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Development and validation of the survey items of the South Korean elementary teachers' anxiety about teaching mathematics (S-ATM)

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Abstract: This article is a report about the development of a new instrument to measure South Korean elementary teachers' anxiety about teaching mathematics; it explores the instrument's underlying dimensions by examining the responses of 64 South Korean elementary teachers. From the conceptual framework, I designed three sub-scales in the Survey Items of the South Korean Elementary Teachers' Anxiety about Teaching Mathematics (S-ATM): preference for mathematics or mathematics instruction, confidence in mathematics or mathematics instruction, and effectiveness of mathematics instruction. I conducted analyses of the principal components to determine the factor structures of the scales. The results showed that the relativity for each sub-scale's Cronbach's alpha was greater than .700. I also examined this scale's validity by surveying the same participants with the Mathematics Teaching Efficacy Belief Instrument and comparing the results. The results demonstrated that the mathematics teaching anxiety sub-scales were significantly collated with the validation scale statistically. Its psychometric properties were sound, and the S-ATM instrument can be recommended for use in investigating South Korean elementary teachers' anxiety about teaching mathematics.

Keywords: Anxiety about Teaching Mathematics, Mathematics Anxiety, Elementary Teacher, Teacher Education, Scale Development

1. Introduction

The term "mathematics anxiety" indicates feelings of panic and mental disorganization that some people experience when they solve mathematics problems [1]. Preventing students from feeling mathematics anxiety in a classroom setting is important to helping them learn because students' mathematics anxiety may threaten their academic achievement scores as well as their participation in a mathematics classroom [2].

Diverse studies suggest that teachers may be in the best position to prevent students' mathematics anxiety because they could be one of its main causes [2, 3]. In particular, as studies reveal that teachers' anxiety about teaching mathematics may then influence students' mathematics anxiety [4, 5] , interest in examining teachers' anxiety about teaching mathematics has increased. However, the current amount of research on in-service teachers' anxiety over teaching mathematics is relatively small, and the constructs of elementary teachers' anxiety about teaching mathematics are still vague [6]. Thus, diverse approaches are needed to understand elementary teachers' anxiety about teaching mathematics.

To broaden the general understanding of teachers' anxiety about teaching mathematics and its effects on their classroom instruction, I would focus on developing the survey items on South Korean elementary teachers' anxiety about teaching mathematics (S-ATM) by conducting pilot tests on South Korean elementary teachers. Reference [7] suggested that international research could provide opportunities to understand diverse issues about teaching and learning mathematics, although the subject of mathematics itself may not vary significantly from country to country [8]. In particular, investigating elementary teachers in South Korea may offer valuable insights to researchers, policymakers, and teachers, especially in the United States, because South Korean students score consistently better on international assessments (e.g., PISA and TIMSS) than U.S. students in the subject of mathematics, although South Korea's national mathematics curriculum was initially based on U.S. mathematics curriculum standards and is still influenced by it [9].

2. Framework

Reference [10] argued that elementary teachers who have anxiety about teaching mathematics may exhibit the following behaviors: (a) not showing that they like mathematics, (b) not making mathematics enjoyable, (c) not showing the use of mathematics in everyday life, (d) not adapting instructions to students' interests, (e) not establishing attainable objectives, (f) not providing engaging mathematics activities, and (g) not employing meaningful teaching methods. In addition, Reference [11] pointed out that elementary teachers who feel anxiety about teaching mathematics may lack confidence in their abilities and may not want to teach mathematics; therefore, they put less effort into designing their mathematics instructions.

Based on the evidence from the studies on teachers' anxiety about teaching mathematics, I developed the conceptual framework as shown in Fig 1. This conceptual framework provided the basis for developing the survey items for S-ATM in this study.

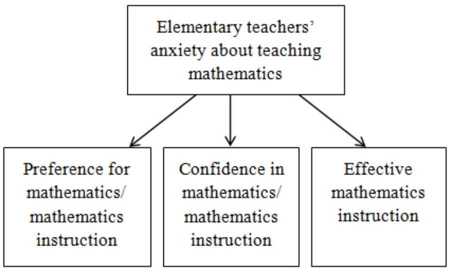

Figure 1. *Conceptual framework.*

3. Instrument Design

An initial pool of 50 items was generated based on the conceptual framework of this study. I used a 4-point Likert scale to elicit sufficient reliability, where 1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Disagree. I did not include a distinct "not sure" or "uncertain" response because the participants may have defaulted to this middle option and overlooked the real meaning of the questions.

A professor who teaches statistics courses in an America university reviewed the initial question pool. After the first review, the questions were translated into Korean because the participants in this study are South Korean elementary teachers. Although I am a native speaker of Korean who is also fluent in English, and I spent 10 years teaching in South Korea, the questions were translated into Korean based on categories of change for translating instruments into another language to maintain validity [8]: (1) changes related to general cultural context, (2) changes related to the school context, and (3) changes related to mathematical substance. In addition, two South Korean elementary teachers who have more than 10 years of teaching experience validated the instruments' translation, verifying the translations' accuracy and confirming that any changes regarding wording and cultural fit were in line with common presentations in Korean. During the reviewing process, the experts identified problems of redundancy among items and vagueness of statements. Based on this expert feedback, I reduced the final questionnaire to 25 scale items (plus 3 demographics questions) for piloting, as illustrated in Tables 1 and 2.

Table 1. *Survey items on S-ATM (English).*

Constructs	Survey Items (English)
Preference for mathematics or mathematics instruction [1-9]	1. Teaching difficult mathematics concepts is uncomfortable for me. 2. I like teaching mathematics. 3. I like solving mathematics problems. 4. I am nervous when I solve mathematic problems. 5. I did well in mathematics classrooms when I was a student. 6. I did not want to take mathematics courses when I was a student. 7. I have math anxiety. 8. It makes me nervous to think about any types of mathematics problems. 9. I am comfortable solving mathematics problems.
Confidence in mathematics/ mathematics instruction [10-18]	10. I am confident in teaching mathematics. 11. I am confident in teaching difficult mathematics concepts. 12. I am confident in solving mathematics problems. 13. Most of the other teachers in my school are better than me at teaching mathematics. 14. I like mathematics. 15. I am not sure that I can improve my teaching ability in mathematics. 16. If I don't know the answer for students' mathematics questions, it is ok, since I believe that I can find answer in the end. 17. I am nervous when a student suggests diverse ways of problem solving, which I am not familiar with. 18. I can open my mathematics classroom to my supervisor at any time.
Effective mathematics instruction [19-25]	19. When I teach mathematics, I allow my students to ask questions a lot. 20. I am familiar with diverse mathematics materials for teaching mathematics except textbook. 21. I have difficulties teaching mathematics concepts to students. 22. I do not know diverse mathematics activities. 23. I do not know how to differentiate instruction according to students' levels in my mathematics classroom. 24. I do not welcome students' questions during mathematics instruction. 25. When teaching mathematics, I ignore students' questions.

Table 2. *Survey items on S-ATM (Korean).*

Constructs	Survey Items (English)
수학 및 수학교육에 대한 선호도 [1-9]	1. 나는 어려운 수학개념을 가르치는 것이 불편하다. 2. 나는 수학을 가르치는 것을 좋아한다. 3. 나는 수학 문제를 푸는 것을 좋아한다. 4. 나는 수학문제를 풀 때 불안하다. 5. 내가 학생이었을 때 나는 수학을 잘했다. 6. 내가 학생이었을 때 나는 수학 수업 듣는 것을 좋아하지 않았다.

Constructs	Survey Items (English)
수학 및 수학교육에 대한 자신감 [10-18]	7. 나는 수학 불안이 있다. 8. 나는 수학문제를 생각하면 긴장된다. 9. 나는 수학문제를 풀 때 편안하다. 10. 나는 수학을 가르치는데 자신감이 있다. 11. 나는 어려운 수학 개념을 가르치는데 자신이 있다. 12. 나는 수학에 자신이 있다. 13. 우리 학교 대부분의 선생님들은 나보다 수학을 잘 가르친다. 14. 나는 수학을 좋아한다. 15. 나는 내 수학교수능력이 향상될 수 있을지 잘 모르겠다. 16. 학생들의 수학 질문에 당장 대답할 수 없어도, 나는 내가 결국 답을 찾을 수 있다는 것을 믿기 때문에 괜찮다.. 17. 나는 학생들이 내가 익숙하지 않은 방법으로 수학문제를 풀면 긴장된다. 18. 나는 내 수학 수업을 장학사에게 언제든지 공개할 수 있다.
수학수업의 효율성 [19-25]	19. 나는 수학수업을 할 때 학생들로 하여금 질문을 많이 하도록 한다. 20. 나는 다양한 수학교구를 잘 알고 있다. 21. 나는 수학개념을 학생들에게 가르치는 것에 대해 어려움을 느낀다. 22. 나는 다양한 수학활동들을 잘 알지 못한다. 23. 나는 수학수업에서 수준별 수업을 어떻게 해야 할지 잘 모르겠다. 24. 나는 수학 수업 중 학생들의 질문이 별로 달갑지 않다. 25. 나는 수학 수업 중 내가 답을 알지 못하는 학생들의 질문은 무시한다.

4. Sample

Conducting a survey helped me develop a broader perspective about elementary teachers' anxiety about teaching mathematics because surveys are useful when the purpose of a study is to describe quantitatively specific aspects of a given population [12]. If a survey obtains data based on a representative sample, the data can be generalized to a population [13]. Therefore, I surveyed randomly selected South Korean elementary teachers to ensure validity and to generalize my findings.

The locations of the elementary schools where the participants taught are likely insignificant because teachers' quality and distribution are highly controlled by the government of South Korea. Also, by law, teachers are required to change schools every 5 years. Therefore, it is unlikely that the schools' locations significantly affect elementary teachers' anxiety about teaching mathematics. Working with alumni from the Seoul National University of Education, I recruited participants for the survey via e-mail.

Sixty-four South Korean elementary teachers completed the survey. Of these participants, 14 were excluded from analysis because they did not answer all the items. However, I did include participants who only neglected the demographic items because the purpose of this study is not to analyze the survey results according to the participants' demographic information. The information regarding missing cases is shown in Table 3.

Table 3. *Information about missing cases regarding demographic information.*

	Cases					
	Answered		Did not answered		Total	
	N	Percent	N	Percent	N	Percent
Gender	49	98.0%	1	2.0%	50	100.0%
Teaching Experiences	50	100.0%	0	0.0%	50	100.0%
Certification Level*	49	98.0%	1	2.0%	50	100.0%

*Note. When completing the bachelor's degree program, graduates receive teacher certification at the second level and only receive the first level after teaching 3 to 5 years and completing 180 hours of professional development courses in a teacher preparation program.

Table 4 summarizes the demographic information of the pilot sample. Respondents were predominantly female (80.0%), but this dominance might not be problematic in this pilot survey because 76.2% of the 181,435 elementary teachers in South Korea in 2012 were female [14]. The majority of respondents (80%) had been teaching between 0 and 15 years. In addition, more than half (70%) had earned the Elementary School Teacher's License Level 1.

Table 4. *Demographics of pilot sample (n=50).*

Characteristics		Frequency	Percent
Gender	Male	9	18.0
	Female	40	80.0
Teaching Experiences	0-5 years	14	28.0
	6-10 years	16	32.0
	11-15 years	10	20.0
	16-20 years	2	4.0
	More than 21 years	8	16.0
Certification Level	Level 1	35	70.0
	Level 2	14	28.0

5. Item Description

Table 5 contains the means and the standard deviation for all items on the S-ATM scales. In general, respondents scored high on the items, with mean scores ranging from 2.34 to 3.18. However, the items did demonstrate some variance, with standard deviations ranging from .49 to .87. Eight reverse-coded items were included in the instrument to control for acquiescence (e.g., "I am nervous when I solve mathematics problems").

***Table 5.** Descriptive statistics for S-ATM scale.*

Items	Number	Minimum	Maximum	Mean	Std. Deviation
1	50	2	4	2.92	.528
2	50	2	4	2.98	.622
3	50	1	4	3.04	.755
4	50	1	4	2.96	.699
5	50	2	4	2.94	.843
6	50	1	4	2.88	.799
7	50	1	4	3.14	.639
8	50	1	4	3.10	.678
9	50	1	4	2.76	.657
10	50	2	4	2.84	.681
11	50	1	4	2.60	.782
12	50	2	4	2.98	.742
13	50	1	4	2.76	.625
14	50	1	4	2.66	.872
15	50	1	4	2.80	.606
16.	50	2	4	3.14	.495
17	50	1	4	2.68	.768
18	50	1	4	2.34	.717
19	50	2	4	2.76	.687
20	50	1	4	2.40	.700
21	50	1	4	2.78	.679
22	50	1	4	2.42	.673
23	50	1	4	2.48	.707
24	50	2	4	3.10	.580
25	50	1	4	3.18	.661

To check the differences in responses to the 25 items, I compared their mean according to gender, years of teaching experience, and level of certification. When I conducted 25 t-tests and analysis of variance (ANOVA) with a single sample, I used an adjusted α-level. Because α = .02, the mean did not vary statistically according to gender, years of teaching experience, and level of certification. Thus, I concluded that there were no significant differences in terms of gender, years of teaching experience, or level of certification when participants responded to the survey items. In addition, the participants' genders, years of teaching experience, and levels of certification did not affect the analysis of the survey data.

6. Factor Structure

I analyzed the principal components to determine the factor structures of S-ATM scales. The components were designed to maximize the total amount of variance explained. I conducted separate principal component analyses on each of the sub-scales because the scales were conceptualized as distinct components, as shown in the conceptual framework.

6.1. Preference for Mathematics/Mathematics Instruction

The Preference for Mathematics/Mathematics Instruction sub-scale contained nine items, which met the assumption of principal component analysis with a Kaiser-Meter-Olkin (KMO) Measure of Sampling Adequacy of .801, a non-zero determinant. The initial extraction yielded two components with an eigenvalue greater than 2. An oblimin rotation was then conducted, resulting in a two-component solution, with each component including five variables. As shown in Table 5, except for items 1 and 5, items loaded substantially on one of the components (> .5).

Subsequently, I reran the principal component analysis without items 1 and 5 and extracted two components. I then conducted an oblimin rotation that resulted in two distinct components, where items had high loadings on one component (> .5) and no significant loadings on another component, as shown in Table 6.

***Table 6.** Pattern matrix for the preference for mathematics/mathematics instruction.*

Items	Component 1	Component 2
7	.909	
8	.842	
6	.806	
4	.776	
3		.903
9		.896
2		.830

The first components contained items that described respondents' negative perspectives toward mathematics or mathematics education (e.g., "I have math anxiety"). The items on the second component described participants' positive perspectives toward mathematics or mathematics education (e.g., "I like teaching mathematics"). Although I reversed the scores of items, which were stated negatively, the results of the analysis revealed two components among the items in this category.

I then performed separate principal component analyses on each group of items. When I conducted the principal component analyses separately for each component, the KMO for both analyses was greater than .7. The Cronbach's alpha for both components equaled .861, indicating that a variance of about 86.1% in the scale was considered reliable for components 1 and 2. If an item were deleted, the Cronbach's alpha would decrease, indicating that each item may have contributed to the reliability of the data in some way. In addition, for both components, the inter-item correlations among items were all positive, representing items that measured the component consistently. Thus, I determined that it was justifiable to interpret scores that happened to aggregate.

6.2. Confidence in Mathematics/Mathematics Instruction

The Confidence in Mathematics/Mathematics Instruction sub-scale contained nine items, which met the assumption of principal component analysis with a KMO Measure of Sampling Adequacy of .702, a non-zero determinant. The initial extraction yielded two components with an eigenvalue greater than 2. I then conducted an oblimin rotation, resulting in a two-component solution, with each component including five variables. As shown in Table 7, items loaded substantially on one of the components (> .5).

Table 7. *Pattern matrix for the confidence in mathematics/mathematics instruction.*

Items	Component	
	1	2
11	.904	
12	.812	
10	.807	
14	.712	
18	.674	
16	.576	
15		.852
13		.773
17		.668

The first components contained items that described respondents' confidence in mathematics or mathematics education (e.g., "I am confident in teaching difficult mathematics concepts"). The items for the second component represented participants' lack of confidence in mathematics or mathematics education (e.g., "I like teaching mathematics"). Although I reversed the scores of the items, which were stated negatively, the results of the analysis demonstrated that there were two components among the items in this category.

I then performed separate principal component analyses on each group of items. When the principal component analysis was conducted separately for each component, the KMO for both analyses was greater than .7. The Cronbach's alpha for component 1 was equal to .843 and for component 2 was equal to .861, indicating that an approximate 84.3% variance in the scale was considered reliable for component 1 and an approximate 86.1% variance in the scale was considered reliable for component 2. If an item were deleted, the Cronbach's alpha would decrease, indicating that each item may have contributed to the reliability of the data in some ways. In addition, for both components, the inter-item correlations among items were all positive, representing items that measured the component consistently. Thus, I determined that it was justifiable to interpret scores that happened to aggregate.

6.3. Effective Mathematics Instruction

The Effective Mathematics Instruction sub-scale contained seven items, which met the assumption of principal component analysis with a KMO Measure of Sampling Adequacy of .711, a non-zero determinant. The initial extraction yielded two components with an eigenvalue greater than 2. I then conducted an oblimin rotation, resulting in a two-component solution, with each component including five variables. As shown in Table 8, except for items 21, 23, and 24, items loaded substantially on one of the components (> .5) as shown in the Table 8.

Table 8. *First pattern matrix for the effective mathematics instruction.*

Items	Component	
	1	2
23	.872	-.294
21	.784	.223
25	.724	
22	.724	
24	.550	.506
19		.941
20		.703

Subsequently, I reran the principal component analysis while considering diverse cases, such as when either item 23, 24, or 25 were deleted or when only two of them were deleted. Also, I reran the principal component analysis without all three items. As a result, when I reran the analysis without items 23 and 24, two components were extracted. I then conducted an oblimin rotation, resulting in two distinct components, for which items had high loadings on one component (> .5) and no significant loadings on another component, as shown in Table 9.

Table 9. *Second pattern matrix for the effective mathematics instruction.*

Items	Component	
	1	2
21	.861	
22	.785	
25	.746	
19		.925
20		.789

The first components contained items that described respondents' ineffective mathematics instruction (e.g., "I have difficulties teaching mathematics concepts to students"). The items for the second component represented participants' effective mathematics instruction (e.g., "When I teach mathematics, I allow my students to ask questions a lot"). Although I reversed the scores of the items, which were stated negatively, the results of the analysis demonstrated that there were two components among the items in this category.

I then performed separate principal component analyses on each group of items. Each analysis did not meet all the assumptions of a principal component analysis because the analysis had KMOs of .585 for component 1 items and .599 for component 2 items, respectively. One explanation for the low KMO is the small number of items because the KMO may increase when the number of items in the principal component analysis increases [15]. However, the relativity was acceptable because the reliability for component 1 items was .724 and for component 2 items was .667. In addition, corrected-item total correlations were greater than .5. Thus, I decided to retain items 19, 20, 21, 22, and 25 in the scale, although the KMO for each analysis was less than .7.

6.4. Creating Scale Scores

Based on the results of analysis as discussed above, I deleted items 1, 5, 24, and 25 from the mathematics teaching anxiety scale. Thus, the final measurement scale comprised 21 items. With this scale, I determined the preliminary scale score by calculating the average score of the items in each of the subscales. Descriptive statistics for the items are presented in Table 10.

Table 10. *Descriptive statistics.*

	N	Minimum	Maximum	Mean	Std. Deviation	Reliability	Standard Error of Measurement
P_N*	50	1.00	4.00	3.02	.59299	.861	0.59
P_P	50	1.33	4.00	2.92	.59966	.861	0.59
C_N	50	1.00	4.00	2.74	.51534	.861	0.18
C_P	50	2.00	4.00	2.76	.54206	.843	0.21
E_N	50	1.33	4.00	2.79	.53828	.724	0.17
E_P	50	2.00	4.00	2.58	.60068	.667	0.34

* Note. P_N: Preferences for mathematics/mathematics education items, which were stated in negative ways (e.g., "Teaching mathematics concepts, such as fractions, is uncomfortable for me").
P_P: Preferences for mathematics/mathematics education items, which were stated in positive ways (e.g., "I like teaching mathematics").
C_N: Confidence in mathematics/mathematics education items, which were stated in negative ways (e.g., "Most of the other teachers in my school are better than I am at teaching").
C_P: Confidence in mathematics/mathematics education items, which were stated in positive ways (e.g., "I am confident teaching mathematics").
E_N: Effective mathematics instruction items, which were stated in negative ways (e.g., "I have difficulties teaching mathematics concepts to students").
E_P: Effective mathematics instruction items, which were stated in positive ways (e.g., "When I teach mathematics, I allow my students to ask questions a lot").

6.5. The Relationship Among Sub-Scales

To acquire a better understanding of the relationship between the sub-scales, I created a Pearson Correlation Matrix using the six sub-scales, as shown in Table 11. Although some sub-scales did not significantly correlate with the other sub-scales statistically (e.g., effective mathematics instruction negative), most of sub-scales significantly correlated with the other sub-scales generally.

Table 11. *Correlations.*

		P_N	P_P	C_N	C_P	E_N	E_P
P_N	Pearson Correlation	1	.392**	.685**	.417**	.706**	.131
	Sig. (2-tailed)		.005	.000	.003	.000	.363
	N	50	50	50	50	50	50
P_P	Pearson Correlation	.392**	1	.210	.859**	.395**	.564**
	Sig. (2-tailed)	.005		.143	.000	.005	.000
	N	50	50	50	50	50	50
C_N	Pearson Correlation	.685**	.210	1	.314*	.739**	.232
	Sig. (2-tailed)	.000	.143		.027	.000	.106
	N	50	50	50	50	50	50
C_P	Pearson Correlation	.417**	.859**	.314*	1	.460**	.619**
	Sig. (2-tailed)	.003	.000	.027		.001	.000
	N	50	50	50	50	50	50
E_N	Pearson Correlation	.706**	.395**	.739**	.460**	1	.284*
	Sig. (2-tailed)	.000	.005	.000	.001		.046
	N	50	50	50	50	50	50
E_P	Pearson Correlation	.131	.564**	.232	.619**	.284*	1
	Sig. (2-tailed)	.363	.000	.106	.000	.046	
	N	50	50	50	50	50	50

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

I then conducted a principal component analysis of the six sub-scales. Two components emerged with eigenvalues greater than 1. The first component accounted for 56% of the variance, and the second component accounted for 24% of the variance in the scales. Sub-scales that related to negative perspectives (e.g., ineffective mathematics instruction) all loaded highly on the first component, while sub-scales related to positive perspectives (e.g., effective mathematics instruction) loaded highly on the second component, as shown in Table 12.

Table 12. *Pattern matrix for the S-ATM.*

	Component	
	1	2
C_N	.930	
P_N	.884	
E_N	.863	
P_P		.900
C_P		.887
E_P		.849

7. Evidence of Validity

One way to test for validity is to administer other items at the same time the pilot measures are being conducted. One related scale was included in this analysis: the Mathematics Teaching Efficacy Belief Instrument (MTEBI). Reference [16] demonstrated a direct relationship between the perceived levels of teacher efficacy and attitudes toward innovative reform practices. In particular, beliefs have been closely associated with behavior in Bandura's theory of social learning [17]. Bandura suggested that people develop a generalized expectancy concerning action-outcome contingencies based upon their life experiences [17]. Based on these researchers' arguments, I used MTEBI as the validation scale for this study. The MTEBI consisted of 21 items, and reliability analysis produced an alpha coefficient of .88 for the scale ($n = 324$) [18]. According to this validity scale, all assumptions of principal component analysis were met for this pilot survey. The determinant was 2.84, the KMO statistic was .737, and the reliability of this scale was 85%. Thus, it was acceptable to use this scale for validating the mathematics teaching anxiety scales that I developed for this study.

In general, the mathematics teaching anxiety sub-scales were collated with the validation scale, as shown in Table 13. The Pearson correlations between the mathematics teaching anxiety sub-scales and validation scale were all statistically significant ($p < .05$). The correlations ranged from .51 to .77, as shown in Table 13, suggesting that the developed scale in this study might be a sufficient indicator of mathematics teaching anxiety among South Korean elementary school teachers.

Table 13. *Correlations with the validation scale.*

		P_N	P_P	C_N	C_P	E_N	E_P	VS
VS	Pearson Correlation	.519*	.691*	.643*	.772*	.686*	.654*	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	47	47	47	47	47	47	47

*. Correlation is significant at the 0.01 level (2-tailed).

8. Closing Comments

The purpose of this analysis was to design measures that could be used to evaluate South Korean elementary teachers' mathematics teaching anxiety. Six sub-scales were created to assess different aspects of the teachers' mathematics teaching anxiety based on this study's conceptual framework. These scales each significantly correlated with the teachers' beliefs regarding their mathematics-teaching efficacy.

However, more investigation is needed regarding the ways of stating the sentence in each item. Although I theorized that three domains may relate to teachers' mathematics teaching anxiety from the conceptual framework and I reversed the scores of all negative-statement items when I analyzed the survey results, the different component loadings that resulted were not expected. As discussed above, all positive-statement items (e.g., "I like teaching mathematics") were loaded on one component, while all negative-statement items (e.g., "Teaching mathematics concepts, such as fractions, is uncomfortable for me") were loaded on the other component in all three domains. Thus, more investigation is needed regarding how the wording of items affected the participants' responses and how these differences may relate to teachers' mathematics teaching anxiety.

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