



SECOND-ORDER FACTOR ANALYSIS OF TEACHERS' CORRECT USE OF THEIR VOICES SCALE IN CLASSROOM MANAGEMENT (TCUVS)

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Abstract:

The aim of this study was to test the validity and reliability of the Teachers' Correct Use of their Voices Scale (TCUVS) in classroom management and to try to explain the factors of the scale using the second order factor analysis. The participants of the study were 1095 teachers working at various educational levels in the province of Antalya, Turkey in the 2018-2019 academic year. Exploratory and confirmatory factor analysis was used in the development of the TCUVS. The scale developed as a result of the first order factor analysis consists of seven dimensions (voice health problems, voice protection, the harmony between voice and body, correct use of voice, correct use of speech voice, directing voice, voice distortion) and 31 items. The results of the second-order confirmatory factor analysis conducted to better evaluate the results of the seven-dimensional first-order confirmatory factor analysis and to summarize the dimensions of the scale showed that the model with two factors (voice problems and professional use of voice) and six sub-dimensions (voice protection, the harmony between voice and body, correct use of voice, correct use of speech voice, directing voice, voice distortion) better fits the data statistically. A moderate relationship was found between the factors of voice problems and professional use of voice. It can be said that the internal consistency of the dimensions of the TCUVS was strong; the confirmatory factor analysis goodness of fit criteria and combined reliability level were adequate; and only the rate of mean variance explained was found to be limited. Therefore, the fit of the model to the data was found sufficient.

Keywords: voice, correct use of voice, teachers, second order factor analysis

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1. Introduction

The fact that voice is one of the most important tools in teaching profession requires durability of teachers' voice. However, teachers, who are professional voice users, are increasingly at risk for voice disorders (Roy, Merrill, Thibeault & Smith, 2004). In the United States, 71% of the teachers experience more frequent voice health problems than those who are not teachers (Cutiva & Burdorf, 2015). Roy et al. (2004) stated that teachers have an 81% chance of having problems with their voices for a second time compared to those who are not teachers. Teachers are more sensitive to voice fade-out, edema, polyps and nodules than nonvocal professionals (Russell, Oates & Greenwood, 1998; Smith, Kirchner, Taylor, Hoffman & Lemke, 1998; Smith, Lemke, Taylor, Kirchner & Hoffman 1998), and the probability of developing dysphonia increases (Cutiva, Vogel & Burdorf, 2013).

Smith, Gray, Dove, Kircher and Heras (1997) compared teaching and other professional groups and found that the majority of teachers have problems with their voice. Smith et al. (1997) state that teaching is a high-risk profession in terms of voice disorders and that this health problem may have both economic and work-related effects. Researches focusing on the teacher sample (Roy et al., 2004; De Jong, Kooijman, Thomas, Huinck, Graamans, & Schutte, 2006) show that teachers have higher rates of voice problems than non-teachers. According to Houtte, Claeys, Wuyts and Lierde (2010), this high prevalence is due to teachers' intensive and long-term professional voice use, speaking in a noisy environment, and inadequate techniques in improving ambient voice. Voice disorder is defined as the voices that interfere with communication or as the inability to perform as usual and to fulfill tasks properly. Voice disorder leads to a decrease in the quality of teaching, an increase in absenteeism, and a huge financial burden. There are also individual and emotional consequences of voice disorders for teachers. Teachers may feel limited due to voice problems in their current job performances and future job or career options (Smith, Gray, Dove, Kirchner & Heras, 1997). Nevertheless, only one-third of teachers with voice complaints ask for professional help (Da Costa V., Prada, Robert & Cohen, 2012).

Teachers' staying away from teaching activities due to voice disorders causes them to feel insecure and isolated. When teachers have problems with their voice, they cannot perform the routine classroom functions and thus may lose their professional identity. Personal characteristics such as excessive talking or shouting, inappropriate environmental characteristics of schools, as well as biological factors such as allergies or pharyngeal/laryngeal reflux are among the factors associated with voice disorders (Giannini, Latorre & Ferreira, 2012). The number of students in the classroom (Kooijman et al., 2006), frequent exposure to children with upper respiratory tract infection (Smith et al., 1997), and classes with poor noise or acoustics force the teacher to speak out loud and pay more effort to be able to teach a large group, which increases the risk of teachers having problems with the use of their voice (Sapir, Keidar & Mathers-Schmidt, 1993). Other adverse working conditions such as dry air, dust, smoke, and temperature changes

can irritate the mucosa and affect voice negatively (Verdolini & Ramig, 2001). There are several studies showing that psycho-emotional factors and stress are associated with voice disorders (Russell, Oates, & Greenwood, 1998; Gotaas & Starr, 1993; Kooijman et al., 2006). Emotions can affect voice production negatively, especially in sensitive people. The increase in stress changes voice with an increase in tone (Gotaas & Starr, 1993; Nerriere, Vercambre, Gilbert & Kovess-Masfety, 2009).

Focusing on teachers with voice problems is important in terms of representing other occupational groups that use their voice extensively for work or communication. According to Smith et al. (1997), despite the devastating effects of voice problems, there is no reliable data on the prevalence of voice disorders in the adult population and little information is available in the literature on voice problems in potentially high-risk occupational groups (such as teacher, priests in mosques, singers, etc.). Presenting this problem with data can help gain an insight into the prevalence and incidence of voice problems, explain the causes, determine the frequency of the problems, identify the features that increase the risk, and help develop early screening or disease prevention programs. In this context, it has been observed that no official report has been kept regarding the voice problems of teachers in Turkey. About one and a half million teachers serve in Turkey (National Education Statistics Formal Education 2017-2018, 2018). It can be said that the problems that teachers will experience with their voices will have an economic and labor cost to the country.

In contrast to the detailed literature describing voice risk factors, little attention is paid to the consequences of voice disorders. It is seen that the literature on teachers' correct use of voice or investigating their voice-related problems is limited. The research on whether teachers receive information about their physiology, voice techniques and voice hygiene during their training or career is also limited. The aim of this study is to analyze the correct use of voice in teachers and to help develop preventive programs to reduce the impact and severity of voice problems in teachers. Accordingly, it aims to develop a scale to obtain information about teachers' correct use of their voices in classroom management.

2. Method

In this section, information about the participants, data collection tool, data collection process and data analysis is given.

2.1 Participants

The reason for the inclusion of teachers in all stages of education in the central districts of Antalya in the study is that the problems related to the correct use of voice can be experienced by all teachers. In this context, the participants are the teachers who worked at various educational levels in the province of Antalya in the 2018-2019 academic year. The participants were determined using maximum diversity and easily accessible case

sampling technique, which is one of the purposeful sampling methods. A total of 1095 teachers participated in the study.

2.2 Demographic Characteristics of the Participants

The demographic characteristics of the teachers who participated in the study are given in Table 1. 64.6% of the participants were female and 35.2% were male. Of the participants, 21.5% were in the 22-30 age group, 36.8% were in the 31-39 age group, 26.3% were in the 40-48 age group, and 14.7% were 49 and over. 18.2% of the participants had 1-8 years, 19.4% had 9-16 years, 15.3% had 17-24 years, and 11.2% had 25 years or more teaching experience.

Table 1: The frequency and percentage distribution of the demographic characteristics of teachers

Independent Variables		N	%
Gender	Female	707	% 64.6
	Male	385	% 35.2
Age	22-30	235	% 21.5
	31-39	403	% 36.8
	40-48	288	% 26.3
	49 and above	161	% 14.7
Seniority	1-8 years	199	% 18.2
	9-16 years	212	% 19.4
	17-24 years	167	% 15.3
	25 years and more	123	% 11.2
Smoker	Yes	309	% 28.2
	No	779	% 71.1
Having voice treatment	Yes	81	% 7.4
	No	1000	% 91.3
Problems with voice	I have no problems with my voice	484	% 44.2
	Dry throat	422	% 38.5
	Aphonia	334	% 30.5
	Being tired while speaking	267	% 24.4
	Having difficulty breathing while speaking	92	% 8.4
	Voice loss	56	% 5.1
Level of difficulty in teaching due to voice problems	None	430	% 39.3
	A little	343	% 31.3
	Moderate	229	% 20.9
	Severe	66	% 6.0

28.2% of the participants reported that they smoke, while 71.1% of them did not smoke. In addition, 91.3% of the participants did not receive any treatment related to their voices. When the voice problems are examined, it is seen that 44.2% of the participants did not have any problems with their voices, 38.5% had a dry throat, 30.5% had aphonia, 24.4% felt tired while talking, 8.4% had difficulty breathing while talking, and 5.1% suffered from serious health problems such as loss of voice. 39.3% of the participants did not have

any difficulty in teaching due to voice problems, 31.3% had some problems, 20.9% had moderate problems and 6% had severe problems (Table 1).

2.3 Development of the Data Collection Tool

The TCUVS was developed following the steps below:

To create the item pool, the literature related to the correct use of voice and the voice of teachers was reviewed (Cutiva & Burdorf, 2015, 2016; Giannini et al., 2014; Cutiva, Vogel & Burdorf, 2013; Da CotaV, Prada, Roberts & Cohen, 2012; Giannini, Latorre, Ferreira, 2012; Roy et al., 2004; Russell, Oates & Greenwood, 1998; Gotaas & Starr, 1993). As a result, a preliminary draft form consisting of 60 items was created. This form was examined by 45 teachers who were enrolled in the graduate program in Educational Administration. The reason for choosing teachers who have graduate education was that they had higher awareness level than the other teachers and that they may have had problems about using their voices correctly because they were teaching some classes like other teachers. In line with the opinions of the teachers, the number of the items in the preliminary draft was reduced to 48. The preliminary draft which was examined by the teachers was re-examined by two faculty members who are experts in the field of Education Management and Teacher Training to ensure content validity. In this context, the expert evaluation form prepared by the researcher was sent to the two experts, who were asked to comment on the intelligibility of the scale items and their suitability in terms of measuring teachers' correct use of their voices. In the preliminary draft form containing the items, the expressions "appropriate, must be corrected, not appropriate, and suggestions" were written next to each item and the experts were asked to mark the appropriate expression in their opinion. In line with the feedback received from the experts, the items in the scale were revised in terms of language, intelligibility, appearance and appropriacy to the aim of the study, and fifteen more items were eliminated. As a result of the feedback from the experts, a preliminary draft with a five-point Likert response system was obtained. The preliminary draft prepared to evaluate teachers' correct use of their voices included 45 items and was a five-point Likert type scale (5 = I fully agree, 1 = I disagree).

2.4 Data Analysis

SPSS 20.00, one of the statistical package programs, and LISREL 8.54 (Jöreskog & Sörbom, 2001) were used in the statistical analysis of the preliminary draft data regarding teachers' correct use of voices in classroom management.

The Pearson product-moment correlation coefficient technique was used to determine the correlation between variables. The correlation coefficients were interpreted as "high" between 0.70 and 1.00, "medium" between 0.69 and 0.30, and "low" at 0.29 and lower (Büyükoztürk, 2005).

2.5 Reliability and Validity Analysis

The reliability of the scale was evaluated with the Cronbach's alpha coefficient and item-total correlations, and the results obtained were given in Table 2 together with factor analysis results. In the reliability analysis of the preliminary draft scale, items with values less than .20 (Item20 and Item22) were eliminated from the preliminary draft. Then, the overall reliability of the scale was found to be .84. Thus, factor analysis was started with the remaining 43 items.

As a result of the exploratory factor analysis, twelve items (Items 3, 10, 13, 15, 16, 21, 26, 33, 36, 40, 43, and 45) were eliminated from the 43-item draft scale because their loadings were below .50, and a scale consisting of seven dimensions and 31 items was obtained. The overall reliability of the 31 items in the scale was found to be .80. This value shows that the items used to evaluate the correct use of voice in classroom management are consistent (Cronbach, 1990). The Cronbach's alpha value was calculated for each factor.

The Confirmatory Factor Analysis (CFA) was performed to confirm the factor structures of the scale. Convergent validity, discriminant validity, composite reliability, and the average variance (Average Variance Extracted =AVE) explained by each construct were evaluated using the confirmatory factor analysis results. The Maximum Likelihood method was used in confirmatory factor analysis. As the sample size increases, sensitivity in determining the difference between the data obtained from the highest likelihood method also increases (Hair, Anderson, Tatham & Black, 1998). In the study, it was found that the seven-factor (voice health problems, voice protection, harmony between voice and body, correct use of voice, correct use of speech voice, directing voice, voice distortion) teachers' correct use of voice in classroom management model was found to fit best to the data. Table 2 shows that the compliance statistics such as RMSEA, CFI, AGFI and RMR index are within the acceptable range.

3. Findings

3.1 The First Order Factor Analysis Method

The Maximum Likelihood method was chosen as the parameter estimation method because most of the variables showed small skewness and kurtosis (in the range of -1 and +1) and the data did not violate multiple normality strongly. The standardized first-order factor loadings are highly appropriate and statistically significant (t values range from 12.72 to 28.94). Each dimension obtained as a result of the exploratory factor analysis was named according to the variables and factor loadings they had. The scale included seven dimensions (voice health problems, voice protection, harmony between voice and body, correct use of voice, correct use of speech voice, directing voice, voice distortion) and 31 items (Table 2).

The total reliability of the scale was found to be .80, and the reliability coefficients for the seven dimensions of the scale were as follows: voice health problems .88, voice protection .84, harmony between voice and body .77, correct use of voice .69, correct use

of speech voice .61, directing voice .78, and voice distortion .59. These values point to high internal consistency (Hair, Anderson, Tahtam & Black, 1998). As a result of the exploratory factor analysis, the rate of total variance explained was found to be 59%. The variances of the dimensions were voice health problems 16%, voice protection 12%, harmony between voice and body 8%, correct use of voice 7%, correct use of speech voice 6%, directing voice 5%, and voice distortion 5%, respectively. The factor loadings of the items ranged from .867 to .504. According to the KMO and Bartlett Sphericity Test results, the KMO value of 31 items was .875 and the Bartlett Sphericity Test result was calculated as 12210.601 and $p = .000$ ($p < .001$) (Table 2). The obtained data led to the conclusion that exploratory factor analysis can be performed on the scale. The findings of the exploratory factor analysis are given in Table 2.

Table 2: Exploratory factor analysis results of the TCUVS and Cronbach's alpha results of the factors

Dimensions	Items	D1	D2	D3	D4	D5	D6	D7
D1 = Voice health problems (\bar{x} =2.45)	M9	.822						
	M8	.817						
	M6	.790						
	M23	.749						
	M7	.738						
	M12	.735						
	M11	.626						
D2 = Voice protection (\bar{x} =3.01)	M17	.592						
	M44	.558						
	M41		.783					
	M42		.741					
	M14		.693					
	M5		.688					
D3 = Harmony between voice and body (\bar{x} =4.16)	M35		.670					
	M34		.654					
	M39		.631					
	M37			.801				
D4= Correct use of voice (\bar{x} =4.26)	M38			.796				
	M24			.621				
	M25			.565				
	M2				.821			
D5= Correct use of speech voice (\bar{x} =4.17)	M1				.811			
	M4				.555			
	M28					.790		
	M27					.639		
D6= Directing Voice (\bar{x} =2.57)	M32					.556		
	M31					.504		
	M30						.867	
D7= Voice distortion (\bar{x} =2.41)	M29						.853	
	M18							.819
Eigenvalues		4.850	3.672	2.632	2.090	1.865	1.681	1.443

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The rate of variance explained (%)	16	12	8	7	6	5	5
The rate of cumulative variance explained (%)	16	28	36	43	49	54	59
Cronbach Alpha value	.88	.84	.77	.69	.61	.78	.59
KMO = .875 Bartlett's Test of Sphericity = 12210.601							
Fit indices: RMSEA = .045 GFI= .93 AGFI= .91 NFI= .95							

The arithmetic mean values of the dimensions regarding teachers' correct use of their voices in classroom management are shown in Table 2 (in parentheses next to each factor). It is seen that correct use of voice factor has the highest mean with 4.26, followed by the correct use of speech voice factor with a mean of 4.17. It was found that the voice distortion factor has the lowest mean with 2.41. Thus, it can be said that the teachers in the study perceived correct use of voice, correct use of speech voice, the harmony between voice and body, and voice protection to be relatively more important in classroom management compared to voice distortion, voice health problems, and directing voice.

Lisrel 8.54 software (Jöreskog & Sörbom, 2001) was used for confirmatory factor analysis. Error variances (M12 - M7 = .20, M38 - M37 = .25, M41 - M35 = .29, M38 - M39 = .17) were calculated as a result of four modifications made in three dimensions (Hair, Anderson, Tatham & Black, 1998). The fit indexes were compared with the general criteria, and it was observed that the values were within acceptable limits. The fit indices of the model obtained from the confirmatory factor analysis of the scale were examined and the RMSEA (root mean square error of approximation) = .045, AGFI (adjusted goodness of fit index) = .91, GFI (goodness of fit index) = .93, NFI (normalized fit index) = .95, CFI (comparative fit index) = .97, SRMR (standardized root mean square residual) = 0.061, RMR (root mean residual) = .048 fit statistics of the four-factor model was within acceptable range (Schermelel-Engel, Moosbrugger & Müller, 2003). Fit indices and acceptable criterion values of the model are presented in Table 3.

Table 3: Good fit indices of the TCUVS

Fit indices	Good fit	Acceptable fit	The proposed model
χ^2	$0 \leq \chi^2 \leq 2sd$	$2sd < \chi^2 \leq 3 sd$	1314.79 (sd=409)
χ^2/sd	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	3.21
RMSEA	$0 \leq RMSEA \leq 0,05$	$0,05 < RMSEA \leq 0,10$	.045
GFI	$0,95 \leq GFI \leq 1,00$	$0,90 \leq GFI < 0,95$	.93
AGFI	$0,90 \leq AGFI \leq 1,00$	$0,85 \leq AGFI < 0,90$	.91
NFI	$0,95 \leq NFI \leq 1,00$	$0,90 \leq NFI < 0,95$	.95
CFI	$0,95 \leq CFI \leq 1,00$	$0,85 \leq CFI < 0,90$	.97
RMR	$0 \leq RMR \leq 0,05$	$0,05 < RMR \leq 0,10$	.048
SRMR	$0 \leq SRMR \leq 0,05$	$0,05 < SRMR \leq 0,10$	.061

Source: Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness of Fit Measures. *Methods of Psychological Research Online*, 8(2), 52.

Table 4 presents the standardized Lambda-x values, t-values and multiple correlation squares of the items obtained from the confirmatory factor analysis.

Table 4: The standardized Lambda-x values, t-values and R² values of the TCUVS

Dimensions	Items	Lambda-x	t	R ²	Dimensions	Items	Lambda-x	t	R ²
D1 = Voice health problems	M9	.82	31.93	.67	D3 =	M37	.61	19.78	.38
	M8	.81	31.11	.65	Harmony between voice and body	M38	.59	19.11	.35
	M6	.77	28.94	.59		M24	.66	21.74	.43
	M23	.73	26.86	.53	D4 =	M25	.70	23.42	.49
	M7	.67	23.80	.44	Correct use of voice	M2	.78	24.64	.61
	M12	.66	23.54	.44		M1	.68	21.46	.46
	M11	.57	19.71	.33	D5= Correct use of speech voice	M4	.55	17.03	.30
	M17	.55	18.89	.30		M28	.40	11.78	.16
M44	.49	16.43	.24	M27	.57	17.26	.32		
D2 = Voice protection	M41	.58	19.40	.33	M32	.51	15.21	.26	
	M42	.63	21.48	.39	M31	.68	20.85	.46	
	M14	.73	26.39	.54	D6 =	M30	.75	19.68	.57
	M5	.68	23.65	.46	Directing voice	M29	.85	21.17	.72
	M35	.50	16.21	.25	D7 =	M18	.55	12.72	.31
	M34	.72	25.51	.51	Voice distortion	M19	.76	14.45	.58
	M39	.69	24.82	.48					

When the Lambda-x values showing factor loadings are examined, it is seen that the factor loadings vary between .85 and .40, which indicates that the factor loadings of the items are adequate. As a result, the seven-factor structure of the TCUVS was confirmed by the confirmatory factor analysis.

3.2 The Second Order Factor Analysis Model of the TCUVS

The second order confirmatory factor analysis (Hair et al., 1998) was performed in order to better evaluate the results of the seven-dimensional first-order factor analysis and to summarize the dimensions of the TCUVS. Since the conformity criteria were not within the acceptable range, the first model was improved. The first model was analyzed with two dimensions and seven sub-dimensions. As the result of the analysis, the t-value (.32) of the voice distortion dimension was found to be less than 1.96, and thus, the analysis was repeated. The scale converges when the voice distortion dimension is removed from the model. For this reason, it was decided to eliminate the dimension of voice health problems from the developed model. In line with the results obtained, the second order factor model is given in Figure 1 and the conformity criteria for the second order factor analysis are given in Table 5. When the values in Table 5 are examined, it is seen that the two-factor and six sub-dimensional model is the most appropriate model for the data.

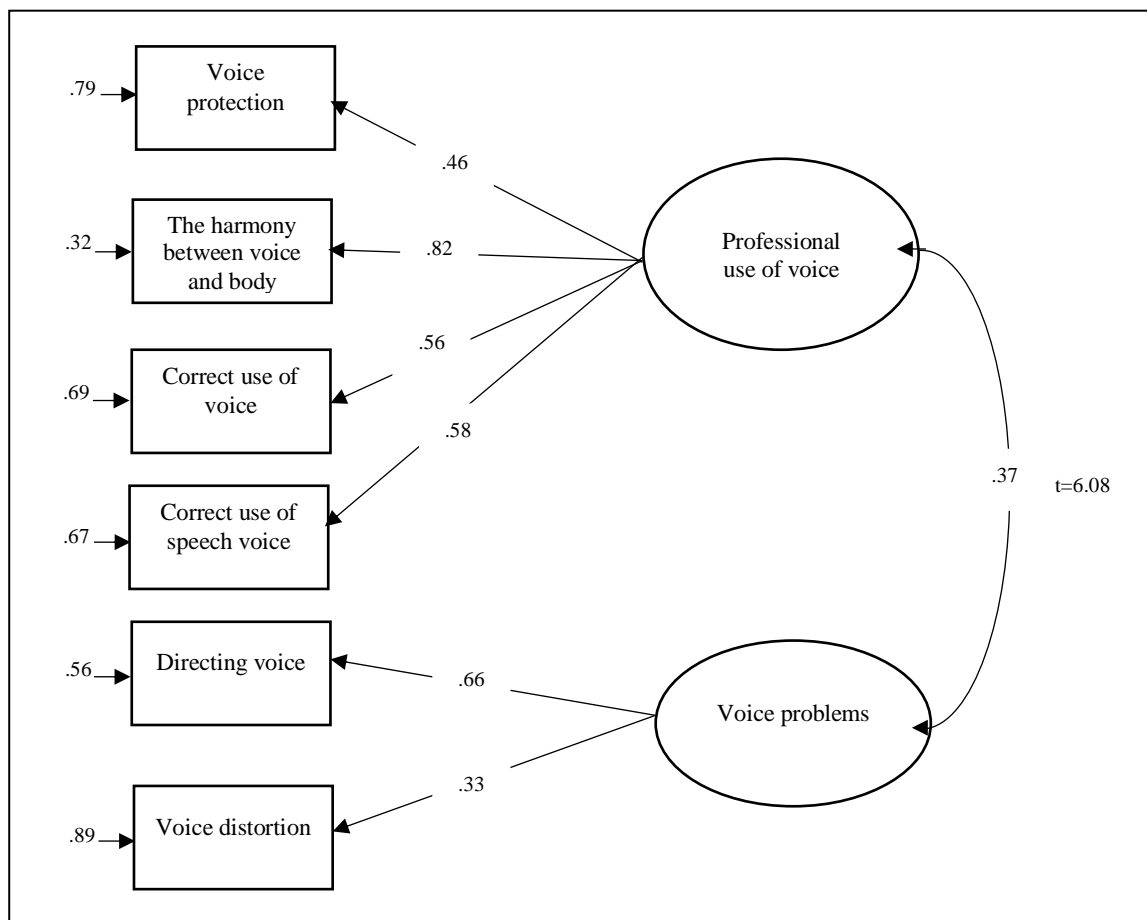


Figure 1: The second order factor analysis of the TCUVS

As shown in Figure 1, the dimensions of directing voice and voice distortion constitute the first factor of the second order factor model. The new factor was called voice problems. The dimensions of voice protection, harmony between voice and body, correct use of voice, and correct use of speech voice constitute the second factor of the second order factor model. This new factor was called professional use of voice. A moderate positive relationship was observed between the factors of voice problems and professional use of voice ($\beta = .38$) ($t = 6.08$). The dimension affecting the professional use of voice factor most was found to be the harmony between voice and body with a loading of .82, while the factor affecting the same factor least was voice protection with a loading of .46. The dimension affecting the voice problems factor was found to be directing voice with a loading of .66, while the least effective dimension was voice distortion with a loading of .33 (Figure 1).

Table 5: Goodness of fit indices of the second order factor analysis of the TCUVS

Fit indices	Good fit	Acceptable fit	The proposed model
χ^2	$0 \leq \chi^2 \leq 2sd$	$2sd < \chi^2 \leq 3 sd$	7.93 (sd=7)
χ^2/sd	$0 \leq \chi^2/df \leq 2$	$2 < \chi^2/df \leq 3$	1.13
RMSEA	$0 \leq RMSEA \leq 0,05$	$0,05 < RMSEA \leq 0,10$	.01
GFI	$0,95 \leq GFI \leq 1,00$	$0,90 \leq GFI < 0,95$	1.00
AGFI	$0,90 \leq AGFI \leq 1.00$	$0,85 \leq AGFI < 0,90$	.99
NFI	$0,95 \leq NFI \leq 1.00$	$0,90 \leq NFI < 0,95$	.99
CFI	$0,95 \leq CFI \leq 1.00$	$0,85 \leq CFI < 0,90$	1.00
RMR	$0 \leq RMR \leq 0,05$	$0,05 < RMR \leq 0,10$	.008
SRMR	$0 \leq SRMR \leq 0,05$	$0,05 < SRMR \leq 0,10$	.013

Source: Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness of Fit Measures. *Methods of Psychological Research Online*, 8(2), 52.

According to the second order confirmatory factor analysis, it was confirmed that the TCUVS is a two-factor and six sub-dimensional structure. The fit indices of the model obtained from the confirmatory factor analysis of the TCUVS were examined and chi-square value ($\chi^2 = 7.93$), degree of freedom ($df = 7$), and $p = 0.33871 \geq 0.05$ were found. Since the aim was to develop a model that fits the data, a non-significant chi-square value is desired. The chi-square value obtained here is not significant, meaning that the model fits the data (Tabachnick & Fidel, 2015). The p value should be interpreted according to the results of the confirmatory factor analysis. This value gives information about the significance of the difference (χ^2) between the expected covariance matrix and the observed covariance matrix. Therefore, the expected value is $p \geq .05$ (Bagozzi, 1981). In this scale, $p = 0.33871 \geq .05$, which indicates that the data fits perfectly. The fit index values were found to be RMSEA = .011, NFI = .99, GFI = 1.00, AGFI = .99, CFI = 1.00, SRMR = .013, and RMR = .008. Therefore, the fit of the model to the data was found sufficient.

Factor loading values, error coefficients and correlations between dimensions of the two-dimensional and six-subdimensional model of the scale are given in Figure 1. In addition to the goodness of fit indices, the composite reliability of the indicators in the scale was evaluated by assessing validity and reliability. For this purpose, construct reliability and mean variance added by each structure were examined with two types of reliability assessments. The combined reliability shows the internal consistency of the indicators in a factor and the rate of acceptable reliability is .70. The variance explained need to be above .50. Below are the formulae of construct reliability and the rate of mean variance explained (Hair et al., 1998, 611-612):

$$\text{Construct Reliability} = (\sum \text{Factor Loadings})^2 / [(\sum \text{Factor Loadings})^2 + \sum \text{Error coefficients}]$$

$$\text{Mean Variance Explained} = (\sum \text{Factor Loadings}^2) / [(\sum \text{Factor Loadings}^2) + \sum \text{Error coefficients}]$$

Table 6: Construct reliability, AVE, correlation square and interdimensional correlation (Pearson Product-Moment)

Construct	Construct reliability	AVE	K1	K2	1	2	3	4	5	6
Voice problems	.40	.27	1	.262**	.250**	.189**	.146**	.146**	.823**	.736
Professional use of voice	.70	.38		1	.705**	.795**	.672**	.694**	.282**	.113**
1 = Voice protection	.84	.51			1	.388**	.259**	.225**	.300**	.072*
2 = Harmony between voice and body	.74	.41				1	.450**	.475**	.200**	.087**
3 = Correct use of voice	.71	.46					1	.339**	.130**	.096**
4 = Correct use of speech voice	.62	.30						1	.148**	.073**
5 = Directing voice	.88	.64							1	.221**
6 = Voice distortion	.60	.44								1

p** < .01, p* < .05

The combined reliability values of the two dimensions and the six sub-dimensions of the scale are given in Figure 1, while the AVE, correlation square and inter-dimensional correlation are given in Table 6. It is seen in Table 6 that the construct reliability of the dimensions of the TCUVS other than voice problems, correct use of speech voice, and voice distortion dimensions is higher than .70; however, the rates of the mean variance explained of the dimensions other than directing voice and voice protection dimensions are below .50. Thus, it can be said that the internal consistency of the dimensions that make up the criteria of teachers' correct use of their voices in classroom management is strong, whereas their power to explain the structure remains limited.

When the correlation between the dimensions in Table 6 is examined, a significant positive relationship was observed between voice problems and directing voice ($r = .823$) and between professional use of voice and harmony between voice and body ($r = .795$); a moderate positive relationship was found between voice protection and the harmony between voice and body ($r = .388$), between the correct use of speech and the harmony between voice and body ($r = .475$), and between the correct use of voice and the correct use of speech voice ($r = .339$), and finally a low positive significant relationship was found between the correct use of speech voice and directing voice ($r = .148$).

As a result, it can be said that the internal consistency of the dimensions of teachers' correct use of voice in classroom management is strong, the confirmatory factor analysis goodness of fit criteria and combined reliability level are sufficient, and only the rate of mean variance explained is limited. Thus, the fit of the model to the data was found sufficient.

4. Conclusion and Discussion

The aim of this study was to test the validity and reliability of the TCUVS and to try to explain the factors of the scale with the second order factor analysis. The exploratory and confirmatory factor analyses were performed in the development of the scale.

The scale developed as a result of the first order factor analysis consists of seven dimensions and 31 items. The seven dimensions obtained as a result of exploratory factor analysis were named as voice health problems, voice protection, harmony between voice and body, correct use of voice, correct use of speech voice, directing voice, and voice distortion. As a result of the exploratory factor analysis, the internal consistency values of the scale were found to be acceptable. In the first-order confirmatory factor analysis of the TCUVS, four improvements were made for three dimensions. The internal consistency coefficient calculated using the Cronbach's alpha formula for the reliability study of the scale was found to be at a good level both for the whole scale ($\alpha = .80$) and for the sub-dimensions (voice health problems, $\alpha = .88$; voice protection, $\alpha = .84$; harmony between voice and body, $\alpha = .77$, correct use of voice, $\alpha = .69$, correct use of speech voice, $\alpha = .61$; directing voice, $\alpha = .78$; voice distortion, $\alpha = .59$) (Cronbach, 1990).

According to the findings obtained from the first-order confirmatory factor analysis of the TCUVS, the teachers considered the harmony between voice and body, directing voice, and the correct use of speech voice to be more important than the other dimensions. The results of the second-order confirmatory factor analysis performed to better evaluate the results of the seven-dimensional first-order confirmatory factor analysis and to summarize the dimensions of teachers' correct use of voice in classroom management show that statistically the two-factor model fits the data better. A moderate relationship was found between the dimensions of voice problems and professional use of voice. Accordingly, it can be said that there is a direct proportional relationship between voice problems and professional use of voice in the assessment of teachers' correct use of their voices in classroom management.

As a result, with this study, the scale of Teachers' Correct Use of their Voices in classroom management was developed. With this scale whose validity and reliability were confirmed, it will be possible to obtain information about teachers' correct use of their voices in classroom management. In addition, since the most powerful tool used by teachers in their profession is voice, a strong data-based expectation can be put forward in the development of policies for the protection, development and improvement of voice. It is recommended that this scale be applied to larger samples and different groups, and its reliability and validity be retested.

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