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Anxiety Scale For Science Teachers' Laboratory Work And Teaching: Validity and Reliability Analyses¹

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ABSTRACT

This study aimed to develop a valid and reliable measurement tool to determine sources of anxiety for science teachers who do laboratory teaching. For this purpose, fifty-four participants in the field of science education (five doctoral students, nine graduate students, twelve teachers and twenty-eight undergraduate students) were asked to write a composition about "What anxieties does a science teacher experience in teaching process and in laboratory?" After content analysis of the compositions, a sixty-five item pool was created based on a review of the relevant literature. The item pool was presented to four experts' opinions (three science experts and one language expert) to check its content and language validity. In keeping with the experts' opinions, five items were excluded from the scale. A ten-point Likert scale draft consisting of sixty items was first pilot tested with fourteen science teachers and then administered to one hundred and eleven teachers. The data collected were subjected to exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The Cronbach alpha coefficients (0.91) of the sub-dimensions of the scale were high (science and laboratory=0.95, communication=0.91, and classroom management=0.88), indicating that items in the sub-dimensions were consistent with each other. The CFA results showed that the T

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values of all items were significant ($p<0.05$). These results show that this is a valid and reliable scale that can be used to measure anxieties about the laboratory teaching of science teachers.

Key Words: Science teacher, anxiety scale, validity and reliability.

Fen Bilimleri Öğretmenlerinin Laboratuvar ve Öğretim Sürecine İlişkin Kaygı Ölçeği: Geçerlik ve Güvenirlik Çalışması

ÖZET

Bu çalışmanın amacı derslerinde laboratuvar kullanması gereken fen öğretmenlerinin öğretim ve deney sürecine ilişkin kaygı kaynaklarını belirleyecek geçerli ve güvenilir bir ölçme aracı geliştirmektir. Bu amaç doğrultusunda Fen Eğitimi alanından 5'i doktora öğrencisi, 9'u yüksek lisans öğrencisi, 12'si öğretmen ve 28'i lisans öğrencisi olan toplam 54 katılımcıya "Fen bilimleri öğretmeni laboratuvarında ve öğretim sürecinde hangi kaygıları hisseder?" konulu birer kompozisyon yazmaları istenmiştir. Kompozisyonlara içerik analizi yapıldıktan sonra, ilgili literatür taranarak 65 maddelik bir madde havuzu oluşturulmuştur. Oluşan madde havuzu dil ve kapsam geçerliğini sağlamak amacıyla 3'ü fen bilimleri uzmanı 1'i Dil uzmanı olan 4 uzman görüşüne sunulmuş ve uzman görüşleri doğrultusunda 5 madde ölçekten çıkarılmıştır. 10'lu Likert tipindeki 60 madde içeren ölçek taslağı önce 14 fen bilimleri öğretmenin katılımıyla pilot uygulamada denenmiş, daha sonra 111 öğretmene uygulanarak, toplanan verilere açımlayıcı faktör analizi (AFA) ve doğrulayıcı faktör analizi (DFA) yapılmıştır. Ölçeğin alt boyutlarına ilişkin Alpha katsayılarının (0.91) yüksek olması (Fen ve Laboratuvar =.95, İletişim=.91 ve Sınıf yönetimi=.88) alt boyutlarda yer alan maddelerin birbiriyle tutarlı olduğunu göstermiştir. DFA sonuçlarına göre tüm maddelerin t değerleri anlamlı bulunmuştur ($p<0.05$). Sonuç olarak, bu ölçeğin fen bilimleri öğretmenlerinin laboratuvar ve öğretim sürecindeki kaygılarını ölçebilecek, geçerli ve güvenilir bir ölçek niteliği taşıdığı söylenebilir.

Anahtar Sözcükler: Fen bilimleri öğretmeni, kaygı ölçeği, geçerlik ve güvenilirlik.

INTRODUCTION

Teaching is a profession with high social expectations. Anxiety levels rise with efforts to meet social expectations and practice the profession responsibly. The word, anxiety, derives from the Latin word, anxieties, and the Turkish Language Association (2015) defines it as a feeling of tension that is unknown that generally occurs with the idea that

something bad is going to happen. Freud defined anxiety as an unpleasant mood, an undesirable thing that can be experienced anywhere and at any time (Usakli and Akpınar, 2015). Another psychological definition sees anxiety as a restlessness felt in the face of a threatening or worrying situation (Isik, 1996). It is caused by a feeling of uncertainty about the future (Cüceloglu, 1996).

The connotations of the concept of anxiety are primarily negative. However, anxiety can be considered both a positive and a negative emotion (Manav, 2011). For example, according to Akgün, Gönen and Aydın (2007) medium-level anxiety stimulates, protects and motivates the organism. When anxiety is brought under control, it helps people to make greater efforts to succeed and to take precautions for negative experiences. Thus, anxiety is a normal and even necessary part of life at manageable levels. However, excessive anxiety can lead to psychological disturbances (Serin and Öztürk 2015).

According to Goldstein, a common cause of anxiety is a discrepancy between people's ability and the expectations put on them. This prevents people's self-realization and causes them to suffer anxiety (Gectan, 1981, cited by Akkaya, 1999). Greater importance is given to social and cultural factors in definitions and explanations of anxiety since social environment and cultural factors assign people responsibilities (Varol, 1990). Marino (2012) argues that anxiety plays a major role in forming our lives and characters. Anxiety is a factor that limits behaviors, increases the likelihood of mistakes and reduces performance capabilities (Istanbul Commerce University, 2015). Increased anxiety can also cause negative outcomes. Thus, it not only adversely affects quality of life (Yilmaz and Ocakci, 2010), but can also have a considerable effect on learning (Kilinckaya, 2013). Therefore, this concept is important for both learning and success (Sahin, Caliskan and Dilek, 2015).

Anxiety Theories

According to the psychoanalytic theory, anxiety was first analyzed scientifically by Freud in the nineteenth century and it is on affective dimension (Karakaya, Avcin and Kumperli, 2016). It was defined as an unconscious emotional response to being unable to act effectively and to put up resistance in the face of a dangerous situation (Karaguvan, 1999). Boeree (2006) notes that Freud specified three types of anxiety: real anxiety, moral anxiety and the last one is neurotic anxiety. For example; when someone pushes you into a well full of poisonous snakes, the fear that you experience is real anxiety, while moral anxiety consists of feelings like embarrassment,

guilt and fear of punishment. Fears of loss such as loss of control, loss of rationality, and even losing one's mind are forms of neurotic anxiety. According to behavioral theory, Strongman (1995) stated that anxiety theory was developed by Pavlov and Watson in the field of learning and its primary aim was to punish the anxiety theory. In a word, it is claimed that organisms should learn to abstain from harmful stimuli through certain mechanisms. These mechanisms are expressed as fear or anxiety. In fact, generally anxieties are defined in different ways within the scope of personality theories (Ensari, 2000). Anxiety is regarded under two titles as state and trait anxiety (Avsaroglu, 2012). According to Coskun and Akkas (2009), state anxiety is an anxiety type that arises before situations seen as dangerous or during events, mostly is connected with logical reasons and with a temporary state generally experienced by every person. Moreover, other people can understand the reason of state anxiety. Some people suffer from general and continuous state of anxiety that is not dependent to a certain event or situation. This is a constant anxiety.

The literature review showed that the anxiety is also discussed in different ways peculiarly in the field of teaching. According to Fuller, anxieties of prospective teachers regarding their professions were subsumed under three groups as; self-centered anxiety, task-centered anxiety, and student-centered anxiety (Bozdam and Tasgin, 2011; Cabi and Yalcinalp, 2013). Individuals create the source of the self-centered anxiety by themselves. It can be said that a prospective teacher who feels student-centered anxieties are more student-centered in their thoughts, designs and practices about teaching. The source of the task-centered anxiety is created by the individual's educational role. The anxiety mainly comes in sight with factors affecting success and failure (Bozdam, 2008; Bozdam and Tasgin, 2011). Another study considered teaching profession as a professional occupation area that has social, cultural, economic, scientific and technological dimensions about the education sector, that requires professional formation and academic study based on specialized knowledge and skills in the field (Erden, 1998). When the literature is examined, Kağıtçı and Kurbanoglu (2013) have developed a measurement tool to be used in measuring the anxiety levels of elementary school students for Science and Technology lesson; Gömleksiz and Yüksel (2003) examined the attitudes and thoughts of the 4th and 5th grade students Transmitted byents regarding the science lesson and found that they had anxiety about the science lesson and it was due to the lack of communication stemming from the teacher; in the study of Uluçınar Sağır (2014) study, they developed a scale to determine the science anxiety of the students in the 6th, 7th and 8th grades of primary

education; Ünal and Kılıç (2016) have examined the laboratory anxiety of teacher candidates. As it can be seen, there has been a need for this study due to the fact that there is almost no measurable instrument to measure the professional anxiety of science teachers in detail although there are scales to measure the anxiety of the primary school, middle school and university students about science.

The Purpose of Study

The literature review showed that as well as clinical studies, many studies measuring occupational anxiety of teachers and prospective teachers especially in education were conducted. However it is seen that potential anxiety sources to be experienced by science teachers in laboratory have not analyzed yet. Science and technology is the primary development indicator of a country. Science teachers have many difficulties in their social lives like everyone else. Leading experts make social and psychological determinations and this study only discussed anxieties that are possible to be experienced in teaching process and in laboratory. The fact that science teachers feel shy while conducting an experiment will adversely affect their students in the short term and progress of the country in science field in the long-term. This study aimed to develop a valid and reliable measurement tool that can be used to determine sources of anxiety experienced by science teachers especially in laboratory and other anxieties possible to be felt in teaching process.

METHOD

The development of scale items, the study group, and validity and reliability analyses took place in this section, respectively.

The Development of Scale Items

To see anxieties of science teachers in a broad perspective in the light of opinions got from individuals in different educational levels; a total of fifty-four (54) participants in the field of science education (five doctoral students, nine graduate students, twelve teachers and twenty-eight undergraduate students) were asked to write a composition about "Which anxiety does a science teacher experience in teaching process and in laboratory?" The written composition letters (Writing essays) were examined using content analysis one of the qualitative analysis methods, and a sixty five-point item pool was created reviewing the relevant literature. In this study 54 composition letters (Writing essays) were examined and 65 items were selected by content analysis.

The basic process in content analysis is to bring together similar data within the framework of specific concepts and themes and to organize them in such a way so that readers can understand (Yıldırım and Şimşek, 2011: 227). -According to Creswell (2003:186-187 Table 10.2.) data collection types may be listed as observations, interviews, documents and audiovisual materials. Document options in types: newspaper, journal, diary, letter and e-mail. In this study, the compositions in the category of letters have been subjected to content analysis and coded. Encoding of data; These parts, forming a meaningful part within themselves, are named by the researcher, in other words they are coded (Neuman, 2012: 668).

Language And Content Validity

The item pool was presented to four experts (three science experts and one language expert) to verify its content and language validity. According to their opinions, five items were excluded from the scale. The draft scale used 10-point Likert scale (1=I never feel anxiety, 10=I always feel anxiety). In practice, it is generally suitable to rank the scale so that positive items get more points (Tavsancil, 2006). The prepared and standardized draft scale was pilot tested with fourteen science teachers. Of them, 4 had worked for 1-5 years, 5 had worked 6-10 years, 3 had worked for 11-15 years, 1 had worked for 18 years and 1 had worked for 30 years. After language and content validity study, the scale with sixty items was administered to one hundred and eleven science teachers for the reliability analysis. The stages of scale development are shown in Figure 1.

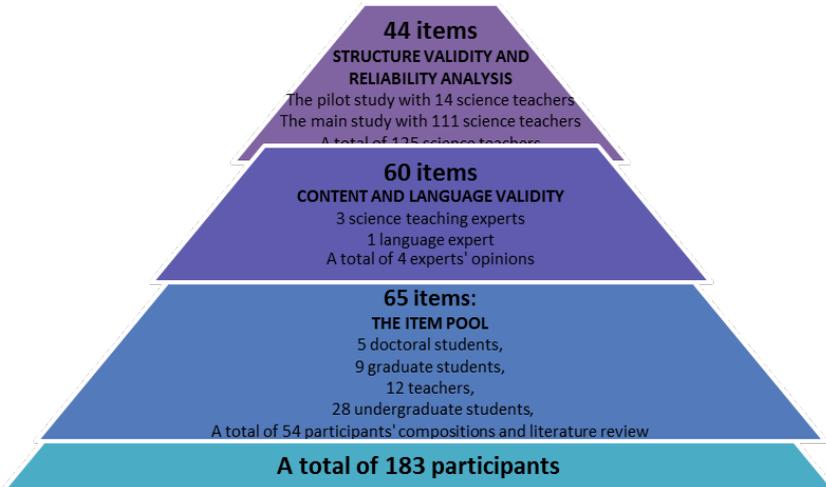


Figure 1. Stages of the scale development

The Study Group

The demographic characteristics of the participating 111 science teachers are shown in Table 1.

Table 1. The Demographic Characteristics Of The Study Group

		Frequency (f)	(%) Percentage
Gender	Female	64	57.66
	Male	47	42.34
	Total	111	100.00
Age	20-25	17	15.32
	26-30	26	23.42
	31-35	39	35.14
	36-40	29	26.13
	Total	111	100.00
Education background	Undergraduate	89	80.18
	Postgraduate	18	16.22
	Doctorate	4	3.60
	Total	111	100.00
Teaching experience	1-5	23	20.72
	6-10	16	14.41
	11-15	28	25.23
	16-20	44	39.64
	21 +	19	17.12
	Total	111	100.00
Laboratory experience	Yes	111	100.00
	No	0	0.00
	Total	111	100.00

The Exploratory Factor Analysis And The Confirmatory Factor Analysis

The collected data were examined using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to determine the scale's factorial structure and for the validity study. The rotated factor loadings were assessed in the first stage of factor analysis. The scale developing process determined that the factor loading should be 0.45, and that the gap between two high factor loadings should be at least 0.10 (Büyüköztürk, 2002). Therefore, items 20, 56, 31, 15, 47, 10, 44, 13, 33 and 41 with factor

loadings were under 0.45 were excluded from the scale. Items 16, 17, 22, 28, 30 and 32 were excluded from the scale because they loaded in at least two factors, and the gap between two loading values was under 0.10. As a result of factor analyses repeated eleven times, the final structure consisted of 44 items and 3 sub-dimensions. The variance explained is shown in Table 2.

Table 2. Variance Explained

Factors	Eigenvalues			The sum of squares of the rotated loadings		
	Total	% of variance explained	% of cumulative variance	Total	% of Variance	% Cumulative
1	16.821	38.229	38.229	9.35	21.25	21.25
2	2.674	6.077	44.306	6.57	14.94	36.19
3	2.644	6.010	50.316	6.21	14.12	50.32

Kaiser-Meyer-Olkin sampling adequacy: 0.893
Chi-square value of Bartlett's sphericity test= 3317.764 SD= 946 p= 0.000

The fact that the Kaiser-Meyer-Olkin value was 0.893—higher than 0.50—indicates adequate sample size (Kalaycı, 2005, p. 322). Higher ratios are better for factor analysis. Bartlett's sphericity test was also used to assess whether the data were suitable for factor analysis. Thus, the study found the data to be suitable for the factor analysis ($p < 0.05$).

The analysis of the total variance explained showed that there were ten factors with an eigenvalue greater than 1 and three factors being greater than 2. Given the variance explained, it was found that 50% of the measured characteristic was measured by the three factor measurement tool. However, according to the examination of eigenvalues or the scree plot, the results were prominently subsumed under three factors. The graph of the eigenvalues is shown in Figure 2.

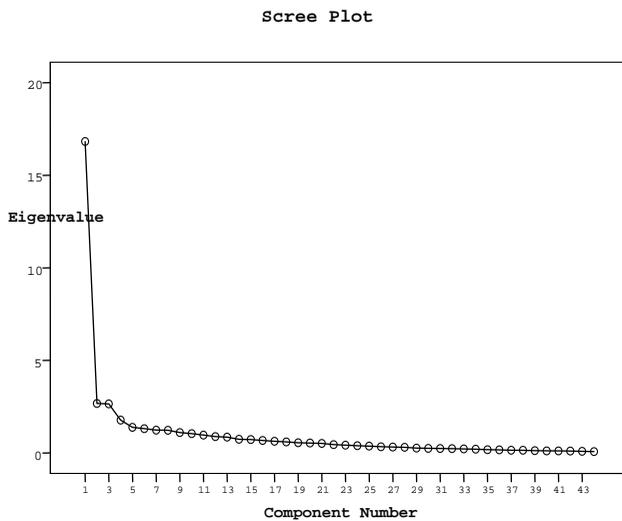


Figure 2. The Factor Graph Of The Eigenvalues

The rotated and ordered factor loadings of the scale items are shown in Table 3.

Table 3: The Factor Loadings of The Scale Items

Items	Factors		
	1	2	3
25- Being unable to earn my students' trust	0.787		
26- Not having the laboratories cleaned	0.765		
49- The failure of my students	0.738		
42- Being unable to explain experiments with scientific facts	0.737		
24- Being unable to refresh my knowledge	0.722		
27- Being unable to do first aid if one of my student feels unwell	0.673		
43- Being unable to relate subjects	0.669		
29- Having inadequate field knowledge	0.666		
21- Being unable to descend to students' level	0.662		
45- Being unable to use experiment equipment	0.657		
50- Being unable to obtain a result from the experiment	0.655		
60- Being unable to effectively use the technology	0.614		
55- Being at a loss in emergency situations such as fire, flood or earthquake	0.569		
46- Being unable to create an image with the microscope	0.558		
34- Being unable to provide examples from daily life	0.548		
58- Causing an accident or injury during an experiment	0.523		
8- Being unable to select materials relevant to the subject	0.485		
23- Being unable to give satisfactory answers to student questions	0.476		
38- Slips of the tongue		0.691	
54- Being unable to use my body language, gestures and facial expressions effectively		0.677	
53- Being unable to communicate with my students		0.646	
39- Being unable to use language effectively		0.644	
40- Being unable to remain patient		0.623	
37- Being unable to stop laughing		0.622	
40- Constantly repeating the same words		0.622	
59- Being unable to arouse my students' interest in the subject		0.610	
36- Being unable to keep my anger in check		0.591	
35- Shaky voice while teaching		0.575	
52- Inadequate physical arrangement of the classroom		0.575	
48- Being unable to treat students with tolerance		0.519	
11- Being unable to manage time efficiently			0.620
4- Being unable to be a role model teacher			0.600
18- Being unable to maintain the distance between me and my students			0.599
19- Being unable to prepare exam questions that accurately measure students' knowledge of subjects I taught them			0.585
6- Being unable to treat my students' equally			0.582
1- Being unable to get my students to acquire the scientific literacy competence			0.566
14- Being unable to ask questions that will increase students' thinking, analysis and questioning skills			0.557
5- Being unable to encourage all students to participate in the lesson			0.553
12- Being unable to be a respectable teacher			0.545
3- Being unable to select an educational method relevant to the subject			0.544
7- Receiving a warning from the school administration			0.542
2- Being unable to get students motivated for the lesson			0.533
9- Being unable to create a democratic classroom environment			0.529
57- Being unable to start and end classes effectively			0.520

Analysis of the factor loadings showed that all items had factor loadings higher than 0.45 value and did not overlap under two factors. The anxiety scale's first factor had 18 items, the second had 12 items, and the third had 14 items. These were called science and laboratory anxieties, communication anxieties and classroom management anxieties, respectively.

The Reliability Analysis Of The Scale

The reliability of the scale was examined using Cronbach's alpha coefficient. The reliability coefficient varies between 0 and +1. Reliability coefficient values approaching one indicate high reliability and high internal consistency and are also desirable. The results of the analysis of the item-total correlations, also known as item validity coefficients, are shown in Appendix 1. It was found that the item-total correlation varied between 0.454 and 0.780 and was higher than 0.30. The reliability of the anxiety scale regarding the science and laboratory competence, the communication, and the classroom management were found to be 0.947, 0.908, and 0.881, respectively, indicating high internal consistency.

The three sub-dimensional structure of the anxiety scale, which consisted of 44 items, about the teaching process of science and technology teachers was tested using confirmatory factor analysis. The factor loadings (λ), the square of multiple correlation value determining the strength of the relationship between the implicit variable and each item (R^2), and T values indicating the significance of the relationship are shown in Appendix 2.

The CFA results showed that T values of all items were significant ($p < 0.05$), and there was no need to exclude any items from the scale. The fit indices tested the observed data to determine whether it fitted well to the three sub-dimensional model. The fit indices of the scale consisting of 44 items are shown in Table 4.

Table 4: Goodness-Of-Fit Indices For The Factor Structure Of The Scale Items (Schermelleh-Engel, Moosbrugger And Müller, 2003)

The Goodness-of-fit Index	The acceptable border	Value
χ^2/SD	<5 at medium level <3 good fit	1157.04/899 = 1.29
GFI	>0.90	0.91
CFI	>0.90	0.94
NFI	>0.90	0.88
NNFI	>0.90	0.93
RFI	>0.85	0.87
S- RMR	<0.08	0.08
RMSEA	<0.08	0.051

Table 4 shows that the likelihood ratio chi-square statistic, the root mean square error of approximation (RMSEA), the standardized root mean square residual (S-RMR), the comparative fit index (CFI), the goodness of fit index (GFI), the normed fit index, and the relative fit index (RFI) were $X^2(899)=1157,04$, $p<0.01$, RMSEA 0.051, S-RMR=0.08, CFI=0.94, GFI=0.91, NFI=0.88, and RFI=0.87, respectively. Confirmatory factor analysis showed that the three factorial structure of the scale was acceptable and yielded valid results. The path graph for the scale items is shown in Appendix 3.

Anxiety Levels

The teachers' scores on the scale indicate three anxiety levels in the following score intervals.

The highest score that can be taken on this scale is 440 and the lowest score is 44 (Tezbaşaran 2008). Calculation of anxiety levels is based on the calculations in the study of Tabanlı and Çelik (2013). Accordingly, 1 standard deviation was subtracted from the arithmetic deviation ($198-66 = 132$) to determine participants' anxiety levels as low-medium-high and below this score has been defined as low anxiety, 1 standard deviation was added to the arithmetic mean ($198 + 66 = 264$), and above this score has been determined as high anxiety. The points between 133-264 have also been considered as anxiety.

Low level anxiety: Scores between 44 and 132 indicate teachers who have low level anxiety. This level of anxiety can be interpreted two ways according to perceptions of the anxiety source. The first interpretation describes teachers who feel that they can handle potential teaching and laboratory problems, do their jobs as expected and have little anxiety. The

second interpretation describes teachers who underestimate anxiety about their jobs or do not have enough experience to recognize potential problems.

Medium level anxiety: Scores between 133 and 264 indicate teachers who experience medium level anxiety. These teachers rely on their professional training, laboratory ability, science knowledge and communication skills to deliver higher performance.

High level anxiety: Teachers who score 265-440 experience a high degree of tension and anxiety. These teachers are upset by irrelevant questions and in-class surprises and bothered excessively by spontaneity in the classroom or laboratory. Their performance is adversely affected by anxiety.

RESULTS AND RECOMMENDATIONS

To determine anxieties of sciences teachers regarding laboratory and teaching process, this study developed a forty-four item scale which consisted of three sub-dimensions: anxieties about science and laboratory competence, communication anxieties and classroom management anxieties. The study found that the scale had adequate psychometric properties. The scale's dimension of anxieties about science and laboratory competence measured the competence perception levels of teachers in laboratory work and science. This sub-dimension included 18 items and has an alpha coefficient of 0.947. Here are some items in this sub-dimension: "Being unable to explain experiments with scientific facts," "Having inadequate field knowledge," "Causing an accident or injury during an experiment," and "Being unable to do first aid if one of my student feels unwell." The maximum possible score on this sub-dimension is 180, and the minimum is 18. Higher scores indicate high in-class anxiety levels. The dimension of anxieties about communication measured anxiety levels of teachers about in-class communication. This sub-dimension included 12 items and has an alpha coefficient of 0.908. Here are some items in this sub-dimension: "Being unable to use my body language, gestures and facial expressions effectively," "Shaky voice while teaching," "Being unable to communicate with my students," and "Constantly repeating the same words." The maximum possible score on this sub-dimension is 120, and the minimum is 12. Higher scores indicate that higher anxiety levels about in-class communication. The dimension of anxieties about classroom management measured teachers' anxiety levels about classroom management. This sub-dimension included 14 items and has an alpha coefficient of 0.881. Here are

some items in this sub-dimension: "Being unable to create a democratic classroom environment," "Being unable to select an educational method relevant to the subject," "Being unable to encourage all students to participate in the lesson," and "Being unable to manage time efficiently." The maximum possible score on this sub-dimension is 140, and the minimum is 14. Higher scores indicate that higher anxiety levels about classroom management.

The high alpha coefficients of the sub-dimensions of the scale showed that items included in sub-dimensions were consistent with each other. The results of the EFA and CFA confirmed the scale's validity. The Kaiser-Meyer-Olkin value was 0.893, indicating that the data were suitable for factor analysis ($p < 0.05$). The item-total correlation as the item validity coefficient of scale items varied between 0.454 and 0.780 and was higher than 0.30. The three sub-dimensional structure of the anxiety scale was tested using confirmatory factor analysis. The factor loadings (λ), the square of multiple correlation value determining the strength of the relationship between the implicit variables and each item (R^2), and T values indicating significance of the relationship were calculated. The result of confirmatory factor analysis showed that the three factorial structure of the scale was acceptable and yielded valid results. In conclusion, the validity and reliability studies show that this scale is suitable for use in studies with science teachers (Appendix 4).

In similar studies of the literature; it has been found that the students have anxiety for Science course and there is a lack of communication between teachers and students (Gömleksiz ve Yüksel- 2003); with the analysis of the data gathered, students' anxiety situations under various sub-dimensions have been revealed and solutions about these anxiety situations have been discussed (Ünal ve Kılıç-2016); the Cronbach alpha reliability coefficient of scale has been found as 0.88. The science anxiety scale that has been developed is a valid and reliable tool. It is believed that the scale will be useful to determine the science anxiety of the student of science and technology teachers (Uluçınar Sağır 2014); As a result, the Cronbach Alpha coefficient, which is the internal consistency coefficient of the scales, has been calculated as 0,91, and this value also overlaps with findings of Field, 2005; Pallant, 2001; Tabachnick and Fidell, 1996; Cronbach, 1951, cited by Dağlı and Baysal, 2016; Büyüköztürk 2002.

Scales should be developed to determine the non-teaching anxiety sources of teachers. New studies should inquire about how teachers can cope

with these anxieties. The relationship between the anxieties identified by this study and social anxieties should also be examined.

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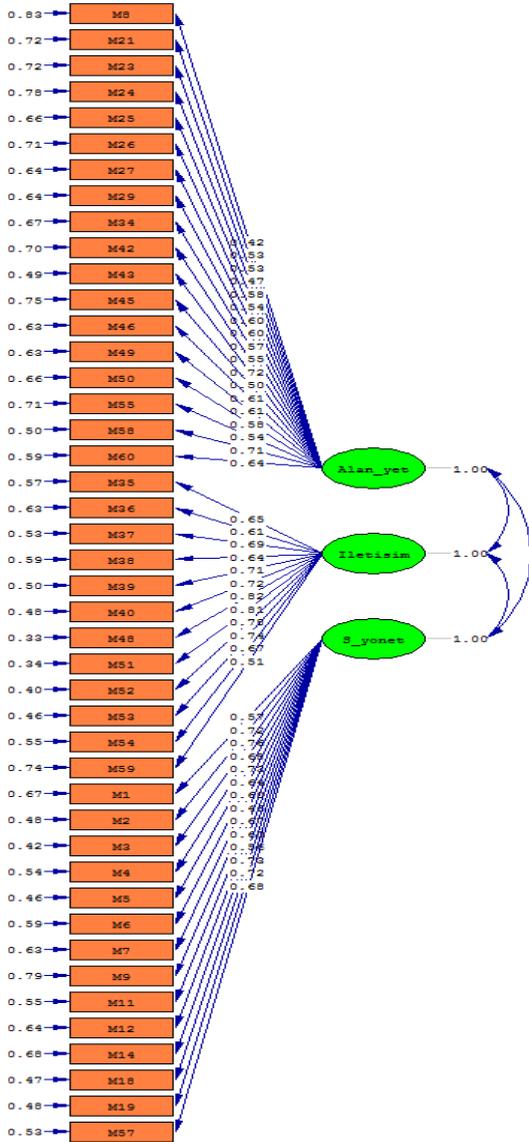
Appendix 1. Item- total correlation

	Item Total Correlati on	The Alpha Coeffi cient	Numbe r of Items
8- Being unable to select materials or experiments relevant to the subject	0.559		
21- Being unable to descend to students' level	0.647		
23- Being unable to give a satisfactory answer to student questions	0.579		
24- Being unable to refresh my knowledge	0.696		
25- Being unable to earn my students' trust	0.754		
26- Not having laboratories cleaned	0.780		
27- Being unable to do first aid if one of my student feels unwell	0.693		
29- Having inadequate field knowledge	0.672		
34- Being unable to provide examples from daily life	0.635	0.947	18
42- Being unable to explain experiments with scientific facts	0.752		
43- Being unable to relate subjects	0.727		
45- Being unable to use experiment equipment	0.732		
46- Being unable to create an image with the microscope	0.611		
49- The failure of my students	0.756		
50- Being unable to obtain a result from the experiment	0.750		
55- Being at a loss in emergency situations such as fire, flood or earthquake	0.672		
58- Causing an accident or injury during an experiment	0.621		
60- Being unable to use technology	0.718		
35- Shaky voice while teaching	0.652		
36- Being unable to keep my anger in check	0.636		
37- Being unable to stop laughing	0.654		
38- Slips of the tongue	0.580		
39- Being unable to use language effectively	0.667		
40- Constantly repeating the same words	0.611		
48- Being unable to treat students with tolerance	0.667	0.908	12
40- Being unable to remain patient	0.687		
52- Inadequate physical arrangement of the classroom	0.539		
53- Being unable to communicate with my students	0.632		
54- Being unable to use my body language, gestures and facial expressions effectively	0.611		
59- Being unable to arouse my students' interest in the subject	0.739		
1- Being unable to get my students to acquire the scientific literacy competence	0.454		
2- Being unable to get students motivated for the lesson	0.541		
3- Being unable to select an educational method relevant to the subject	0.527		
4- Being unable to be a role model teacher	0.495		
5- Being unable to encourage all students to participate in the lesson	0.564		
6- Being unable to treat my students' equally	0.515		
7- Receiving a warning from the school administration	0.509		
9- Being unable to create a democratic classroom environment	0.525	0.881	14
11- Being unable to manage time efficiently	0.680		
12- Being unable to be a respectable teacher	0.500		
14- Being unable to ask questions that will increase students' thinking, analysis and questioning skills	0.568		
18- Being unable to maintain the distance between me and my students	0.583		
19- Being unable to prepare exam questions that accurately measure students' knowledge of subjects I taught them	0.653		
57- Being unable to start and end classes effectively	0.607		

Appendix 2. Multiple correlation and T values

Sub-dimension	Item no	Lambda	r2	T value
Anxieties about science and laboratory competence	I8	0.42	0.17	3.97
	I21	0.53	0.28	5.44
	I23	0.53	0.28	4.99
	I24	0.47	0.22	5.46
	I25	0.58	0.34	6.55
	I26	0.54	0.29	5.77
	I27	0.60	0.36	7.42
	I29	0.60	0.36	7.23
	I34	0.57	0.33	6.45
	I42	0.55	0.3	6.90
	I43	0.72	0.51	8.96
	I45	0.50	0.25	5.00
	I46	0.61	0.37	6.86
	I49	0.61	0.37	6.34
	I50	0.58	0.34	6.94
I55	0.54	0.29	5.24	
I58	0.71	0.5	9.82	
I60	0.64	0.41	8.09	
Anxieties about in-class communication	I35	0.65	0.43	7.42
	I36	0.61	0.37	6.52
	I37	0.69	0.47	8.26
	I38	0.64	0.41	7.51
	I39	0.71	0.5	8.99
	I40	0.72	0.52	10.29
	I48	0.82	0.67	12.36
	I51	0.81	0.66	12.42
	I52	0.78	0.6	11.74
	I53	0.74	0.54	8.57
	I54	0.67	0.45	8.84
I59	0.51	0.26	5.73	
Anxieties about classroom management	I1	0.57	0.33	6.23
	I2	0.72	0.52	8.61
	I3	0.76	0.58	10.29
	I4	0.68	0.46	7.53
	I5	0.73	0.54	9.59
	I6	0.64	0.41	7.25
	I7	0.60	0.37	6.64
	I9	0.46	0.21	4.66
	I11	0.67	0.45	8.14
	I12	0.60	0.36	7.37
	I14	0.56	0.32	6.37
	I18	0.73	0.53	9.33
	I19	0.72	0.52	9.00
I57	0.68	0.47	7.73	

Appendix 3.The path graph for the scale items



Chi-Square=1157.04, df=899, P-value=0.00000, RMSEA=0.051

Appendix 4. Anxiety Scale For Science Teachers' Laboratory Work And Teaching

Items										
Sample marking										
	1	2	3	4	5	x	7	8	9	10
FACTOR 1: Anxieties about the field (science and laboratory) competence										
1. Being unable to get my students to acquire the scientific literacy competence	1	2	3	4	5	6	7	8	9	10
2. Not having laboratories to be cleaned	1	2	3	4	5	6	7	8	9	10
3. The failure of my students	1	2	3	4	5	6	7	8	9	10
4. Being unable to explain experiments with scientific facts	1	2	3	4	5	6	7	8	9	10
5. Being unable to refresh my knowledge	1	2	3	4	5	6	7	8	9	10
6. Being unable to do first aid if one of my student feels unwell	1	2	3	4	5	6	7	8	9	10
7. Being unable to establish correlation between subjects and experiments	1	2	3	4	5	6	7	8	9	10
8. Having inadequate science knowledge	1	2	3	4	5	6	7	8	9	10
9. Being unable to descend to a student's level	1	2	3	4	5	6	7	8	9	10
10. Being unable to use experiment equipment	1	2	3	4	5	6	7	8	9	10
11. Being unable to obtain a result from the experiment	1	2	3	4	5	6	7	8	9	10
12. Being unable to effectively use the technology	1	2	3	4	5	6	7	8	9	10
13. Being at a loss in emergency situations such as fire, flood or earthquake	1	2	3	4	5	6	7	8	9	10
14. Being unable to create an image with the microscope	1	2	3	4	5	6	7	8	9	10
15. Being unable to provide examples from daily life	1	2	3	4	5	6	7	8	9	10
16. Causing an accident or injury during an experiment	1	2	3	4	5	6	7	8	9	10
17. Being unable to select materials relevant to the subject	1	2	3	4	5	6	7	8	9	10
18. Being unable to give satisfactory answers to student questions	1	2	3	4	5	6	7	8	9	10
FACTOR 2: Anxieties about communication										
19. Slips of the tongue	1	2	3	4	5	6	7	8	9	10
20. Being unable to use my body language, gestures and facial expressions effectively	1	2	3	4	5	6	7	8	9	10
21. Being unable to communicate with my students	1	2	3	4	5	6	7	8	9	10
22. Being unable to use language effectively	1	2	3	4	5	6	7	8	9	10
23. Being unable to remain patient	1	2	3	4	5	6	7	8	9	10
24. Being unable to stop laughing	1	2	3	4	5	6	7	8	9	10
25. Constantly repeating the same words	1	2	3	4	5	6	7	8	9	10
26. Being unable to arouse my students' interest in the subject	1	2	3	4	5	6	7	8	9	10
27. Being unable to keep my anger in check	1	2	3	4	5	6	7	8	9	10
28. Shaky voice while teaching	1	2	3	4	5	6	7	8	9	10
29. Inadequate physical arrangement of the classroom	1	2	3	4	5	6	7	8	9	10

30. Being unable to treat students with tolerance	1	2	3	4	5	6	7	8	9	10
FAKTÖR 3: Anxieties about classroom management										
31. Being unable to manage time efficiently	1	2	3	4	5	6	7	8	9	10
32. Being unable to be a role model teacher	1	2	3	4	5	6	7	8	9	10
33. Being unable to maintain the distance between me and my students	1	2	3	4	5	6	7	8	9	10
34. Being unable to prepare exam questions that accurately measure students' knowledge of subjects I taught them	1	2	3	4	5	6	7	8	9	10
35. Being unable to treat my students equally	1	2	3	4	5	6	7	8	9	10
36. Being unable to maintain discipline	1	2	3	4	5	6	7	8	9	10
37. Being unable to ask questions that will increase students' thinking, analysis and questioning skills	1	2	3	4	5	6	7	8	9	10
38. Being unable to encourage all students to participate in the lesson	1	2	3	4	5	6	7	8	9	10
39. Being unable to be a respectable teacher	1	2	3	4	5	6	7	8	9	10
40. Being unable to select an educational method relevant to the subject	1	2	3	4	5	6	7	8	9	10
41. Receiving a warning from the school administration	1	2	3	4	5	6	7	8	9	10
42. Being unable to get students motivated for the lesson	1	2	3	4	5	6	7	8	9	10
43. Being unable to create a democratic classroom environment	1	2	3	4	5	6	7	8	9	10
44. Being unable to start and end classes effectively	1	2	3	4	5	6	7	8	9	10

Appendix 5. Turkish version of the instrument

Maddeler											Hiç Kaygı Duymam		Çok Kaygı Duyarım	
Örnek işaretleme	1	2	3	4	5	x	7	8	9	10	1	←	→	10
FAKTÖR 1: Alan (Fen ve laboratuvar) yeterliliğine ilişkin kaygılar														
1. Öğrencilerime Fen okur yazarı yeterliğini kazandıramamaktan	1	2	3	4	5	6	7	8	9	10				
2. Laboratuvarın temizliğinin sağlanamamasından	1	2	3	4	5	6	7	8	9	10				
3. Öğrencilerimin başarısız olmasından	1	2	3	4	5	6	7	8	9	10				
4. Deneyi bilimsel gerçeklerle açıklayamamaktan	1	2	3	4	5	6	7	8	9	10				
5. Bilgilerimi yenileyememekten	1	2	3	4	5	6	7	8	9	10				
6. Öğrencilerimden biri rahatsızlırsa ilk yardım yapamamaktan	1	2	3	4	5	6	7	8	9	10				
7. Konular ve deneyler arasında iliksi kuramamaktan	1	2	3	4	5	6	7	8	9	10				
8. Fen bilgimin yetersiz kalmasından	1	2	3	4	5	6	7	8	9	10				
9. Öğrenci seviyesine inememekten	1	2	3	4	5	6	7	8	9	10				
10. Deney araçlarını kullanamamaktan	1	2	3	4	5	6	7	8	9	10				
11. Deneyden sonuç alamamaktan	1	2	3	4	5	6	7	8	9	10				
12. Teknolojiyi etkin kullanamamaktan	1	2	3	4	5	6	7	8	9	10				

13. Yangın, sel ve deprem vb. durumlarda nasıl davranacağını bilememekten	1	2	3	4	5	6	7	8	9	10
14. Mikroskopta görüntüyü sağlayamamaktan	1	2	3	4	5	6	7	8	9	10
15. Günlük hayattan örnek verememekten	1	2	3	4	5	6	7	8	9	10
16. Deney yaparken kazaya sebep olmaktan (öğrencilerime ve kendime zarar vermekten)	1	2	3	4	5	6	7	8	9	10
17. Konuya uygun materyal seçememekten	1	2	3	4	5	6	7	8	9	10
18. Öğrencilerin sorduğu soruya tatmin edici bir cevap verememekten	1	2	3	4	5	6	7	8	9	10
FAKTÖR 2: İletişime ilişkin kaygılar										
19. Dilimin sürçmesinden	1	2	3	4	5	6	7	8	9	10
20. Beden dili/ jest ve mimiklerimi etkin kullanamamaktan	1	2	3	4	5	6	7	8	9	10
21. Öğrencilerimle iletişim kuramamaktan	1	2	3	4	5	6	7	8	9	10
22. Dili etkili kullanamamaktan	1	2	3	4	5	6	7	8	9	10
23. Sabırlı olamamaktan	1	2	3	4	5	6	7	8	9	10
24. Gülmemi durduramamaktan	1	2	3	4	5	6	7	8	9	10
25. Sürekli aynı kelimeleri tekrarlamaktan	1	2	3	4	5	6	7	8	9	10
26. Öğrencilerin konuya ilgisini nasıl çekeceğimi bilememekten	1	2	3	4	5	6	7	8	9	10
27. Öfkeme hakim olamamaktan	1	2	3	4	5	6	7	8	9	10
28. Ders anlatırken sesimin titremesinden	1	2	3	4	5	6	7	8	9	10
29. Sınıfın fiziksel düzenlemesinin yetersiz kalmasından	1	2	3	4	5	6	7	8	9	10
30. Öğrencilere karşı hoşgörülü olamamaktan	1	2	3	4	5	6	7	8	9	10
FAKTÖR 3: Sınıf yönetimine ilişkin kaygılar										
31. Zamanı etkin kullanamamaktan	1	2	3	4	5	6	7	8	9	10
32. Örnek bir öğretmen olamamaktan	1	2	3	4	5	6	7	8	9	10
33. Öğrencilerle aramdaki seviyeyi koruyamamaktan	1	2	3	4	5	6	7	8	9	10
34. Öğrettiğim konuları uygun şekilde ölçecek sınav sorusu hazırlayamamaktan	1	2	3	4	5	6	7	8	9	10
35. Öğrencilerime eşit davranamamaktan	1	2	3	4	5	6	7	8	9	10
36. Disiplini sağlayamamaktan	1	2	3	4	5	6	7	8	9	10
37. Öğrencilere , düşünme, analiz etme ve sorgulama becerisini artıracak sorular soramamaktan	1	2	3	4	5	6	7	8	9	10
38. Derse sınıfın tamamının katılımını sağlayamamaktan	1	2	3	4	5	6	7	8	9	10
39. Saygın bir öğretmen olamamaktan	1	2	3	4	5	6	7	8	9	10
40. Konuya uygun öğretim yöntemi seçememekten	1	2	3	4	5	6	7	8	9	10
41. Okul yönetiminden uyarı almaktan	1	2	3	4	5	6	7	8	9	10
42. Öğrencinin derse motivasyonunu sağlayamamaktan	1	2	3	4	5	6	7	8	9	10
43. Demokratik bir sınıf atmosferi oluşturamamaktan	1	2	3	4	5	6	7	8	9	10
44. Derse etkili giriş ve kapanış yapamamaktan	1	2	3	4	5	6	7	8	9	10

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