

Received: November 18, 2022

Accepted: December 9, 2022

<http://dergipark.org.tr/rep>

e-ISSN:2602-3733

Copyright © 2022

December 2022 • 6(2) • 193-206

Research Article

<https://doi.org/10.54535/rep.1206987>

The Relationship between Mathematics Anxiety and Mathematics Achievement: Meta Analysis Study*

Hakan Ulum¹

Necmettin Erbakan University

Tuncay Küçükdanacı²

Ministry of Education

Abstract

The overarching goal of this research is to synthesize previous studies on the relationship between mathematics anxiety in primary school and academic success in mathematics course. The studies that were included in the synthesis were evaluated based on a variety of criteria. As a direct consequence of the searching, a total of 21 studies were incorporated into the investigation. Calculating what is known as "inter-coder reliability" was one of the methods used in the study to guarantee the accuracy of the coding protocol. After performing the necessary calculations, it was determined that a reliability of 0.74 was adequate. The reliability of the research, the potential for bias in publication, and the methods used to evaluate the quality of primary studies. There was no evidence of bias. The findings of the meta-analysis indicate that there is an inverse correlation between math anxiety and math achievement, which corresponds to a moderate effect size. The size of this effect was determined by the number of studies included in the analysis. According to the random effects model, the effect size that was determined to have been produced by 21 separate studies was found to be -.42. The measurement tool that was used for the region, the type of study, the education level, and the achievement score were all taken into account during the analyses of moderator variables. It was determined that the moderators, with the exception of the regional moderator, did not produce a statistically significant change in the magnitude of the effect.

Key Words

Mathematics Anxiety • Mathematics Achievement • Meta Analysis

*This research was presented as an oral presentation at the 20th International Primary Teacher Education Symposium (2022).

¹ **Correspondance to:** Necmettin Erbakan University Konya, Turkey. E-mail: hakanulum@gmail.com **ORCID:** 0000-0002-1398-6935

² Ministry of Education, İzmir, Turkey. E-mail: tuncaykcd@gmail.com **ORCID:** 0000-0002-5039-4656

Citation: Ulum, H. & Küçükdanacı, T. (2022). The relationship between mathematics anxiety and mathematics achievement: meta analysis study. *Research on Education and Psychology (REP)*, 6(2), 193-206.

Concepts

Anxiety about mathematics can be described as a feeling of tension, anxiety, or fear, and it can significantly impair one's ability to perform mathematical tasks (Ashcraft, 2002). There is also widespread agreement regarding the ways in which math anxiety can affect mathematical performance. Anxiety has a negative impact on performance because it "brings anxiety to bear on performance," which impairs cognitive processing. As early as 1957, Dreger and Aiken had the hunch that some people suffer from a condition known as "numbers anxiety." Since that time, numerous studies have investigated the connection between math anxiety and math performance and found a negative relationship between the two (Parajes & Miller, 1994).

Rationale and Purpose of the Study

The requirement for a "meta analysis" became apparent as more studies revealed the connection between math anxiety and mathematical performance. In his meta-analysis, Hembree (1990) presented a more simplified picture of the relationship between math anxiety and math achievement. Following that, a number of meta-analyses on this topic were carried out. In the 1990s, meta-analyses found a significant, small-to-moderate, and negative relationship between mathematical achievement and mathematical anxiety (Ma, 1999). A number of meta-analyses carried out in the 2000s came to the conclusion that there is a significant, moderate, and inverse relationship between mathematical ability and mathematical anxiety (Namkung et al., 2019; Zhang, et al., 2019; Li et al., 2021; Barroso et al., 2021). Research has continued to investigate this relationship using a greater diversity of samples and measurements ever since these publications were made. In addition, it is believed that there is a requirement for more research to be done on this relationship and for more of the relationship's characteristics to be displayed. In point of fact, carrying on this practice was the primary motivation behind this investigation. But by approaching it from a variety of angles,... Let's explain this in more detail. The material for the meta-analysis became available as the researchers investigated the relationship in question using an increasing variety of samples and measurements. in the years that followed, an increasing number of primary studies were conducted. for example, the range of values for the independent variables that were utilized in these studies. If it is possible to identify the moderators that steer the trajectory of the relationship between math anxiety and success, then this will be one factor that contributes to an increase in success. Remember! The illuminating ways in which the moderators discuss Karl Pearson's work on the typhoid vaccine It is believed that Karl Pearson's synthesis of the results obtained from various studies that were conducted against the typhoid vaccine served as the inspiration for the meta-analysis (Cheung, 2015). Latitudes would not have been regarded as a moderator if this work had not been done. Without testing, we would not have known that the vaccine was successful in chilly environments. And it's possible that a great number of additional people would lose their lives to typhoid. In this sense, each individual meta-analysis study contributes to the advancement of future research. The moderators that were determined in this study may be excluded from future meta-analyses that will be made on the subject of this study or on topics that are similar. This piece of work is also rooted in that tradition. A meta-analysis this study was recently carried out by Bayırlı and colleagues (2021), who found very similar results. However, as I mentioned earlier, primary work has become more demanding in comparison to the previous year. And perhaps most importantly, the moderators came to the conclusion that there were certain people who were

disqualified. Conventional reviews concentrate on aspects of the participant, intervention, and study design, among other things, that have an impact on the variables that were examined. cannot be explained methodically in any way. In meta-analysis, the moderator analysis is used to assess the effects of factors like these on the variation in effect size. If the results of the moderator analyses demonstrate that certain characteristics do not have an effect on the overall impact, then this demonstrates that the results are reliable and can be transferred to situations that are equivalent. If moderator analyses reveal that particular characteristics have an impact on the effect as a whole, then the sources of variation that are responsible for this can be investigated (Glasziou et al., 2001; Lipsey et al., 2001). In addition to this, one of the purposes of meta-analysis is to identify incomplete (unexplored) relationships or relationships that have received a lower amount of research by providing suggestions that may be useful to researchers in the future (Cooper et al., 2019). Analyzing the moderator's role is important in these situations. As a result, the purpose of this particular meta-analysis was to provide an update on the relationship between math anxiety and math achievement as well as the moderators and to draw attention to a number of points with regard to the current moderators. The purpose of this research is to compile a summary of the findings that have been obtained from previous research on the connection between math anxiety and mathematical ability. Hypotheses based on research:

1. There is a correlation between having math anxiety and having a moderately negative level of math achievement. The effect size that was calculated has a significant value.

2. The moderators that have an impact on the calculated effect size are the measurement tool that was used for the region, the type of study, the education level, and the achievement score.

Method

Research Design

The meta-analysis method was used in the study to group the studies on the relationship between mathematics anxiety and mathematics achievement under certain criteria in order to analyze the findings by combining them. This was done in order to reduce the amount of time spent on each individual study.

Research Instruments and Processes

In the meta-analysis process, the keywords "mathematics success" and "mathematics anxiety" were searched in the TR ULAKBIM Index and National Thesis Center of Turkey databases. The Google academic search engine was used. The inclusion criteria of the study are:

1. There are studies being carried out between 2010 and 2022.
2. There are studies carried out in Turkey.
3. The studies included in the research, conducted at home and abroad,
4. include master's theses, doctoral theses, and articles.
5. To be published in scientific, peer-reviewed journals (for articles) or approved by the jury (for theses), correlational studies with statistical findings are conducted.
6. Include moderators who will be reviewed.

During the course of the research, the Comprehensive Meta-Analysis 2.0 (CMA) program was utilized. For the CMA, processing was done on the data from primary studies that fulfilled the criteria. Studies were looked at based on the criteria that were established, and the 21 studies that satisfied the criteria for inclusion were examined.

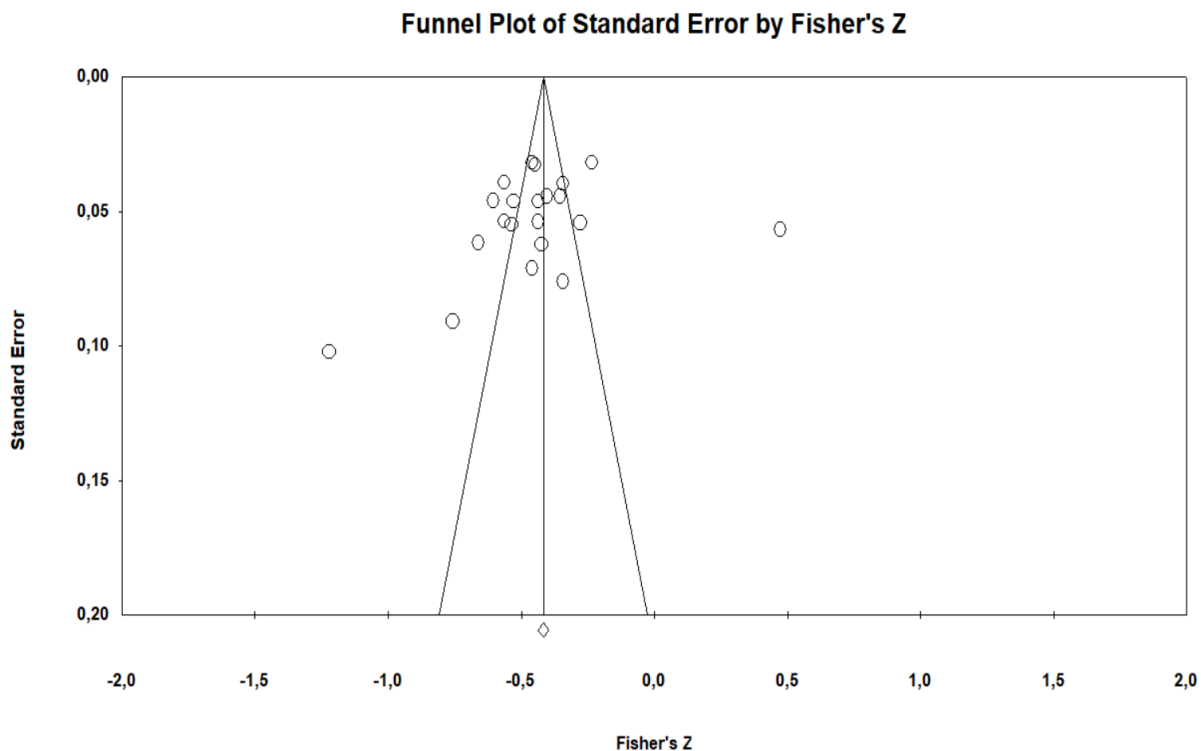
Research Validity and Reliability

The validity of the research was ensured by investigating publication bias and analyzing the validity studies of the studies that were included. The reliability of the research was ensured through the control of two independent coders who coded each of the included studies in accordance with the data coding form that was prepared by the researchers. It was determined that the inter-coder reliability coefficient, also known as AR, was 0.74. This is sufficient.

The most crucial aspect of the reliability analysis of meta-analyses is the examination of publication bias. Both of these approaches were utilized in this investigation in order to test for publication bias. The funnel plot and Egger's regression test are two examples of this. The results of these tests are presented in the following table.

Figure 1

Funnel plot



The funnel plot reveals that the 21 studies that were analyzed were distributed evenly on both sides of the effect size vertical line and very close to the combined effect size. This can be seen by comparing the individual effect sizes of each study to the total effect size. In the absence of any publication bias, it is anticipated that the studies will

spread symmetrically on both sides of the vertical line that represents the overall effect size (Borenstein et al., 2009: 284). As can be seen in this section, the research did not uncover any publication bias.

Table 1

Egger's regression test findings

Lower Limit	Upper Limit	sd	p
-10.94	4.11	3.59	0.35*

* $p < .05$

Egger's regression test is an additional test that is used to test for publication bias. On the other hand, this test demonstrates, in accordance with the significance level indicated by "p," whether or not the funnel plot is asymmetrical (Egger et al., 1997). If the Egger test yields a result that does not meet the criteria for significance, this indicates that there is no issue with publication bias (Klassen & Tze, 2014). It can be concluded that there is no publication bias because the value that was obtained in this research did not equal $p=0.35$ ($p>.05$).

Data Analysis

In this section, the results and data obtained from the CMA analysis are presented in the form of graphs and tables, as well as their interpretations.

Figure 2

Uncombined Findings of the Meta-Analysis by Random Effects Model (CMA)

Model	Study name	Outcome	Statistics for each study					Sample size	Correlation and 95% CI					
			Correlation	Lower limit	Upper limit	Z-Value	p-Value		Total	-1,00	-0,50	0,00	0,50	1,00
	DELIOGLU,	1,000	0,440	0,346	0,525	8,328	0,000	314						
	PEKDEMIR	Blank	-0,230	-0,288	-0,170	-7,335	0,000	984						
	KULUNK	Blank	-0,270	-0,365	-0,169	-5,105	0,000	343						
	KOZA	1,000	-0,330	-0,397	-0,259	-8,639	0,000	638						
	TEMEL,	Blank	-0,330	-0,456	-0,191	-4,509	0,000	176						
	KARLI	Blank	-0,340	-0,415	-0,261	-7,981	0,000	511						
	PEKER &	Blank	-0,383	-0,455	-0,306	-9,087	0,000	510						
	KILIC, 2011	Blank	-0,400	-0,497	-0,293	-6,818	0,000	262						
	BABAN,	Blank	-0,410	-0,482	-0,332	-9,424	0,000	471						
	ILHAN &	Blank	-0,410	-0,494	-0,319	-8,091	0,000	348						
	RENCBER,	Blank	-0,420	-0,471	-0,366	-13,660	0,000	934						
	ILHAN &	Blank	-0,430	-0,536	-0,310	-6,471	0,000	201						
	KESICI,	Blank	-0,430	-0,480	-0,378	-14,412	0,000	985						
	BOZKURT,	Blank	-0,484	-0,550	-0,412	-11,439	0,000	472						
	SARIGOL,	1,000	-0,490	-0,567	-0,404	-9,767	0,000	335						
	CETINER,	Blank	-0,510	-0,584	-0,428	-10,498	0,000	351						
	YILMAZ,	Blank	-0,510	-0,565	-0,451	-14,303	0,000	649						
	MUTLU,	Blank	-0,540	-0,601	-0,473	-13,112	0,000	474						
	DURSUN &	Blank	-0,579	-0,654	-0,493	-10,719	0,000	266						
	KANDAL &	Blank	-0,639	-0,733	-0,521	-8,321	0,000	124						
	KALIN,	Blank	-0,840	-0,890	-0,770	-11,965	0,000	99						

When the uncombined effect sizes are looked at, it can be seen that the study by Kalın (2010) has the greatest effect, while the study by Delioglu (2017) has the smallest effect. The highest effect was found in the former.

Table 2

Combined Meta-Analysis Results by Random Effects Model

	Effect Size (r)	Lower Limit	Upper Limit	Z Value	p
Random Effects Model	- 0.422	-0.497	-0.340	-9.184	0.000*

* $p < .05$

Research was conducted using the random effects model. The study under this model revealed that the association between math aptitude and anxiety had a combined effect size of -.42. (ranging from .34 to -.49 for a 95.00 confidence level). According to [Cohen et al. \(2007\)](#), who calculated this number as a negative and medium impact size, there is an inverse relationship between mathematics fear and achievement.

The effect size value is between .00 and .10, which is very weak; between .10 and .30, which is weak; between .30 and .50, which is medium; between .50 and .80, which is strong; and if it is greater than .80, it is interpreted as having a very strong effect, according to [Cohen et al. \(2007, p. 521\)](#).

Table 3

Results of the moderator analysis by research type variable

Research type	Confidence Interval (95%)					Heterogeneity		
	k	ES (r)	Low	Up	z	Q	df	p
Article	7	-0.473	-0,550	-0.387	-9,600			
Master's thesis	14	-0.394	-0,499	-0.278	-6.239	1.281	1	0,258
Gruplararası Toplam	21	-0.443	-0,506	-0.375	-11.393			

* $p < .05$

The relationship between mathematics anxiety and mathematics achievement did not differ statistically significantly according to the study types, according to the random effects model, as a result of the comparison between the groups in terms of the common effect sizes of the studies in two categories, article and master's thesis ($Q_{\text{Intergroup}} = 1,281$, $sd = 1$, $p = 0.258$). No matter the sort of labor, there is a reciprocal negative association between math anxiety and math achievement.

Table 4

Results of the moderator analysis by area variable

Area	k	Confidence Interval (95%)				Heterogeneity		
		ES (r)	Low	Up	z	Q	df	p
Eastern Anatolia	2	-0.495	-0.593	-0.382	-7.592	73.582	6	0.000
Ege	2	0.034	-0.678	0.712	0.077			
South East Anatolia	3	-0.453	-0.511	-0.392	-12.714			
Central Anatolia	7	-0.481	-0.584	-0.363	-7.148			
Black Sea	2	-0.240	-0.290	-0.189	-8.911			
Marmara	4	-0.471	-0.514	-0.427	-17.899			
Uncertain Region	1	-0.639	-0.733	-0.521	-8.321			
Total Between Groups	21	-0.399	-0.426	-0.372	-25.804			

*p < .05

According to the random effects model, mathematics anxiety and achievement were compared between groups in terms of the common effect sizes of the studies in seven categories: Uncertain Region, Eastern Anatolia Region, Central Anatolia Region, Marmara Region, South East Anatolia Region, Black Sea Region, and Aegean Region. According to the regions, it was found that the association between the groups varied statistically substantially ($Q_{\text{Intergroup}} = 73.582, sd = 6, p = .000$). When the effect sizes calculated for the groups are compared, it can be said that the Uncertain Region, Eastern Anatolia Region, Central Anatolia Region, Marmara Region, South East Anatolia Region, Black Sea Region, and Aegean Region, respectively, have significantly higher levels of the negative relationship between mathematics anxiety and mathematics achievement. In other words, the Uncertain Region, Eastern Anatolia Region, Central Anatolia Region, Marmara Region, South East Anatolia Region, Black Sea Region, and Aegean Region are more affected, correspondingly, by the reciprocal negative association between mathematics anxiety and mathematics achievement.

Table 5

Results of the moderator analysis by area variable teaching level variable

Teaching level	k	Confidence Interval (95%)				Heterogeneity		
		ES (r)	Low	Up	z	Q	df	p
Primary school	2	-0.415	-0.643	-0.12	-2.700	4.870	2	0.092
High school	2	-0.282	-0.386	-0.171	-4.851			
Secondary school	17	-0.439	-0.527	-0.342	-8.043			
Total Between Groups	21	-0.388	-0.435	0.297	-9.525			

*p < .05

The relationship between mathematics anxiety and achievement did not differ statistically significantly depending on education levels, as shown by the comparison between the groups in terms of the common effect sizes of the studies in 3 categories (primary school, secondary school, and high school) using the random effects model ($Q_{\text{Intergroups}} = 4.870$, $sd = 2$, $p = .092$). Education levels have little effect on the reciprocally negative association between math anxiety and math achievement.

Table 6

Results of the moderator analysis by the success score measurement tool variable

Success score measurement tool	Confidence Interval (95%)					Heterogeneity		
	k	ES (r)	Low	Up	z	Q	df	p
Report grade	9	-0.45	-0.628	-0.226	-3.732			
Achievement test	3	-0.389	-0.56	-0.187	-3.627			
Course grade	4	-0.4	-0.461	-0.335	-11.01	0.279	3	0.964*
National exam	5	-0.416	-0.506	-0.317	-7.561			
Total Between Groups	21	-0.406	-0.454	-0.356	-14.322			

* $p < .05$

The relationship between mathematics anxiety and mathematics achievement was statistically significant according to the measurement method used for the achievement score, as shown by the intergroup comparison made in terms of the common effect sizes of the studies in 4 categories: report grade, achievement test, course grade, and national exam. ($Q_{\text{Intergroups}} = 0.279$, standard deviation = 3, $p = .964$) There was no difference in level. Regardless of the assessment method used to determine the accomplishment score, there is a negative link between mathematics anxiety and achievement.

Results

The studies conducted using the random effects model revealed an opposing correlation ($p = 0.000$) and -0.42 between mathematics anxiety and mathematics achievement, which corresponds to a modest effect size. According to Cohen's (2007) classification, this outcome was obtained. This impact size's 95 percent confidence interval has a lower limit of -0.497 and an upper limit of -0.340 . The opposing effect can be explained by a decline in mathematical achievement as mathematics anxiety rises, according to the meta-analysis. In a similar vein, it may be said that as math achievement declines, math fear rises. For all moderators save the "region" moderator, it was believed that the distribution between the groups was homogeneous for the analysis. In other words, it was found that the average effect size value was unaffected by the grouping formed for the measurement tool utilized for the study type, education level, and accomplishment score.

Discussion, Conclusion & Suggestions

The findings of Şad et al. (2016) and Bayrı et al. (2021) in the Turkish sample are greatly expanded and supported by this investigation. The results of previous meta-analysis research on this topic published in the literature are consistent with the medium impact size in the negative direction found as a consequence of the meta-analysis. Numerous meta-analyses on this topic have really been conducted, as I noted in the beginning to my study. These research yielded comparable findings (Ma, 1999; Şad et al., 2016; Zhang et al., 2019; Namkung et al., 2019; Bayırlı et al., 2021; Li et al., 2021). In terms of moderator analysis, this study is valued, nonetheless. In contrast to other studies, the modifiers of the measurement method for the region and accomplishment score were applied in this one. Similar to the others, the moderators and study style were considered crucial at the teaching level. According to the moderators of the assessment method used to determine the area and achievement score, considerable differences between the effect sizes were anticipated, as indicated in the research hypothesis. because it was believed that the regional cultures were to blame for the children' varying levels of mathematics anxiety and achievement. There may also be differences in how much value is placed on mathematics in certain areas. The negative association between mathematics anxiety and achievement was found to be less pronounced in the Aegean and Black Sea regions, respectively, when the effect sizes determined for the groups were compared. The outcome to be obtained is that it processes the general effects, i.e., that mathematics achievement declines as mathematics anxiety rises, or that mathematics anxiety rises as mathematics achievement declines. Culture, geography, and region-specific elements can be useful in this regard. Following this point, experimental research can be ordered. Additionally, Central Anatolia and the Marmara regions' results were seen to be more similar to the overall outcome. These findings could lead to suggestions that either the Black Sea's weather avoids mathematics anxiety or the Marmara region's urban structure causes it. The measurement method chosen was a different moderator success score, which the hypotheses predicted would vary greatly. This claim's foundation is the lack of a standard for the instruments used to assess math proficiency, which raises questions about their validity and dependability. According to the study's findings, the assessment method utilized to determine the accomplishment score had no effect on the negative link between mathematics anxiety and achievement. These resources included achievement assessments, report cards with grades, and national exams. In Turkey, instructors are expected to have their lecture notes and report cards prepared. They purchase and employ tools that lack accurate and trustworthy internet information. It's possible that an inaccurate measurement of math proficiency will result in an inaccurate correlation with math anxiety. This is the premise of the theory. Other exams (achievement tests, national exams), which were deemed legitimate and reliable and were the subject of a number of analyses, did not differ from one another. The investigation revealed that the negative association between mathematics anxiety and achievement remained constant across educational levels. The effect sizes for the moderator variable of education level did not demonstrate a significant difference in Bayırlı et al. study's from 2021, either. In the study conducted by Şad et al. (2016), it was shown that there was a significant difference between high school and secondary school levels and that secondary school students' mathematics anxiety had a greater impact on their math achievement than did high school students'. The negative connection between math anxiety and math achievement did not vary among research types, according to the other moderator's analysis. The notion that the publications underwent a more thorough peer-reviewing process served as the foundation for this

hypothesis. In this regard, it was anticipated that the impact sizes would be significantly different from those in the master's thesis. Additionally, no other study that used moderator analysis was discovered.

The following suggestions were made in light of the findings of this meta-analysis:

1. Various factors were discussed in this study while taking into account the recommendations from earlier studies. In this situation, it is possible to keep looking into the impacts of various moderators. As a result, a conversational setting centered on comparing effect sizes will be established.

2. The association between mathematical achievement and mathematics anxiety has not been the subject of any university-level research in Turkey. At the primary school level, it is extremely uncommon. The association between mathematics proficiency and anxiety for various educational levels and corresponding age ranges will be uncovered when more studies on this subject are conducted.

3. There are regional differences in the strength of the inverse relationship between math anxiety and achievement. This is a topic for a causal analysis.

Ethic

Since this study is a compilation/meta-analysis study, it is not subject to ethics committee approval.

Author Contributions

All of the authors have contributed equally to this article.

Conflict of Interest

The authors declare there is no conflict of interest in this study.

Funding

The authors has not received funding from any institution for this article.

References

- Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, 11(5), 181-185.
- *Baban, A. (2018). *Mathematical concern and perceived teacher attitude in middle school students* (Unpublished Master Thesis). Nişantaşı University, Institute of Social Sciences, İstanbul.
- Barroso, C., Ganley, C. M., McGraw, A. L., Geer, E. A., Hart, S. A., & Daucourt, M. C. (2021). A meta-analysis of the relation between math anxiety and math achievement. *Psychological Bulletin*, 147(2), 134.
- Bayırlı, H., Geçici, M. E., & Erdem, C. (2021). The Relationship between mathematics anxiety and mathematics achievement: A Meta-analysis study. *Pamukkale University Journal of Education*, 1-23.
- Borenstein, M., Hedges, L. V., Higgins, J. P. T., ve Rothstein, H. R. (2009). *Introduction to Meta-Analysis*. Chichester: John Wiley ve Sons Ltd.
- *Bozkurt, S. (2012). *An investigation into the relationship between test anxiety, mathematics anxiety, academic achievement and mathematics achievement of the seventh and eighth grade primary school students* (Unpublished Master Thesis). İstanbul University, Institute of Social Sciences, İstanbul.
- Cheung, M. W. L. (2015). *Meta-analysis: A structural equation modelling approach*. United Kingdom: John Wiley ve Sons Ltd.
- Cohen, L., Manion, L. & Morrison, K. (2007). *Research method in education* (6th edition). New York: Taylor & Francis e-Library.
- Cooper, H., Hedges, L. V., ve Valentine, J. C. (Eds.). (2019). *The handbook of research synthesis and meta-analysis* (Third edit). Russell Sage Foundation.
- *Çetiner, İ. (2018). *The effect of mathematical concerns of eighth grade students on mathematical achievement in the transition from primary to secondary education test (TEOG)*. (Unpublished Master Thesis). Çanakkale Onsekiz Mart University, Institute of Educational Sciences, Çanakkale.
- *Delioğlu, H. N. (2017). *8th grade students of success of mathhematics and test and mathematics anxiety, mathematics self efficacy of investigation*. (Unpublished Master Thesis). Adnan Menderes University, Institute of Social Sciences, Aydın.
- Dreger, R. M., & Aiken Jr, L. R. (1957). The identification of number anxiety in a college population. *Journal of Educational psychology*, 48(6), 344.
- *Dursun, Ş. & Bindak, R. (2011). Primary Education II. Investigation of mathematics anxiety of high school students. *Cumhuriyet University Faculty of Letters Journal of Social Sciences*, 35(1), 18-21.
- Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *Bmj*, 315(7109), 629-634.

- Glasziou, P., Irwig, L., Bain, C., ve Colditz, G. (2001). *Systematic reviews in health care: a practical guide*. Cambridge University Press.
- Hembree, R. (1990). The nature, effects, and relief of mathematics anxiety. *Journal for Research in Mathematics Education*, 21, 33–46. doi:10.2307/749455
- *İlhan, M. & Öner-Sünkür, M. (2012). Predictive power of math anxiety, positive and negative perfectionism for 8th grade students' mathematics achievement. *Mersin University Journal of the Faculty of Education*, 8(1), 178-188.
- *İlhan, M. & Öner-Sünkür, M. (2013). Investigation of predictive power of mathematics anxiety on mathematics achievement in terms of gender and class variables. *Gaziantep University Journal of Sciences*, 12(3), 427-441.
- *Kalin, G. (2010). *The examination of elementary students' mathematics attitudes, self efficiency, anxiety and achievement master thesis*. . (Unpublished Master Thesis). Başkent University, Institute of Education Sciences, Ankara.
- *Kandal, R., & Baş, F. (2021). The prediction status of secondary school students' metacognitive awareness, self-regulatory learning strategies, anxiety and attitude levels towards mathematics on mathematics achievement. *International Journal of Educational Studies in Mathematics*, 8(1), 27-43.
- *Karlı-Şentürk, C. (2016). *The prediction of high school students' maths anxiety*. (Unpublished Master Thesis). Ahi Evran University, Institute of Educational Sciences, Kırşehir.
- *Kesici, A. (2015). *The effect of secondary school students' affective features towards mathematics and the stress they experience before the teog exam (the exam for accessing to various types of high schools) on their mathematical success* (Unpublished Doctoral Thesis). Dicle University, Institute of Educational Sciences, Diyarbakır.
- *Kılıç, A. S. (2011). The relationship between general achievement, mathematics achievement, attitudes towards mathematics lesson, motivation and mathematics anxiety of primary school secondary school students (Unpublished Master Thesis). Gazi University, Institute of Educational Sciences, Ankara.
- Klassen, R. M., & Tze, V. M. (2014). Teachers' self-efficacy, personality, and teaching effectiveness: A meta-analysis. *Educational Research Review*, 12, 59-76.
- *Koza-Çiftçi, Ş. (2015). Effects of secondary school students' perceptions of mathematics education quality on mathematics anxiety and achievement. *Educational Sciences: Theory and Practice*, 15(6), 1487-1501.
- *Külünk-Akyurt, G. (2019). *Examination of the relationship between primary school 4th grade students' mathematics motivation, anxiety and success*. (Unpublished Master Thesis). Ordu University, Institute of Social Sciences, Ordu.

- Li, Q., Cho, H., Cosso, J. et al. Relations Between Students' Mathematics Anxiety and Motivation to Learn Mathematics: a Meta-Analysis. *Educ Psychol Rev* 33, 1017–1049 (2021).
- Lipsey, M. W., Puzio, K., Yun, C., Hebert, M. A., Steinka-Fry, K., Cole, M. W., ...Busick, M. D. (2012). *Translating the statistical representation of the effects of education interventions into more readily interpretable forms*. National Center for Special Education Research.
- Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education*, 30(5), 520-540.
- *Mutlu, Y., Söylemez, İ. & Yasul, A. F. (2017). *Examining of the relationship between math anxiety and math achievement of elementary school students*. *Journal of Human Sciences*, 14(4), 4425-4434.
- Namkung, J. M., Peng, P., & Lin, X. (2019). The relation between mathematics anxiety and mathematics performance among school-aged students: A meta-analysis. *Review of Educational Research*, 89(3), 459-496.
- Pajares F, Miller MD. (1994) Role of self-efficacy and self-concept beliefs in mathematical problem solving: A path analysis. *Journal of Educational Psychology* 86(2), 193-203.
- *Pekdemir, Ü. (2015). *The relations between math achievement and math anxiety, self-esteem, academic self-efficacy beliefs and automatic thoughts of 9th and 10th grade students*. (Unpublished Master Thesis). Karadeniz Technical University, Institute of Educational Sciences, Trabzon.
- *Peker, M. & Şentürk, B. (2012). An investigation of 5th grade students' math anxiety in terms of some variables. *Dumlupınar University Journal of Social Sciences*, 34, 21-32.
- *Reçber, Ş. (2011). *An investigation of the relationship among the seventh grade students' mathematics self efficacy, mathematics anxiety, attitudes towards mathematics and mathematics achievement regarding gender and school type* (Unpublished master thesis). Middle East Technical University, Ankara.
- *Sarığöl, S. (2019). *The role of parental math anxiety in students' math anxiety and performance* (Unpublished master thesis). Boğaziçi University, İstanbul.
- Şad, S. N., Kış, A., Demir, M., & Özer, N. (2016) Meta-analysis of the relationship between mathematics anxiety and mathematics achievement. *Pegem Journal of Education and Instruction*, 6(3), 371-392.
- *Temel, Z. (2018). *The predictive power in success of 8th grade students' attitudes and anxiety towards maths about exponents*. (Unpublished Master Thesis). Necmettin Erbakan University, Institute of Educational Sciences, Konya.
- *Yılmaz, H. R. (2015). *Examination of the relationship between mathematics achievement and mathematics anxiety, test anxiety and some demographic variables in primary school secondary school students*. (Unpublished Master Thesis). Gaziantep University, Institute of Educational Sciences, Gaziantep.

Zhang J, Zhao N and Kong QP (2019) The Relationship Between Math Anxiety and Math Performance: A Meta-Analytic Investigation. *Front. Psychol.* 10:1613. doi: 10.3389/fpsyg.2019.01613