the individual and thoughts of inadequacy reduce academic achievement. Anxiety that students may experience in lessons such as mathematics and foreign language can be given as an example to this situation (Bedel, 2015; Köksal et all, 2014Tobias and Weissbrod (1980) define math anxiety as a state of despair and mental disorganization. Ayan (2014) and Şahin (2009) stated that mathematics anxiety is a multi-faceted anxiety and defined it as a situation that includes people's irrational fears about mathematics lessons and prevents them from learning mathematics. On the other hand, Ma and Xu (2004) defined Mathematics anxiety as an uncomfortable feeling that occurs when students have to do a math-related homework or task. They explained the basic components of this feeling as behavioral symbols such as sadness, mental disorder, helplessness, disappointment, tension, fear, dislike and anxiety. These explanations about the dynamics of math anxiety shed light on the relationship between math anxiety and cognitive distortions. As a result, it is seen that all these explanations and other research findings are similar to the results obtained from this study.

As a result of the hierarchical regression analysis, it was seen that motivation regulation and cognitive distortion's sub-dimension scores towards academic achievement predicted mathematics anxiety scores at a statistically significant level. Motivation regulation and cognitive distortion scores were found to be similarly significant predictors of students' math anxiety scores. It can be said that the findings obtained from this study are important findings in understanding mathematics anxiety. Based on these findings, various studies can be suggested to the students with the math anxiety regarding both motivation regulation skills and cognitive distortions. Teachers can organize studies for students to regulate their motivation with in-class activities. Individual or group counseling practices will be effective in dealing with cognitive distortions. Finally, other studies, qualitative and mixed-type research methods, can be conducted to understand other components of math anxiety

References

Akçakın, V., Cebesoy, Ü., B. & İnel, Y. (2015). İki boyutlu matematik kaygısı ölçeğinin Türkçe formunun geçerlik ve güvenirlik çalışması [Validity and reliability study of Turkish version of bidimensional mathematics anxiety scale]. *GUJGEF 35*(2), 283-301.

American Psychiatric Association, (2014). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current directions in psychological science, 11*(5), 181-185. https://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Faust, M. W. (1994). Mathematics anxiety and mental arithmetic performance: An exploratory investigation. *Cognition and Emotion, 8*, 97–125. https://doi.org/10.1080/02699939408408931

Ayan, A. (2014), *Ortaokul öğrencilerinin matematik öz-yeterlik algıları, motivasyonları, kaygıları ve tutumları arasındaki ilişki. [The relationship between mathematics self-efficacy, motivations, anxieties and the attitudes for secondary school students*]. Master Thesis, Balıkesir University.

Avcı, Ö. (2020). *Motivasyona kuramsal bakış: Atıf, beklenti-değer ve öz belirleme. [Theoretical view of motivation: Attribution, expectation-value, and self-determination]*. Ö. Avcı, & E. Akyıldız (Ed.), Eğitimde motivasyon-kuramsal arka plan, gelişimsel dönemler ve öğrenme-öğretme (pp:3-51). Ankara: Nobel.

Babbie, E. R. (2010). *The practice of social research*. 12th ed. Belmont, CA: Wadsworth Cengage.

Bai, H. (2011). Cross-validating a bidimensional mathematics anxiety scale. *Assessment. 1*, 178-182.

Baloğlu, M. (1999). A comparison of mathematics anxiety and statistics anxiety in relation to general anxiety. Retvired 15 july 2022 from https://files.eric.ed.gov/fulltext/ED436703.pdf.

Barriga, A. Q., Landau, J. R., Stinson, B. L., Liau, A. K., & Gibbs, J. C. (2000). Cognitive distortion and problem behaviors in adolescents. *Criminal justice and behavior*, *27*(1), 36-56. https://doi.org/10.1177/0093854800027001003

Beaudoin, C. M. (2006). Competitive orientations and sport motivation of Professional women football players, An internet survey. *Journal of Sport Behavior, 29*, 201-212.

Beck, J. S. (2006). *Bilişsel davranışçı terapi: temelleri ve ötesi. [Cognitive behavioral therapy: Basics and beyond]*. Ankara: Nobel.

Bedel, A. (2015). The relationship between interpersonal problem solving, positive-negative affect andanxiety. *Studia Psychologica, 57*(2), 121. https://doi.org/10.21909/sp.2015.02.688

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences, 107*(5), 1860-1863. https://doi.org/10.1073/pnas.0910967107

Bembenutty, H., McKeachie, W. J., Karabenick, S. A., & Lin, Y. G. (1998). The Relationship between Test Anxiety and Self-Regulation on Students' Motivation and Learning. Retvired 15 july 2022 from https://files.eric.ed.gov/fulltext/ED424244.pdf

Berkant, H.G. & Gençoğlu Ş.S. (2015). *Farklı lise türlerinde çalışan matematik öğretmenlerinin matematik eğitimine yönelik görüşleri. [Mathematics Teachers' Views Working in Different Types of High School on Mathematics Education]*. Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi, 1(12), 194-217.

Bonner, R. L., & Rich, A. (1988). Negative life stress, social problem-solving self-appraisal, and hopelessness: Implications for suicide research. *Cognitive Therapy and Research, 12*(6), 549-556. https://doi.org/10.1007/BF01205009

Boyacioglu, N., & Kucuk, L. (2011). Irrational beliefs and test anxiety in Turkish school adolescents. *The Journal of School Nursing, 27*(6), 447-454. https://doi.org/10.1177/1059840511417631

Büyüköztürk, Ş. (2012). *Sosyal bilimler için veri analizi el kitabı [Handbook of data analysis for social sciences]*. Ankara: Pegem Akademi Yayıncılık.

Campbell, J. I. (Ed.). (2005). *Handbook of mathematical cognition*. Psychology Press.

Clak, D. A., & Beck, A. T. (1999). *Scientific foundations of cognitive theory and therapy of depression.* John Wiley & Sons.

Cleary, T.J., & Chen, P.P. (2009). Self-regulation, motivation, and math achievement in middle school: variations across grade level and math context. *Journal of School Psychology, 47* (5), 291-314. https://doi.org/10.1016/j.jsp.2009.04.002

Dawes, R. M. (1964). Cognitive distortion. *Psychological Reports, 14*(2), 443-459. https://doi.org/10.2466/pr0.1964.14.2.443

Demir, S., & Durmaz, M. (2018). A opinions of elementary maths teachers about maths anxiety and their intervention methods. *Academia Journal of Eucational Research, 3*(1), 17-27.

Dryden, D., David, D. ve Ellis, A. (2009). *Rational emotive behavior therapy*. K. S. Dobson (Yay. haz.). Handbook of Cognitive-Behavioral Therapies. Guilford Press.

Ellis, A. (1976). The biological basis of human irrationality. *Journal of individual psychology, 32*(2), 145-168.

Esen-Aygün, H. (2022). *Matematik Kaygısının Bilişsel ve Duyuşsal Faktörleri. [Cognitive and Affective Factors of Math Anxiety]*. In: Math Anxiety (Edt. Baloğlu & Sarı). Ankara: Vizetek.

Fair, S.E. (1986). *Cognitive content and ristortion associated with mood- induced repressive and anxiousstates* Arizona. Arizona State University.

Fraser, H., & Honeyford, G. (2000). *Children, parents and teachers enjoying numeracy: Numeracy hour success through collaboration*. London: David Fulton.

Furner, J. M., & Berman, B. T. (2003). Review of research: math anxiety: overcoming a major obstacle to the improvement of student math performance. *Childhood education, 79*(3), 170-174. https://doi.org/10.1080/00094056.2003.10522220

Geist, E. (2010). The anti-anxiety curriculum: Combating math anxiety in the classroom. *Journal of Instructional Psychology, 37*(1). Retvired 19 july 2022 from https://www.andrews.edu/sed/gpc/faculty-research/montagano-research/the-anti-anxiety-cur.pdf

Grunschel, C., Schwinger, M., Steinmayr, R., & Fries, S. (2016). Effects of using motivational regulation strategies on students' academic procrastination, academic performance, and

well-being. *Learning and Individual Differences, 49*, 162-170. https://doi.org/10.1016/j.lindif.2016.06.008

Harper, N. W., & Daane, C. J. (1998). Causes and reduction of math anxiety in preservice elementary teachers. *Action in Teacher Education, 19*(4), 29-38. https://doi.org/10.1080/01626620.1998.10462889

Hébert, T. P., & Furner, J. M. (1997). Helping high ability students overcome math anxiety through bibliotherapy. *Journal of Secondary Gifted Education, 8*(4), 164-178. https://doi.org/10.1177/1932202X9700800403

Jager-Hyman, S., Cunningham, A., Wenzel, A., Mattei, S., Brown, G. K., & Beck, A. T. (2014). Cognitive distortions and suicide attempts. *Cognitive therapy and research, 38*(4), 369-374. https://doi.org/10.1007/s10608-014-9613-0

Kazelskis, R. & Kazelskis, R. K. (1999). *The Math Anxiety Questionnaire: A Simultaneous Confirmatory Factor Analysis a Across Gender.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association. Point Clear, AL.

Karasar, N. (2016). *Bilimsel araştırma yöntemi [Scientific research method].* Ankara: Nobel Yayıncılık.

Kaya, İ. (2018). Akademik başarıya ilişkin bilişsel çarpıtmalar ölçeğinin (ABIBÇÖ) geliştirilmesi [The development of cognitive distortions scale related to academic achievement (CDS-AA)]. *Mersin University Journal of the Faculty of Education 14*(3), 1082-1098. https://doi.org/10.17860/mersinefd.435605

Kesici, A. ve Aşılıoğlu B. (2017). Ortaokul öğrencilerinin matematiğe yönelik duyuşsal özellikleri ile Temel Eğitimden Ortaöğretime Geçiş (TEOG) sınavları öncesi yaşadıkları stresin matematik başarısına etkisi. *Ahi Evran Üniversitesi Kırşehir Eğitim Dergisi, 18*(3), 395-414. https://doi.org/10.29299/kefad.2017.18.3.021

Kim, Y. E., Brady, A. C., & Wolters, C. A. (2018). Development and validation of the Brief Regulation of Motivation Scale. *Learning and Individual Differences, 67*, 259-265. https://doi.org/10.1016/j.lindif.2017.12.010

Krinzinger, H., Kaufmann, L., & Willmes, K. (2009). Math anxiety and math ability in early primary school years. *Journal of psychoeducational assessment, 27*(3), 206-225. https://doi.org/10.1177/0734282908330583

Köksal, O., Arslan, C., & Bakla, A. (2014). An investigation into foreign language learning anxiety, stressand personality in higher education. *International Journal on New Trends in Education and Their Implications, 5*(2), 199-208.

Kuzu, O. & Çalışkan, N. (2018). *Öğretmen adaylarinin motivasyon ve matematik kaygı düzeylerinin çeşitli değişkenler açısından incelenmesi. [Examination of teacher candidates' motivation and math anxiety levels in terms of various variables].* (In, Eğitim Bilimleri Çalışmaları, pp, 5-12). Ankara: Çizgi Yayınları.

Külünk Akyurt, G. (2019). *İlkokul 4. sınıf öğrencilerinin matematik motivasyonu, kaygısı ve başarısı arasındaki ilişkinin incelenmesi [An analysis of relationship between mathematics motıvation, anxiety and achievement of 4th graders].* Master Thesis, Ordu Üniversity.

Legg, A. M., & Locker Jr, L. (2009). Math performance and its relationship to math anxiety and metacognition. *North American Journal of Psychology, 11*(3).

Li, K. (2017). Motivational regulation in foreign language learning. *Springer.* https://doi.org/10.1057/978-1-349-93118-7

Limón, M. (2001). On the cognitive conflict as an instructional strategy for conceptual change: A critical appraisal. *Learning and instruction, 11*(4-5), 357-380. https://doi.org/10.1016/S0959-4752(00)00037-2

Lyons, I. M., & Beilock, S. L. (2012). When math hurts: math anxiety predicts pain network activation in anticipation of doing math. *PloS one, 7*(10). https://doi.org/10.1371/journal.pone.0048076

Ma, X., & Xu, J. (2004). The Causal Ordering of Mathematics Anxiety and Mathematics Achievement: A Longitudinal Panel Analysis. *Journal of Adolescence,* (27), 165- 179. https://doi.org/10.1016/j.adolescence.2003.11.003

Maloney, E. A., & Beilock, S. L. (2012). Math anxiety: Who has it, why it develops, and how to guard against it. *Trends in cognitive sciences, 16*(8), 404-406. https://doi.org/10.1016/j.tics.2012.06.008

Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and anxiety. *Psychological Science, 26*(9), 1480-1488. https://doi.org/10.1177/0956797615592630

Martinez, J. G. (1987). Preventing math anxiety: A prescription. *Academic therapy, 23*(2), 117-125. https://doi.org/10.1177/105345128702300201

McGrath, I. (2002). *Materials evaluation and design for language teaching*. Edinburgh: Edinburgh University Press.

Mitchell, L., & George, L. (2022). Exploring mathematics anxiety among primary school students: Prevalence, mathematics performance and gender. International Electronic *Journal of Mathematics Education, 17*(3)1-11. https://doi.org/10.29333/iejme/12073

Nezu, A. M., & Nezu, C. M. (2001). Problem solving therapy. *Journal of Psychotherapy Integration, 11*(2),187-205. https://doi.org/10.1023/A:1016653407338

Núñez-Peña, M. I., Suárez-Pellicioni, M., & Bono, R. (2013). Effects of math anxiety on student success in higher education. *International Journal of Educational Research, 58*, 36-43. https://doi.org/10.1016/j.ijer.2012.12.004

Peker, M., Mirasyedioğlu, Ş. (2003). Lise 2.sınıf öğrencilerinin matematik dersine yönelik tutumları ve başarıları arasındaki ilişki. [The relationship between the attitudes and achievements of high school 2nd grade students towards mathematics lesson]. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 14*, 157-166.

Pintrich, P. R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research, 31*(6), 459–470. https://doi.org/10.1016/S0883-0355(99)00015-4

Pintrich, P.R., & Schunk, D.H. (2002). *Motivation in education: Theory, research, and applications*. 2nd edition. Englewood Cliffs, NJ: Prentice Hall. Spanish translation, Motiva-cióny educación: teoría, investigación y aplicaciones. Madrid: Pearson, 2004.

Putwain, D. W., Connors, L., & Symes, W. (2010). Do cognitive distortions mediate the test anxiety–examination performance relationship? *Educational Psychology, 30*(1), 11-26. https://doi.org/10.1080/01443410903328866

Ryan, R.M. & Deci, E.L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist, 55*,(1) 68-78. https://doi.org/10.1037/0003-066X.55.1.68

Sarıçam, H. & Erdemir, N. (2019). *Üniversite öğrencilerinin motivasyon düzenleme düzeylerinin belirlenmesi: Bir ölçek uyarlama çalışması [The brief regulation of motivation scale in Turkish university students: A preliminary scale adaptation study].* IX. International Congress of Psychological Counseling and Guidance Research in Higher Education Proceedings, 1, 233-241.

Savaş, E., Taş S. & Duru A. (2010). Matematikte öğrenci başarısını etkileyen faktörler. [Factors affecting student success in mathematics]. *İnönü Üniversitesi Eğitim Fakültesi Dergisi, 11*,(1) 113-132.

Schwarzer, R. (1997). *Anxiety. Germany for the Psychosocial Working Group*. Retrieved 11 June 2022 from http://www.macses.ucsf.edu /Research /Psychosocial /notebook/ anxiety.html,

Schwinger, M., & Stiensmeier-Pelster, J. (2012). Effects of motivational regulation on effort and achievement: A mediation model. *International Journal of Educational Research, 56*, 35-47. https://doi.org/10.1016/j.ijer.2012.07.005

Schwinger, M., Steinmayr, R., & Spinath, B. (2012). Not all roads lead to Rome Comparing different types of motivational regulation profiles. *Learning and Individual Differences, 22*(3), 269-279. https://doi.org/10.1016/j.lindif.2011.12.006

Shores, M. L., & Shannon, D. M. (2007). The effects of self-regulation, motivation, anxiety, and attributions on mathematics achievement for fifth and sixth grade students. *School Science and Mathematics, 107*(6), 225-236. https://doi.org/10.1111/j.1949-8594.2007.tb18284.x

Scarpello, G. (2007). Helping students get past math anxiety. techniques. *Connecting Education and Careers, 82*(6), 34-35.

Şahin, C. (2009). Eğitim Fakültesinde Öğrenim Gören Öğrencilerin Umutsuzluk Düzeyleri. [Hopelessness levels of students studying at faculty of education*]. Selçuk Üniversitesi Ahmet Keleşoğlu Eğitim Fakültesi Dergisi, (27*), 271-286.

Şenol, A., Dündar, S., Kaya, İ., Gündüz, N. & Temel, H. (2015). Investigation of secondary school mathematics teachers' opinions on mathematics fear. *Journal of Theory and Practice in Education,11*(2), 653-672.

Tatar, E. & Dikici, R. (2008). Matematik eğitiminde öğrenme güçlükleri. [Learning difficulties in mathematics education]. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 5*(9), 183-193.

Tobias, S., & Weissbrod, C. (1980). Anxiety and mathematics: An update. *Harvard Educational Review, 50*(1), 63- 71. https://doi.org/10.17763/haer.50.1.xw483257j6035084

Usen, S. A., Eneh, G. A. & Udom, I. E. (2016). Cognitive distortion as predictor of in-school adolescents' depressive symptoms and academic performance in south-south, Nigeria. *Journal of Education and Practice, 7*(17), 23-27.

Vallerand, R. J., & Bissonnette, R. (1992). Intrinsic, extrinsic, and amotivational styles as predictors of behavior, A prospective study. *Journal of Personality, 60*(3), 599–620. https://doi.org/10.1111/j.1467-6494.1992.tb00922.x

Yıldırım, S. (2011). Self-efficacy, Intrinsic Motivation, Anxiety and Mathematics Achievement: Findings from Turkey, Japan and Finland. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 5*(1) 277-29.