Translating the *Children's Anxiety in Math Scale* to Turkish for Use with Turkish Children

Mehmet Ali Kandemir[1], Molly M. Jameson[2*] and James J. Palestro[3]

[1]*Department of Primary Mathematics Education, Balikesir University, Balikesir, Turkey.*
[2]*School of Psychological Sciences, University of Northern Colorado, Greeley, CO, USA.*
[3]*Department of Psychology, Ohio State University, Columbus, OH, USA.*

Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Math anxiety has become problematic for Turkish students and is thought to be a major cause of low math performance on national and international exams. As Turkey attempts to gain entry to the European Union, it is imperative that the Turkish educational system make efforts to decrease students' math anxiety. Turkish researchers lack an appropriate scale to assess math anxiety in their students, however, particularly in their primary grade students. This study attempts to remedy that by translating the *Children's Anxiety in Math Scale* to Turkish and assessing its psychometric properties. After translation, data were collected from 1587 children in grades 1-5 in Turkey; results of an exploratory factor analysis revealed both a three-factor and a one-factor solution. Confirmatory factor analysis suggest that the one-factor solution fits the data best. Suggestions for future research and applications are included.

_____

Corresponding author: E-mail: molly.jameson@unco.edu;

1. INTRODUCTION

In an effort to gain membership into the European Union and its standards and norms, Turkey has implemented a campaign involving numerous social and political reforms [1], the most impactful of which can be seen in Turkey's educational system. There have been shifts in Turkey's curriculum, educational practices, materials, and activities, as well as other components of learning environments. For instance, the national curriculum has shifted from behaviorist teaching approaches to more student-centered cognitive and constructivist approaches that focus on the applicability and practicality of knowledge [2].

Other than curricular changes, the Turkish Education System has been subjected to additional reform with the implementation of national and international exams. This reform is ongoing, but the most impactful change felt throughout Turkey is the implementation of a student selection examination in order to pass on to secondary education. In the Turkish Education System (MEB), the compulsory education period was raised to 12 years in 2012. This system was defined as four years in primary school, four years in secondary school, and four years in secondary education [3]. In 2013, after implementing the 12 years compulsory education system, students were required to pass the Transfer from Elementary Education to Secondary Education (TEOG) examination to move on to secondary school [4].

Unfortunately, based on results from the 1999-2007 Trends in International Mathematics and Science Study (TIMMS) [5,6] and the Program for International Student Assessment (PISA) 2003-2006-2009-2012 exam results [7,8], it was discovered that Turkish students have lower overall success on international exams than other countries and OECD countries. More specifically, it has been observed that Turkish students have lower success on the math subset of both national exams applied in Turkey and international exams applied in other countries. Turkish students also show lower overall success in mathematics when compared to students in other countries [9-16].

1.1 Math Success and Math Anxiety

According to PISA 2003 results [10,11], one of the four factors affecting the math success of Turkish students' on the PISA exam is that students have math anxiety, or the "feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" [17]. In school settings, math anxiety can lead to an extreme avoidance of anything math related, including performing math problems, speaking in math classes, enrolling in math classes, and pursuing college degrees or jobs in STEM (science, technology, engineering, and mathematics) fields [18-20]. While there are environmental influences and individual differences, math anxious individuals typically perform more poorly on math problems and have lower overall final grades in math courses than their non-math anxious peers [21,22]. Turkish students have been found to experience math anxiety at higher levels than other OECD countries, and this anxiety is one of the most important affective characteristics influencing their math success [10,23,24].

While math anxiety is known to be a serious problem in Turkish students, Dede [25] suggests that no sufficient Turkish math anxiety scales have been developed to measure the math anxiety of primary school students. After investigating math anxiety scales that were developed in Turkey and/or adopted to Turkish, most were found to be developed for teaching candidates and not students [26-31]. Erol [32] adopted a scale, originally developed by Richardson & Suinn [17] to Turkish for a high school sample in his study. Bindak [33] developed an upgraded math anxiety scale for students in secondary school. Dede [34] developed a math anxiety scale for students in secondary and high schools that consisted of four factor scales (peer anxiety, task anxiety, individual anxiety, and test anxiety). Ozdemir & Gur [35] adapted the Math Anxiety Scale, which was developed by Ikegulu [36] for 8th grade students, to Turkish. However, these scales are appropriate only for students in secondary and/or high school. To measure math anxiety in primary students, Baloglu & Balgalmis [37] adapted the Mathematics Anxiety Rating Scale Primary Education Form (MARS-E) [38] to Turkish, which is the scale that is most often used to measure math anxiety in primary students. While the MARS-E is a frequently used and adequate scale, there are three major problems with it that cause concern. First, as Ashcraft and Moore [39] point out, it is a dated measure. Second, it was developed for use with upper elementary students, not students in primary grades. Third, and perhaps most importantly, it uses numeric

Likert-type response options for children; this type of response option relies on the ability to conceptually represent emotions as numbers, a skill that is difficult for children [40]. To remedy these problems, Jameson [22] developed the Children's Anxiety in Math Scale (CAMS) which uses facial image response options, was developed with the purpose of capturing math anxiety in children as young as primary grades, and is more up-to-date than previous scales. The CAMS has a solid factor structure and excellent internal consistency, as well as good validity as shown through correlation with math performance [22]; further, it has been effectively used with children as young as kindergarten [41]. Because the CAMS better fits the needs of researchers and educators in Turkey, the purpose of the current research is to translate the CAMS to Turkish and evaluate the factor structure and reliability of the translated version.

2. METHODS

2.1 Translation Process

A panel was assembled to translate the CAMS. The panel consisted of seven members: three with doctorate degrees in mathematics education, two with doctorate degrees in English language education, and two experts in educational sciences and evaluation and assessment. Prior to the panel session, which was to be held for the translation of the scale, the original form of the scale was given to each member, and they were asked to independently translate the items of the scale from English to Turkish. When the panel assembled, the translation was carried out using a back-translation technique: each item was read aloud in English, matched to its literal Turkish equivalent, translated back into English, and then re-translated into Turkish. This process was repeated until a consensus among the members of panel was met concerning the appropriate translation of each item.

The final form of the scale consisted of two sections that were identical with the original scale: the first included demographic information, and the second featured the identical facial expressions found in the original scale (see Appendix). The translated version of the CAMS can be found in the appendix.

2.2 Pilot Study

To ensure that the administration of the scale was fluid as well as to ensure the understanding and appropriateness of the items, a pilot study was conducted at four different primary and one middle schools with 150 students using the Turkish version of the CAMS (T-CAMS). Teachers of each classroom (i.e., four primary teachers and one middle math teacher) were asked to be active participants in the administration by communicating with students and providing feedback to the researcher on the administration process. The procedure was also video recorded with permission whenever possible. After the pilot study, the panel assembled once more with the teachers involved in the pilot study. The video recordings and the feedback from the teachers were shared with the members of the panels. Based on this evidence and the feedback from the teachers, the items of the scale and the administration process were reevaluated and altered by decreasing the language difficulty to ensure full comprehension of each item. Once this modification was complete, the final form of the scale was developed.

2.3 Data Collection

Once the scale was finalized, schools were selected to be included in data collection to assess the psychometric properties of the T-CAMS. Schools were selected based on their ability to accurately reflect the Turkish population in terms of socioeconomic levels. Seven primary schools and three middle schools were selected for the final scale implementation. Both primary and middle schools were selected as the original CAMS was administered to children in grades 1-5 in the United States, which equates to both primary and middle school grades in Turkey. Data were collected from a total of 1587 children in grades 1-5. Effort was made to sample approximately equal numbers of children from each grade level, as well as to equally sample girls and boys. The majority of students came from homes in which their father worked and their mother stayed home (N= 982; 61.9% of sample). The most common profession for the fathers of the sample participants was tradesman (N=267; 16.8% of sample) and for the working mothers of the sample participants was teacher (N=162; 10.2% of sample). See Table 1 for all demographic information. Following standard procedures, Institutional Review Board approval, parental permission, and child assent were collected prior to data collection.

Implementation of the T-CAMS paralleled the standard English-language administration by

providing each student with a paper copy of the demographic sheet and the facial images scale. Items were verbally administered to all participants, beginning with two non-math practice items to ensure children understood how to respond to each item and concluding with the full 16-item T-CAMS. Data collection times ranged from 15 minutes (for secondary students) to 45 minutes (for the youngest primary students) and occurred over a three-month period by one researcher.

Table 1. Participant characteristics

Characteristic	N	Percent of sample
Gender		
Boys	812	51.2%
Girls	775	48.8%
Grade		
1st	250	15.8%
2nd	335	21.1%
3rd	290	18.3%
4th	423	26.7%
5th	289	18.2%

3. RESULTS

Please see Table 2 for descriptive statistics for the T-CAMS.

3.1 Exploratory Factor Analysis (EFA)

With a subset of 500 participants from the total data set, an exploratory factor analysis (EFA) was run with all 16 items of the T-CAMS (see Table 3). Values of the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO = .911) and Bartlett's test of sphericity (χ^2 = 6259.053, *df* =120, *p* < .0001) met the necessary assumptions for conducting the EFA using maximum likelihood method. Because there are likely correlations among various anxiety factors, we chose the oblique Promax rotation. The initial EFA solution contained three factors with eigenvalues exceeding the standard 1.0 value, and these three factors explained 47.94% of the variance. Examination of the scree plot suggested that all three of these factors were providing meaningful contributions to the factorial

structure. The first factor included 11 items (eigenvalue 5.004), the second included three items (eigenvalue 1.55), and the third included two items (eigenvalue 1.112). Internal consistency estimates of the first factor revealed high reliability (coefficient alpha = .856), but estimates of the second and third factor were quite low (coefficient alpha = .448 and .266 respectively).

Because the second and third factor appeared questionable in the T-CAMS, items on those factors were removed from the analysis, and an EFA with varimax rotation was conducted (See Table 4). This EFA revealed a one-factor solution (eigenvalue 4.59) accounting for 41.81% of the variance. A correlation between students' scores on the full-scale (16-item) and shortened 11-item version of the T-CAMS was high and significant (*r* = .951, *p* < .0001), showing that the shortened version could be considered an equivalent measure, with a more clear internal structure. These results were invariant across gender and grade in school.

3.2 Confirmatory Factor Analysis (CFA)

Data from the remaining 1087 participants were used for the confirmatory factor analysis. These students completed the T-CAMS at the same time as the EFA sample, but they were not included in those analyses.

The purpose of the CFA was to estimate the fit of two alternative models generated in the EFA. The two models in review were (a) the original 16-item three-factor scale, and (b) a one-factor 11-item math anxiety scale.

To conduct the CFA, the AMOS statistical package was used employing maximum likelihood analysis. Overall, the indicators for goodness of fit for the data demonstrated that the one-factor 11-item math anxiety scale fits the data slightly better than the original 16-item three-factor scale (see Table 5). Given the different lengths of the scales for these two CFA solutions, the AIC and BIC indicators hold merit in making the final judgment of model fit.

Table 2. Descriptive statistics for the T-CAMS

	Minimum score	Maximum score	Mean score	Standard deviation
Overall sample	22	79	58.97	9.03
Girls	26	76	58.84	8.65
Boys	22	79	59.11	9.39

Table 3. Factor loadings for exploratory factor analysis with promax rotation of 16-item Turkish CAMS (items translated to English)

Item	Factor 1	Factor 2	Factor 3
When I solve math problems, I feel:	.662	-.049	.016
When I think about doing math, I feel:	.640	-.127	.068
Compared to other school subjects, math makes me feel:	.621	-.018	.094
When I solve math puzzles, I feel:	.530	-.138	.151
When the teacher calls on me to answer a math problem, I feel:	.597	.037	-.259
If I have to add up numbers on the blackboard in front of the class, I feel:	.561	.284	-.318
Thinking about working on math in class makes me feel:	.702	-.227	.076
Working on math at home makes me feel:	.725	-.191	.125
When my teacher says that he or she is going to give me a math problem on the blackboard, I feel:	.684	.053	-.236
When I know that my class will be working on math at school, I feel:	.603	-.241	.225
When I know that I am going to have a math test, I feel:	.670	-.041	-.023
When I have a hard math question, I feel:	.399	.655	-.085
When I am working on math problems that are difficult and make me think hard, I feel:	.446	.595	-.098
When I make a mistake in math, I feel:	-.151	.354	.609
When the teacher gives the class a math problem I don't understand, I feel:	.185	.498	.521
When the teacher is showing the class how to solve a math problem, I feel:	.321	-.357	.344
Rotated Eigenvalue	5.004	1.555	1.112
Coefficient Alpha	.856	.448	.266

Note. Factor loadings > .40 are in boldface

Table 4. Factor loadings for exploratory factor analysis with varimax rotation of 11-item Turkish CAMS (items translated to English)

Item	Factor 1
When I solve math problems, I feel:	.666
When I think about doing math, I feel:	.647
Compared to other school subjects, math makes me feel:	.627
When I solve math puzzles, I feel:	.536
When the teacher calls on me to answer a math problem, I feel:	.605
If I have to add up numbers on the blackboard in front of the class, I feel:	.547
Thinking about working on math in class makes me feel:	.715
Working on math at home makes me feel:	.741
When my teacher says that he or she is going to give me a math problem on the blackboard, I feel:	.688
When I know that my class will be working on math at school, I feel:	.619
When I know that I am going to have a math test, I feel:	.688
Eigenvalue	4.599
Coefficient alpha	.856

Taking into consideration the minimal differences in the models, the stronger internal consistency in the shorter scale, the acceptable fit for the 11-item scale, and the interest in maintaining parsimony with the construct of math anxiety, the selection of the 11-item version is most desirable for future uses with the T-CAMS.

4. DISCUSSION

The purpose of the current study was to translate the English *Children's Anxiety in Math Scale* [22]

to Turkish and to assess the psychometric properties of the T-CAMS. The results of this study confirmed that the T-CAMS was a reliable and valid measure of math anxiety in the Turkish sample. The adaptation process provided evidence to support using this scale and also revealed a new factor structure that promotes the use of a shorter form.

Though Jameson's [22] original English-language scale purported a 16-item three-factor conceptualization of math anxiety, the current

model did not provide support for breaking the math anxiety construct into subcomponents such as math error anxiety, math performance anxiety, and general math anxiety. The CAMS includes items that measure these various proposed separate factors, but the current data maintain a strong fit with the single-factor model. Naturally, further research comparing the single-factor and multi-factor models directly is warranted to establish that the findings in this study are accurate with other samples. Adaptation to Turkish of additional math anxiety scales (or using already existing translated math anxiety scales) could be necessary to cross-validate the findings.

Table 5. Fit Indices for competing models of the Turkish CAMS

Model	3 Factor (16 items)	1 Factor (11 items)
CMIN/DF	6.792	4.747
CMIN	679.147	199.375
GFI	.944	.977
CFI	.906	.969
RMSEA	.060	.049
AIC	751.174	247.375
BIC	944.480	376.246

One of the major areas in which Turkish students have difficulties in math compared to other countries participating in the PISA 2012 exam is problem solving [7,8]. The two items that were most factorially conflicted were related to problem solving (i.e., Q8: When the teacher is showing the class how to solve a math problem, I feel:, and Q13: When the teacher gives the class a math problem I don't understand, I feel:), suggesting that Turkish students may perceive problem solving to be a construct separate from mathematics.

Further, examining the items that did not load well and were dropped from the 16-item scale shows that four of the five items are related to completing math that is difficult or prone to errors. It is possible that the factor termed "math error anxiety" on the English version of the CAMS is not a construct present in Turkish students. It is also possible that this error anxiety is a component of Turkish students' self-efficacy in mathematics as opposed to their anxiety in mathematics. Ruzgar, Sokmen, and Boynak [42] state that there is a lot of pressure placed upon Turkish students from a young age to score well in mathematics and sciences so that they enter a strong elementary school and increase their chances of acceptance to a competitive

university. One would then expect that Turkish students would have high math error anxiety, but the T-CAMS did not indicate that. Additional research should explore this discrepancy to uncover the specific nature of this factor in Turkish students.

5. CONCLUSION

In conclusion, the current research provides a valid and reliable measure of Turkish primary students' math anxiety. The establishment of a consistent and equivalent Turkish-language version of the CAMS provides a valuable tool for conducting valid cross-cultural research on math anxiety. This is of particular import for Turkish researchers, as recent multi-national educational assessments have identified that Turkish students experience high math anxiety. In addition to creating and validating the T-CAMS, the results of this research have prompted re-evaluation of the English language version of the CAMS, with preliminary analyses demonstrating that a shortened version of the English CAMS is also a preferred solution for measuring math anxiety in English-speaking elementary students. Further work on validating the CAMS is currently ongoing as we establish the optimal shortened version in both English- and Turkish-speaking samples.

ACKNOWLEDGEMENTS

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Erbas AK, Ulubay M. Implementation of the new Turkish primary education mathematics curriculum in the sixth grade: A survey of teachers' views. The New Educational Review. 2008;16(3-4):51-75.
2. Talim ve Terbiye Kurulu (TTKB). İlköğretim 1–5. Sınıf programları tanıtım el kitabı [Introductory handbook to elementary school curriculum, grade 1–5]. Ankara: TC

MEB Talim ve Terbiye Kurulu Baskanlıgı; 2005.

3. Offical Journal. İlköğretim ve eğitim kanunu ile bazı kanunlarda değişiklik yapılmasına dair kanun; 2012.
Available:http://www.resmigazete.gov.tr/es kiler/2012/04/20120411-8.htm
(Retrieved on 11 November 2012)

4. MEB. 2013-2014 Eğitim–Öğretim yılı orta öğretime geçiş ortak sınavları e-Kılavuzu Education and Instruction year e-Guide of common exams of transferring to secondary education; 2013.
Available:http://www.meb.gov.tr/duyurular/ duyurular2013/teog2013/TEOGKlavuzu20 13.pdf
(Retrieved on 2 September 2013)

5. TIMMS. TIMMS 1999 Türkiye raporu (TIMMS 1999 Turkey Report). Ankara: EARGED Yayınları; 2003.

6. TIMMS. TIMMS 2007 Ulusal Matematik ve Fen Raporu (TIMMS 2007 National Mathematics and Science Report). Ankara: EARGED Yayınları; 2011.

7. OECD. PISA 2012 results: What students know and can do – student performance in mathematics. Reading and Science. PISA. OECD Publishing. 2013;(I-II-III-IV).

8. OECD. PISA 2012 Results: Ready to learn: Students' engagement. Drive and Self-Beliefs, Paris. 2013;(1-3).

9. EARGED. TIMSS-R: Third international mathematics and science study-repeat/ üçüncü uluslararası matematik ve fen araştırmasının tekrarı- uluslararası ölçme ve değerlendirme çalışmaları. Ankara: MEB Eğitimi Araştırma ve Geliştirme Dairesi (EARGED); 2003.

10. EARGED. PISA 2003 Projesi ulusal nihai raporu (PISA 2003 Project national final report), Ankara:Milli Eğitim Basımevi; 2005.

11. EARGED. PISA (Programme for International Student Assessment) 2009 Ulusal nihai rapor (National final report) 5 – 6. MoNE, Educational Research and Development Directorate (ERDD), Ankara; 2010.

12. MEB. PISA 2006 uluslararası öğrenci başarılarını değerlendirme programı ulusal nihai rapor. (PISA 2006 Project national final report). Ankara: MEB-Eğitimi Araştırma ve Geliştirme Dairesi Başkanlığı; 2007.

13. MEB. Mili Eğitim Bakanlığı basın bildirisi: OECD'nin PISA projesine Türkiye'nin katılımı (Ministry of National Education press report); 2008.
Available:http://www.meb.gov.tr/duyurular/ duyurular/pisa/pisaraporu.htm
(Retrieved on 5 July 2011)

14. UNESCO. EFA (Education for all) Global monitoring report 2009. Oxford University Press; 2009.

15. UNESCO. PISA for Development: Expanding PISA to the Developing World; 2013.
Available:http://www.unicef.org.tr
(Retrieved on 13 May 2014)

16. YegiTek. PISA 2012 Ulusal Ön Raporu (PISA 2012 National Preliminary Report), Milli Eğitim Bakanlığı (Ministry of National Education), Ankara: Yenilik ve Eğitim Teknolojileri Genel Müdürlüğü Yayınları; 2013.
Available:http://yegitek.meb.gov.tr/meb_iys _dosyalar/2013_12/13053601_pisa2012_u lusal_n_raporu.pdf
(Retrieved on 15 April 2014)

17. Richardson FC, Suinn RM. The mathematics anxiety rating scale: Psychometric data. Journal of Counseling Psychology. 1972;19:551-554.

18. Ashcraft MH. Math anxiety: Personal, educational and cognitive consequences. Current Directions in Psychological Science. 2002;11:181-185.

19. Ashcraft MH, Kirk EP, Hopko D. On the cognitive consequences of mathematics anxiety. In C. Donlan (Ed.). The development of mathematical skills. Hove, UK: Psychology Press. 1998;175-196.

20. Ma X. A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. Journal for Research in Mathematics Education. 1999;30:520-540.
DOI: 10.2307/749772

21. Ashcraft MH, Krause JA. Working memory, math performance and math anxiety. Psychonomic Bulletin & Review. 2007;14: 243-248.

22. Jameson MM. The development and validation of the Children's Anxiety in Math Scale. Journal of Psychoeducational Assessment. 2013;31:391-395.
DOI: 10.1177/0734282912470131

23. Berberoğlu G. Ev ödevlerinin öğrenme ile ilişkisi. Cito Eğitim: Kuram ve Uygulama Dergisi, Tanitim Sayisi. 2008;50-54.

24. Education Reform Attempt. Ögrencilerimiz gelecege hazır değil (Our kids are not ready for the future); 2007.

Available:http://www.uretim.meb.gov.tr/EgitekHaber/s75/PISA_BilgiNotu.htm
(Retrieved on 10 June 2010)

25. Dede Y. Mathematics anxiety questionnaire: Development and validation. Essays in Education. 2008;23: 1-22.

26. Akin A, Kurbanoglu NI, Takunyaci M. Revize edilmiş matematik kaygısı değerlendirme ölçeği: Doğrulayıcı faktör analizi çalışması (Revised math anxiety evaluation scale: The study of affirmative factor analyzes). Necatibey Faculty of Education Electronic Journal of Science & Mathematics Education. 2011;5(1):163-180.

27. Baloğlu M. Adaptation of the mathematics anxiety rating scale to Turkish, language validity and preliminary psychometric properties. Educational Sciences: Theory & Practice. 2005;5:23-30.

28. Deniz L, Uldas I. Öğretmen ve öğretmen adaylarına yönelik matematik kaygı ölçeğinin geçerlilik güvenilirlik çalışması. (Math anxiety scale for teachers and prospective teachers: Validity and reliability). Eurasian Journal of Educational Research. 2008;30:49-62.

29. Erktin E, Dönmez G, Ozel S. Matematik kaygısı ölçeği'nin psikometrik özellikleri (Psychometric characteristics of the math anxiety scale). Education & Science. 2006;31(140):26-33.

30. Isiksal M, Curran JM, Koc Y, Askun CS. Mathematics anxiety and mathematical self-concept: Considerations in preparing elementary-school teachers. Social Behavior and Personality: An İnternational Journal. 2009;37(5):631-643.

31. Uldas I. Öğretmen ve öğretmen adaylarına yönelik matematik kaygı ölçeği (MKÖ-Ö)'nin geliştirilmesi ve matematik kaygısına ilişkin bir değerlendirme (Developing math anxiety scale for teachers and teacher candidates (MKÖ-Ö) and an evaluation related to math anxiety). Unpublished master's thesis, Marmara University, İstanbul; 2005.

32. Erol E. Prevalence and correlates of math anxiety in Turkish high school students. Yayımlanmamış yüksek lisans tezi (Unpublished master science thesis), Boğaziçi Üniversitesi (Bogazici University), İstanbul; 1989.

33. Bindak R. İlköğretim öğrencileri için matematik kaygı ölçeği (Math anxiety scale for students in primary school). Firat University Journal of Science and Engineering. 2005;17(2):442-448.

34. Dede Y, Dursun S. İlköğretim II. kademe öğrencilerinin matematik kaygı düzeylerinin incelenmesi (Investigation of middle school students' math anxiety). Uludag University Journal of Faculty of Education). 2008;11(2):295-312.

35. Ozdemir E, Gur H. Matematik kaygısı-endişesi ölçeğinin (MKEÖ) Geçerlik ve güvenirlik çalışması (The Study of validity and reliability of math anxiety scale) Education & Science. 2011;*36*(161):39-50.

36. Ikegulu TN. An empirical development of an instrument to assess mathematics anxiety and apprehension. Research report submitted to the US Department of Education; 1998.
Available:riles.eric.ed.gov/fulltext/ED433235.pdf

37. Balgolu M, Balgalmis E. Matematik kaygısını derecelendirme ölçeği ilköğretim formunun Türkçe'ye uyarlanması, dil geçerliği ve psikometrik incelemesi (Adapting to Turkish, examination of language validity and pre-psychometric of math anxiety evaluation scale. Educational Sciences: Theory & Practice. 2010; 10(1):77-110.

38. Suinn RM, Taylor S, Edwards RW. Suinn mathematics anxiety rating scale for elementary school students (MARS-E): Psychometric and normative data. Educational and Psychological Measurement. 1988;48:979-986.
DOI: 10.1177/0013164488484013

39. Ashcraft MH, Moore AM. Mathematics anxiety and the affective drop in performance. Journal of Psychoeducational Assessment. 2009;27: 197-205.

40. DeLoache JS. Dual representation and young children's use of scale models. Child Development. 2000;71:329-338.

41. Satmare GA, Jameson MM. Working memory load and cognitive test anxiety in elementary school students: An experimental study. Poster presented at the Association for Psychological Science Annual Conference, San Francisco, CA; 2014.

42. Ruzgar NS, Sokmen N, Boynak F. Mathematics anxiety among elementary school students and attitude scale. Unpublished manuscript; 2008.
Available:ietc2008.home.anadolu.edu.tr

APPENDIX

Translated version of CAMS and facial image scale used as response option in T-CAMS.

Bu bilgi formu, demografik özelliklerini yazmanız için temel demografik soruları içermektedir. Her çocuk bilgi formu ve yüz ifadelerini alır. Araştırmacı kendini tanıtır ve katılımcılara şöyle der: " Bugün matematikle ilgili neler hissettiğinizle ilgili bazı sorular cevaplayacaksınız. İlk olarak boşluğa adınızı yazın. Daha sonra şu an bulunduğunuz sınıfınızı yazın. Sonra da kız ya da erkek seçeneklerinden birini işaretleyin. En sona da doğum gününüzü yazın. Şimdi size bazı sorular okuyacağım ve her bir sorunun ardından sizi en iyi tanımlayan yüz ifadesini işaretlemenizi isteyeceğim. (yüz ifadesini göstererek)" Çokça somurtmuş olan yüz, üzgün; daha az somurtan yüz, daha az üzgün; ağzı düz olan yüz, ne üzgün ne de heyecanlı; biraz gülümseyen yüz, heyecanlı; yüzünde büyük gülümseme olan da çok heyecanlı olduğunuzu göstermektedir. Herkesin anladığından emin olmak için şimdi iki tane örnek yapacağız.

Matematik Kaygısı Ölçeği

Örnek Maddeler:

Ör. 1: Akşam yemeğinden sonra bana özel bir şeyler ikram edilince kendimi hissediyorum.
Ör. 2 Annem bir kuralı çiğnediğimi öğrenince kendimi… hissederim.

Ölçek Maddeleri

1. Matematik problemlerini çözerken kendimi… hissederim.
2. Matematik hakkında düşünürken, kendimi… hissederim
3. Bana zor gelen matematik problemlerini çözmeye çalışırken, kendimi… hissederim.
4. Diğer derslerle karşılaştırdığımda, matematik beni… hissettirir.
5. Matematikle ilgili bulmaca çözerken, kendimi… hissederim.
6. Zor bir matematik sorusuyla karşılaştığımda, kendimi… hissederim.
7. Matematik problemini çözmem için öğretmen beni çağırdığında, kendimi… hissederim.
8. Öğretmen bir matematik probleminin nasıl çözüldüğünü sınıfa gösterdiğinde, kendimi… hissederim.
9. Sınıfın önünde tahtada soruyu çözmek zorunda kaldığımda, kendimi… hissederim.
10. Matematik dersinde bir hata yaptığımda, kendimi… hissederim.
11. Sınıfta kendimi matematik çalışırken düşünmek beni… hissettirir.
12. Evde matematik çalışmak bana kendimi… hissettirir.
13. Öğretmen, anlamadığım bir matematik problemini sınıfa verdiğinde, kendimi… hissederim.
14. Öğretmen, beni bir matematik problemi çözmem için tahtaya çağırdığında, kendimi… hissederim.
15. Arkadaşlarımın sınıfta matematik çalışacağını öğrendiğimde, kendimi… hissederim.
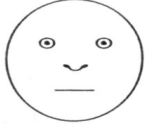16. Bir matematik sınavına gireceğimi öğrendiğimde, kendimi… hissederim.
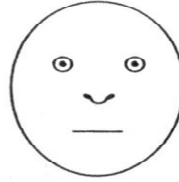
Yüz İfadeleri

= Üzgün Yüz

= Daha Az Üzgün Yüz

= Ne Üzgün Ne de Heyecanlı Yüz

= Heyecanlı Yüz

= Çok Heyecanlı Yüz