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Adaptation of Science Attitude Scale Developed for Elementary School Students to Turkish: Validity and Reliability Study

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ABSTRACT. The purpose of this study is to adapt *"Science Attitude Scale-SAS"*, developed by Wang & Berlin (2010), to Turkish, and investigate the validity and reliability of the Turkish version of the scale. The original version of the scale was composed of 30 items gathered under a one factor structure. First, permission was sought from the developers of the scale. Then, the items of the scale were translated into Turkish by researchers. The linguistic equivalence of the scale was examined by referring to the views of English and Turkish language experts. Once the scale took its final form, an English language expert translated the items of the scale from Turkish to English. The results obtained from these stages indicated that the Turkish translation of the scale closely approximated to the original English scale. Herewith, translation and cross-language validity of the scale was completed. The Turkish version of the scale was administered to total of 1013 elementary school students in Bartın and Düzce. The construct validity of the scale was examined by exploratory factor analysis and confirmatory factor analysis. Finally, the scale consisted of 26 items was gathered under a one factor for elementary school students. The reliability coefficient (Cronbach-Alpha) for the whole scale was calculated as .916 for elementary school students. It is expected that this scale might serve as a beneficial tool for teachers to collect information about elementary school students' attitudes towards science, and as an alternative attitude scale for researchers.

Keywords: Confirmatory factor analysis, exploratory factor analysis, science attitude scale, validity and reliability.

INTRODUCTION

In today's world, in which we are experiencing the information age, it is highly important that individuals have high-order mental processing skills. Through these skills, individuals acquire many other skills such as problem solving, producing and becoming more environmentally aware. One of the main objectives of education systems is to equip students with these skills. The main course in which students are equipped with these skills is Science and Technology courses (Kahyaoğlu & Yangın, 2007). The most significant function of science is to enable individuals to become science literate. Thus, individuals use scientific methods and techniques in solving everyday problems. They offer concrete and rational solutions for the problems they face with in daily life. They are able to access information rapidly, generate new information, use modern technologies effectively and efficiently and develop new systems and technologies. Thus, it is important to teach science effectively and efficiently (Kaptan, 1998).

There are three important factors for students to acquire productive learning experiences. These are development of student attitudes, development of thinking and physical skills and development of information that students acquire as a result of natural events (Doğru & Kıyıcı, 2005; Martin, Sexton, Franklin & Gerlovich, 2005). The attitude is one of these three factors and is highly important in teaching science.

Attitude is the mental predisposition of individuals towards people, objects, subjects and events. Attitudes determine the readiness levels of individuals to a subject. Therefore, students' attitudes towards science will enable them to understand and learn the subjects and activities more easily. On the other hand, students who developed a negative attitude towards science will have difficulty in understanding the subjects, and thus resist participating in activities (Doğru & Kıyıcı, 2005). Attitude is not observable behaviour but a predisposition preparing for the behaviour. As for Pratkanis, Breckler and Greenwald (1988), attitude is individual's evaluation of his/her existing knowledge about some objects (cited in Bilgin & Karaduman, 2005). As for Zacharias and Barton (2004), on the other hand, attitude resists against time and it is related to learnable behaviour, and changes with personal beliefs.

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Research on attitudes towards science started in 1960s and increased significantly between 1970s and 1980s. Science educators have accepted that developing positive attitudes towards science is an important objective of science education (Francis & Greer, 1999; Freedman, 1997; Papanastasiou & Papanastasiou, 2004). Additionally, attitude towards science is a significant factor affecting students' motivation (Hassan, 2008), success (Papanastasiou & Zembylas, 2002), course and career choices (Koballa & Glynn, 2006). Researchers define attitude towards science in different ways (Koballa & Glynn, 2006). These differences in definitions have led to the development of various measurement tools in order to measure student attitudes in one or more dimensional ways.

According to Wang and Berlin (2010) science attitude scales developed so far have been closely criticized, and their deficiencies were reported. Common criticisms are about the deficiencies in the definition, and lack of clarity of attitudes towards the significance of these scales because the term "attitude" might mean attitude towards science, scientific attitudes or understanding the nature of science (Blalock et al., 2008). It might also mean the attitudes of students towards science courses at school, or their attitudes towards science courses outside the school, or their attitudes towards scientists (Kind, Jones & Barmby, 2007).

Another criticism about these scales is the psychometric integrity. Many researchers add scores from different structures to the total score without making psychometric analysis. For instance, Osborne, Simon & Collins (2003) have stated that the attitudes towards science are formed of many structures. They also state that if there is not a single structure in a scale, it is wrong to combine these elements.

On reviewing the literature on science attitude scales, many sub-dimensions could be encountered. Even though many of them show similarity, they are called differently (Wang & Berlin, 2010). When developing the original scale, popular sub-dimensions were preferred, which were determined by Dhindsa and Chung (2003). These sub-dimensions are science enjoyment, science confidence, and importance of science. Some modifications have been performed by the developers of the original scale on aforementioned sub-dimensions that were determined by Dhindsa and Chung (2003). These modifications are as follows: "science enjoyment" was replaced with "the extent to which a student enjoys science class"; "science confidence" was replaced with "the extent to which a student is confident and feels successful in science class; and "importance of science" was replaced with "the extent to which a student thinks their science class to be an important and worthwhile class". A review of the literature revealed that there are very few measurement instruments to assess the levels of attitudes towards science for Turkish elementary school students. Therefore, the present study aimed to adapt the SAS into Turkish.

METHOD

The steps given below are followed regarding the reliability and validity of the scale:

- First of all, English-Turkish linguistic equivalence of each item of the scale which was translated into Turkish by the researchers was examined. A total number of eight researchers with a good level of English, who completed their PhD studies in various universities in Turkey and whose UDS (Language Exam for University Staff) scores range between 61-85, participated in this phase of the study.
- Secondly, the cross cultural validity was examined. A total number of six researchers , four lecturers in Turkish Language Teaching departments in the Faculties of Education at universities, and two Turkish Language teachers working for the Ministry of Education and have 13 to 15 years of professional experience, participated in this phase of the study.
- Later, the items of the scale, which were previously translated into Turkish were translated back into English to determine if they match original scale items.
- After the validity of English-Turkish translation, and the validity of the Turkish scale was provided in terms of language, and meaning, the English and Turkish forms of the scale were applied on the same student group separately, and the consistency between English and Turkish form of the scale was examined. The participants at this phase of the study were sought to be capable of good English so that they could understand the English form of the items of the original scale. Therefore, a total of 33 students studying at 6^{th}, 7^{th} and 8^{th} grades at a private school in Bartın attended the study.

- Finally, the reliability and validity study of the scale was carried out at eight different elementary schools (4^{th}, 5^{th}, 6^{th}, 7^{th} and 8^{th}) with 1013 students in Bartın and Düzce in 2012-2013 and 2013-2014 education years, throughout fall and spring semesters.

Sample of the study

Taking into consideration how easy or accessible is the participation of individuals or groups to the research process, convenience sampling method was used in choosing the samples (Johnson & Christensen, 2004). It is not claimed that the data obtained from the sample group represent the attitudes of all elementary schools students in Turkey, towards science classes. The sample group composed of elementary school students is big enough to examine the construct validity of the data via factor analysis (Büyüköztürk, 2002). Demographic information of the sample group of the study is given in Table 1.

Table 1. Demographic information about of the sample size

Grade level	f	%	Gender	f	%
4^{th} grade	40	4.0	Females	498	49.2
5^{th} grade	181	17.9	Males	512	50.6
6^{th} grade	336	33.1	Not specified	3	0.2
7^{th} grade	226	22.3	Total	1013	
8^{th} grade	225	22.2			
Not specified	5	0.5			
Total	1013				

Data Collection Tools

"*Science Attitude Scale-SAS*", "*English-Turkish Compatibility Grading Form*" and "*Turkish Understandability Grading Form*" were used as data collection tools.

Science Attitude Scale : A one dimensional English form of the SAS developed by Wang & Berlin (2010) including 30 items was used. This scale is an attitude scale with one dimensional theoretical framework and its one dimension structure is explained via explanatory factor analysis, and whose implementation does not take a long time.

The items were formed in 5 *Likert-type* and participants' answers were classified under; *I totally agree (5), I agree (4), Neutral (3), I do not agree (2) and I totally disagree (1).* 16 of the items in the scale were of positive structure while 14 were of negative structure. Total scores from SAS range between 30 to 150. It is determined that the original study carried out with 265 students of 4^{th} and 5^{th} grade included 30 questions in one dimension.

English-Turkish Compatibility Grading Form: In the grading form developed by Baloğlu (2005), the original English questions of the scale were typed to the left side and the Turkish translations were typed to right and a scale showing the "Translation Compatibility Degree" was located to the space in between Turkish and English items. English language experts were asked to read the original scale items first and then the Turkish translation, and were asked to rate between zero (0) and ten (10); zero for the translations which they think does not meet the meaning in the original item; and 10 for the items which they think totally meet the meaning in the original item.

Turkish Compatibility Grading Form: Developed by Baloğlu (2005), this form was used to determine the compatibility of the items to Turkish grammar and comprehensibility levels of the items in the Turkish scale. Turkish language experts rated the items of scale in terms of Turkish language rules. As in English-Turkish compatibility grading form, a scale showing the Turkish comprehensibility degree of each Turkish item was added. In these grading scores between 0 to 10; zero meaning the item is not understood and 10 meaning the item is perfectly understood was used.

Process

Before starting the adaptation of the scale into Turkish, necessary permissions from Tzu-Ling Wang and Donna Berlin, the developers of the scale, were taken via e-mails. After the permission was taken, the scale items were translated into Turkish by the researchers and translation compatibility ratings were demanded for each scale item from English language experts via the English-Turkish compatibility grading form. While doing the rating, the experts made their suggestions for each item, if they had any. Considering the expert suggestions researchers made some changes in the Turkish translation. Some of these changes are given below:

Taking the suggestions of the experts into consideration, the 1th item: *"Doing experiments in science class is boring"* was changed into "*Experiments made in science courses are boring*". And the 30th item which was previously written as "*I am impatient for science courses*" was changed into "*I look forward to science courses*".

Following the English-Turkish compatibility phase of the translated items, Turkish language experts rated the items in the Turkish form in terms of their compatibility to Turkish grammar and their levels of comprehensibility. As in translation compatibility phase, based on expert opinions, some changes have been made on Turkish translations. Some of these changes are as below:

The 3rd item of the scale, which was originally written as "*It is interesting to listen to the course from the teacher in science courses*", was changed into "*It is interesting to listen to science courses from the teacher*." The 7th item of the scale which was "*I learn science better when I study in a group in science courses*" was changed into "*I learn the course better when I study in a group in science courses.*"

To ensure, linguistic equivalence of the scale, Turkish items were translated back into English by an English language expert. The researchers examined the similarities of each item by comparing each item's original English version and its translation back into English. Finally, re-translated English items were translated into Turkish. Thus, the translation and cross-cultural validity of the scale was completed, and the Turkish version of the form was finalized.

The scale, whose linguistic equivalence and cross-cultural validity was ensured, was first applied in English and three weeks later it was applied in Turkish to the same group of students and the consistency level between the two forms were analysed. In these phase in which 33 students participated the results were subjected to Paired samples t-test.

To get an opinion about the one-dimensional structure, validation and reliability of the scale (psychometric features), the data collected from 510 students were subject to exploratory factor analysis, and confirmatory factor analysis was carried out on the data collected from 503 students. The data collected from 1013 individuals following the exploratory and confirmatory factor analysis was calculating the reliability coefficient.

Data Analysis

SPSS 18.0 and LISREL 8.8 statistical programs were used in data analysis.

FINDINGS

English-Turkish conformity

SAS includes one dimension and 30 items. The first statistical analysis in the research was on rating English-Turkish conformity of each item by English language experts and shown in Table 2 are English-Turkish conformity mean and standard deviation scores.

Table 2. English- Turkish conformity mean and standard deviation scores (n=8)

English-Turkish conformity								
Items	Mean	Standard deviation	Items	Mean	Standard deviation	Items	Mean	Standard deviation
Item1	9.62	.744	Item11	8.62	1.76	Item21	8.57	1.98
Item2	9.50	.755	Item12	9.00	1.19	Item22	9.87	.353
Item3	8.62	2.32	Item13	9.87	.353	Item23	9.75	.707
Item4	9.25	1.16	Item14	9.12	2.10	Item24	8.75	1.48
Item5	9.25	2.12	Item15	8.87	1.80	Item25	9.00	2.44
Item6	10.0	.000	Item16	9.50	1.41	Item26	8.12	2.10
Item7	8.87	1.64	Item17	8.12	2.29	Item27	7.85	2.34
Item8	9.50	.925	Item18	9.87	.353	Item28	8.25	2.18
Item9	9.71	.487	Item19	9.75	.707	Item29	8.87	2.10
Item10	8.50	1.85	Item20	9.12	1.64	Item30	8.25	2.31
Skewness		-1.942	Std. error		.752	z-value		-2.58
Kurtosis		4.388	Std. error		1.481	z-value		2.96

As is seen in Table 2, conformity of each scale item's translation with its English original version was found to range between 8.12 and 10.00. The mean of means was calculated by taking all the means for all the items and was found to be 9.06 (sd=1.08). These results indicate higher levels of conformity between the English items and their Turkish translation.

Turkish language conformity

The conformity of the items to Turkish grammar and comprehensibility levels were rated by Turkish language experts in terms of Turkish language rules. Rating results ranged between 7.16 to 10.00 and comprehensibility degrees of all items in the scale are given in Table 3.

Table 3. Turkish language conformity mean and standard deviation scores (n=6)

Turkish language conformity								
Items	Mean	Standard deviation	Items	Mean	Standard deviation	Items	Mean	Standard deviation
Item1	9.66	.816	Item11	9.66	.816	Item21	8.66	2.16
Item2	9.66	.816	Item12	9.83	.408	Item22	10.0	.000
Item3	8.33	1.86	Item13	9.66	.816	Item23	9.00	2.44
Item4	9.16	1.32	Item14	8.66	1.96	Item24	9.00	2.00
Item5	10.0	.000	Item15	9.83	.408	Item25	8.16	2.85
Item6	9.83	.408	Item16	9.66	.816	Item26	8.50	2.73
Item7	7.16	2.48	Item17	9.50	1.22	Item27	8.83	2.40
Item8	9.50	1.22	Item18	9.16	2.04	Item28	8.00	2.75
Item9	9.33	1.21	Item19	9.66	.816	Item29	9.50	1.22
Item10	9.66	.816	Item20	9.50	.122	Item30	9.50	1.22
Skewness		-1.758	Std. error		.845	z-value		-2.08
Kurtosis		2.85	Std. error		1.741	z-value		1.63

The mean of means was calculated by taking all the means for all the items and was found to be 9.22 (sd=.863), which indicates that Turkish items all together have high levels of conformity with the Turkish grammar.

Original English and back-translated English item conformity

Turkish items were translated back to English and the conformity of the original English and back-translated items was investigated. It was found that there was similarities between the original English and back translated items.

Language equivalency

The original English and the Turkish versions were completed by 33 students who go to private schools. First, students completed the original English version and a 3-week later they completed the Turkish version. Paired samples t-test analyses were performed and criterion $\alpha = .005$ for each item. Table 4 shows that the results of both forms highly match up with each other and that there was no statistically significant difference in all items except the 12^{th} and 28^{th} ($p<.05$). At this stage, it was decided that 12^{th} and 28^{th} items should be taken out of the scale and it was determined that the English and Turkish forms in the new scale obtained by excluding 12^{th} and 28^{th} items are consistent; in other words students understood the same thing from both the English and Turkish forms. In addition, students' total scores from the two administrations were compared. There was no significant difference between the two administrations on the total scale ($t=.198$, $p<0.50$).

Table 4. Paired samples t-test results (n=33)

Item No	t	p	Item No	t	p	Item No	t	p
Item1	-.879	.386	Item11	.099	.922	Item21	1.378	.178
Item2	-.367	.716	Item12	2.530	.017	Item22	1.055	.299
Item3	-.267	.791	Item13	-1.184	.245	Item23	-.737	.467
Item4	.133	.895	Item14	-1.099	.280	Item24	-.243	.810
Item5	-.259	.797	Item15	-1.097	.281	Item25	-.321	.750
Item6	-.193	.848	Item16	-.472	.640	Item26	.984	.332
Item7	.000	1.000	Item17	-.657	.516	Item27	-1.873	.070
Item8	.839	.407	Item18	.000	1.000	Item28	2.620	.013
Item9	-1.103	.278	Item19	-.502	.619	Item29	.379	.707
Item10	.000	1.000	Item20	1.809	.080	Item30	.141	.889

Psychometric Characteristics of the Scale (Structural Validity and Reliability)

As for Bindak (2005), since an unreliable scale will not be valid, it is necessary to consider the reliability of a scale before looking for validity. The reliability (internal consistency) of the adapted scale was analysed with item analysis and one based on correlation analysis was made.

When Table 5 is examined, it is seen that the scores of all the items in the original scale show a high correlation with scale scores, and high values ranging between .31 and .70 are obtained. And in the adapted scale the scores of all items are found to have values between .18 and .60. Item-total correlation coefficients refer to a very good item for $r \geq .40$ and a good item for $.30 \leq r \leq 0.39$ (Büyüköztürk, 2002). Thus, the items 3 and 12 in the adapted scale, whose item-total correlation values were found to be lower than .30, were excluded from the scale. It can be said that the remaining items' reliability values are high and they measure similar behaviour.

Table 5. Item-total correlation of the items

Items	Item-total correlations for adapted scale (r)	Item-total correlations for original scale (r)	Items	Item-total correlations for adapted scale (r)	Item-total correlations for original scale (r)	Items	Item-total correlations for adapted scale (r)	Item-total correlations for original scale (r)
1	.35	.47	**11**	.51	.60	**21**	.45	.53
2	.30	48	**12**	.18	.31	**22**	.55	.63
3	.28	.66	**13**	.52	.47	**23**	.49	.66
4	.56	.47	**14**	.60	.46	**24**	.54	.59
5	.54	.56	**15**	.35	.70	**25**	.42	.55
6	.53	.39	**16**	.52	.58	**26**	.57	.70
7	.38	.51	**17**	.38	.46	**27**	.42	.52
8	.55	.51	**18**	.46	.69	**28**	.43	.59
9	.44	.50	**19**	.55	.56	**29**	.60	.48
10	.48	.50	**20**	.51	.54	**30**	.59	.66

Structural validity

Explanatory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were applied to determine the structural validity of the SAS. EFA aims to reach a small number of significant factors that the variables can explain together among a great number of interrelated variables (Çokluk, Şekercioğlu & Büyüköztürk, 2012). In this study, EFA was used to find out the structure of SAS on Turkish students studying at elementary school (Çokluk, Şekercioğlu & Büyüköztürk, 2012). First, the scale's original factor structure (i.e., one factor) was tested with all the original scale items, all but three items (*i.e.*, 3, 12 and 28) included in the model. CFA was performed with the data and results showed that the data did not fit the model (χ^2/df = 1711.48/324; p < 0.001; RMSEA = 0.092; GFI = 0.80; AGFI = 0.77; NFI = 0.92 ; CFI = 0.94; RMR = 0.081; Standardized RMR = 0.065). Therefore, EFA with varimax rotation was performed.

Explanatory Factor Analysis

The correlation matrix among all items was examined in EFA, which was made to determine the structural validity of the SAS, in order to find out whether there were statistically significant correlations. It was found that there were statistically significant relations convenient for factor analysis in the data obtained from elementary school students. In order to find out the convenience of data for factor analysis "KMO" (Kaiser-Meyer-Olkin Measure of Sampling Adequacy Test) coefficient and Barlett's test of sphericity were carried out. The KMO should be higher than .50 for the data to be convenient for factor analysis, and the Barlett's test of sphericity should be significant (Çokluk, Şekercioğlu, & Büyüköztürk, 2012). KMO was found to be .922 for the elementary school students; while Barlett's test of sphericity χ^2 value was found 4390.416 (p<.01). The values obtained show that the factor analysis is applicable and that there is a correlation between the items.

Factor loading values of the items as a result of factor analysis are of great importance. Büyüköztürk (2002) express that if the factor loading values of the items is .45 or higher, that is an indicator of a good result and this value can be lowered to .30 for a small number of items. In this step, it was decided that the 7th item, whose factor loading value was below .30, shall be removed from the scale. After the 7th item is decided to be removed from the scale. Consequently, these four items (3, 7, 12 and 28) were dropped from the scale and analysis was re-run. Varimax vertical rotation was again used in EFA. As a result, KMO was found as .921 and Barlett's test of sphericity χ^2 value was found as 4263.613 (p<.01).

When the total variance values of the items in the SAS are examined, it is seen that the analysed 26 items are grouped under 5 factors with an eigenvalue of over 1, which together explain 52.423% of the variance. However, since all other factors except the 1st one do not have a big contribution to the scale, it is thought that the scale could be one-factor. Therefore, it is thought that the scree plot made using eigenvalue is necessary.

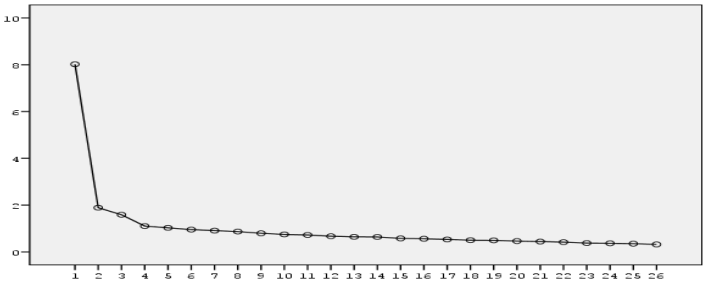

Figure 1. The Scree plot

When Figure 1 is examined, a high fall is seen in eigenvalue line after the first factor. This shows that the scale may have one factor. Examination of the scree plot suggested that an extraction of one component accounted for 30.846% of the variance. To confirm the results suggested by scree test, Horn's parallel analysis was conducted. The data in Table 6 were obtained through the parallel analysis program developed by Watkins, (2000).

Table 6. Comparison of eigenvalues from EFA and criterion values from parallel analysis

	Original scale			Adaptation scale	
Factors	Actual eigenvalue from EFA	Criterion value from parallel analysis	p	Actual eigenvalue from EFA	Criterion value from parallel analysis
1	10.53	1,73	0.000*	8.020	1.43
2	2.19	1,62	0.177	1.888	1.37
3	1.75	1,54	0.254	1.588	1.32
4	1.37	1,48	0.352	1.105	1.28
5	1.20	1,42	0.401	1.029	1.24
6	1.13	1.37	0.412		
7	1.02	1.33	0.441		

*p < 0.001

The results showed only three factors with eigenvalues exceeding the corresponding values of the random eigenvalues generated for 26 variables, 510 subjects and 100 replications. When the results of the parallel analysis and scree plot were evaluated, it is thought that the scale should be three dimensional. But the original scale is decided to be one-dimensional with similar results; confirmatory factor analysis was conducted for one-dimensional structure with a different sample.

Confirmatory Factor Analysis

Confirmatory factor analysis was conducted on the Turkish version of the form via LISREL 8.8 statistics program. It was tested if the data collected from different sample groups confirmed the one sub-dimensions. Figure 2 and 3 demonstrates the significance levels of t values and error variance of the indicators based on the data collected from the sample group of 503 students.

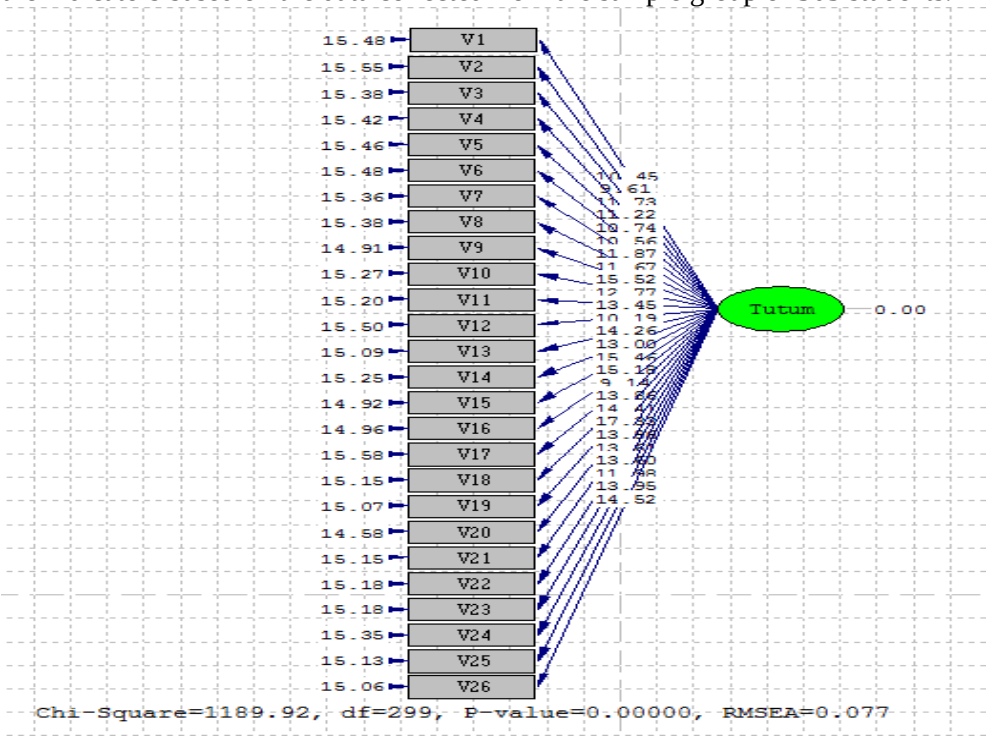

Figure 2. t values (n=503)

Figure 2 demonstrates the t values in relation to latent variables that able to explain the observed variable, and the error variance of the observed variables. When the t values exceed 1.96, it is statistically significant at .05, and when they exceed 2.56, it is statistically significant at .01. On

observing the t values, all indicators are statistically significant at .01. In addition, it was observed that the error variance of the observed variables gets quite appropriate values (Figure 3).

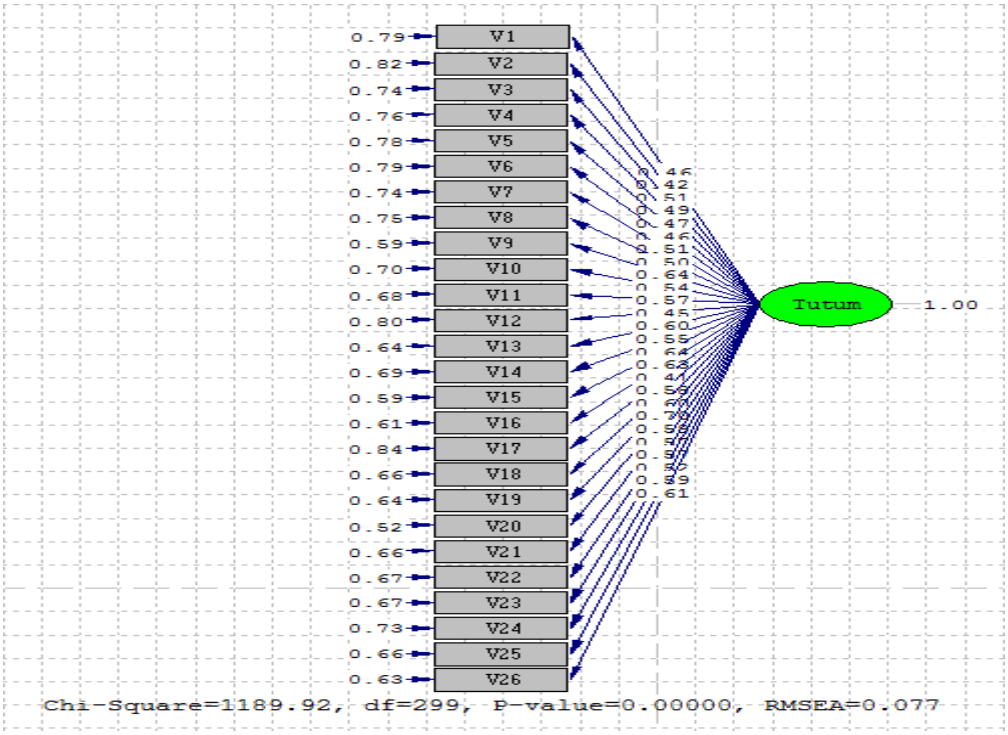

Figure 3. Error variances (n=503)

There are many compliance statistics for the analyses in structural equation modeling. The most frequently used compliance statistics indices were used for the data analysis in this study (Table 7). p value was analyzed to get information about the statistically significant difference (χ^2 value) between the anticipated co-variance matrix and the observed co-variance matrix. Even though it is desirable to have an insignificant p value, it is tolerable to have a statistically significant p value in this study as is the case in studies with large sample sizes (Çokluk, Şekercioğlu, & Büyüköztürk, 2012).

Table 7. Compliance statistics (n=503)

Model	χ^2/df	GFI	AGFI	RMSEA	CFI	NNFI	RMR	SRMR
	3.97	.85	.82	.077	.95	.95	.089	.057

The ratio of χ^2 value to its degree of freedom is important statistics. When the ratio is 3 or below 3, it shows that the compliance is high, but when the ratio is below 5 (Kline, 2005; Sümer, 2000) it shows moderate conformity. Table 7 demonstrates that χ^2/df ratio represents moderate level compliance. As GFI and AGFI values are not over .90, they represent weak compliance (Hooper, Caughlan & Mullen, 2008). When CFI and NNFI values are over .95, it represents perfect compliance (Sümer, 2000). When RMSEA, RMR and standardized RMR values are below .05, it represents perfect compliance whereas it represents good compliance when they are below .08 (Brown, 2006, s.87; Hu & Bentler, 1999; Jöreskog & Sörbom, 1993). Furthermore, when they are below .10, it represents weak compliance (Tabachnick & Fidel, 2001). It can, therefore, be considered that RMSEA values of the test conducted represent good compliance. On the other hand, observing RMR (.089) and standardized RMR (.057) values, it can be considered that they are in weak and good compliance. According to compliance statistics, it can be considered that this scale which was translated and adapted into Turkish formed a good model with all compliance statistics (excluding GFI, AGFI, RMR) and that it is a valid scale with its factor structures.

Reliability

The Cronbach-Alpha reliability coefficient for the 26-item scale, which was formed by taking 4 items out of the SAS, was found to be .916. This value shows that the adapted form of the scale is highly reliable.

Descriptive results

The data obtained from 1013 students was used to identify whether there was a statistically significant difference between the students' attitudes towards science in terms of their gender and class level. For this purpose, it was decided to conduct a Two-Factor Variance Analysis (ANOVA) for unrelated samples. Here, there were two independent variables of which impact on the dependent variable (attitude) was examined, and these were gender and class level and each one had its sub-factors. First, it was necessary to see whether the data exhibited a normal distribution so that the analysis could produce reliable results. Since the data did not exhibit a normal distribution, non-parametrical Mann Whitney U Test was conducted in order to identify whether gender had a significant effect on the students' attitudes towards the science course (See Table 8).

Table 8. Results of Mann-Whitney U Test

Group	N	Mean	Order mean	Order Total	U	p
Females	502	3.90	484.04	242990.00	116737.000	.020
Males	508	3.98	526.70	267565.00		

When Table 8 is examined it is seen that, according to the results of the Mann-Whitney U Test, which was conducted to identify whether there was a significant difference between the attitudes of the male and female students towards the science course, there was statistically significant difference between the groups' attitudes towards the science course ($U = 116737$; $p<.05$).

Non-parametrical Kruskal-Wallis Test was conducted in order to identify whether the class level had an effect on the students' attitudes towards the science course (See Table 9).

Table 9. Results of Kruskal-Wallis Test

Class level	N	Mean	Order mean	sd	χ^2	p	Significant difference
4. class	40	4.53	779.63	4	132.632	.000	4-5 (p=.005)
5. class	181	4.26	653.42				4-6 (p=.000)
6. class	336	3.99	519.63				4-7 (p=.000)
7. class	226	3.71	414.08				4-8 (p=.000)
8. class	225	3.75	404.03				5-6 (p=.000)
Total	1008	3.94					5-7 (p=.000)
							5-8 (p=.000)
							6-7 (p=.000)
							6-8 (p=.000)
							7-8 (p=.893)

While the Kruskal-Wallis Test put forth whether there was a significant difference between the compared means, it does not give information on the size of this difference. Since the Kruskal-Wallis Test does not include multiple comparisons option, a comparison was made with the Mann-Whitney U Test for the possible couples of all class levels in order to identify whether there was a significant difference between any class levels. When Table 9 is examined, it is seen that there was a significant difference between the attitudes towards the science course between all class level except for the 7^{th} and 8^{th} classes. In addition, it is understood that, a decrease occurred in the elementary school students' attitudes towards the science course as the class level increases.

DISCUSSION

SAS developed by Wang & Berlin (2010) was adapted into Turkish in the scope of this study. The scale has one dimensional theoretical frame. One significant feature of the scale is that the one dimensional structure of the scale data is determined successfully by explanatory and confirmatory factor analysis. This dimension enables to measure the attitudes of students at elementary school towards science courses at school.

The sample of the study is adequate for statistical analysis. Results obtained from linguistic equivalence and the cross-cultural validity of the scale show that there is a high correlation between both the items in Turkish and English.

The scores of each item in the scale had a high correlation with the total scores. However, since the item- total correlation value of the 3rd item was lower than .30, it was decided to remove from the scale. Another item (7th item) whose factor loading value was found to be below .30 was also removed from the scale. And 2 other items was removed from the scale as a result of Paired samples t-test and thus, a total of 4 items were removed from the scale and the remaining 26-item one dimensional structure explains 30.840% of the total variance. When it is considered that 30% and over is taken as criteria in explain variance ratio in scale development and adaptation studies, it is seen that the structural validity of the scale is ensured within sample group (Ural & Kılıç, 2006). Confirmatory factor analysis was conducted with 503 elementary school students in order to test whether one sub-dimension confirm the data. According to compliance statistics, it can be considered that the Turkish SAS formed a good model with all compliance statistics. The Cronbach-Alpha value of the scale was found .916.

Within the scope of this study, it is found that there was significant difference between the attitudes of male and female students towards the science course. The findings of this study are not in parallel with the results of similar studies in the literature (Barrington & Hendricks, 1988; Bilgin & Geban, 2004). Some studies indicate that there is no difference based on gender between the attitudes of the primary school students towards the science course (Altınok, 2004). However, as the education level advances, a difference in favor of male students appeared in terms of their attitudes towards the science between the attitudes of male students and female students (Sungur & Tekkaya, 2003). In their study involving students between the ages of 10 and 18, Reid and Skryabina (2003) found that the male and female students at primary school level had a positive attitude towards science, and a significant decrease occurred in female students' attitudes towards science, compared to the male students, starting from the end of the 2nd class of high school. On the other hand, in some studies, it is stated that girls have more positive attitudes towards science (Boone, 1997; Murphy & Beggs, 2003).

Within the scope of this study, it is found that there was a significant difference in students' attitudes towards the science course between all class levels except for 7th and 8th class levels. In addition, it is understood that there is a decrease in the elementary school students' attitudes towards the science course as the class level increases. The findings of this study are parallel to the results of the study conducted by Bozdoğan and Yalçın (2005). There is also little agreement on the relation between class level and attitudes towards science. Many studies state that there is a decrease in student attitudes towards science as they go to upper classes (Francis & Greer, 1999; Greenfield, 1997; Murphy, Ambusaidi & Beggs, 2006; Murphy & Beggs, 2003). However, in other studies, it is found that there is no decrease in student attitudes towards science in higher classes (Aiken, 1979). On the other hand, in a very small number of studies, it is found that older students have more positive attitudes (Hassan, 2008). Pell and Jarvis (2001) state that the decrease started in the last two years of primary school, and the studies by Murphy and Beggs (2003) and Sorge (2007) supports this view.

CONCLUSION AND RECOMMENDATIONS

All results obtained support linguistic equivalence and cross-cultural validity, structural validity (one dimensional structure) and the reliability of the scale. Thus, the scale not only provides an opportunity to measure elementary school students' attitudes towards science but also provides an opportunity for educators to get students' ideas about the subjects in the scale. Thus, educator can identify students' attitudes towards science and can take the necessary precautions to improve the attitudes of the students with a low attitude towards science, and encourage students who already have

positive attitudes towards science. In addition, the scale enables Turkish researchers to make comparative research at international level.

It is expected that this scale will serve as a beneficial tool for teachers to collect information about students' attitudes towards science, and as an alternative attitude scale for researchers. It has been suggested that these findings which are just a beginning for the adaptation of the SAS into Turkish should be supported with research conducted with different sample groups, and that they will provide new evidence for the validity and reliability of the Turkish form.

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Appendix-1

No	Fen Tutum Ölçeği	Tamamen Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Tamamen Katılıyorum
1	Fen dersinde yapılan deneyler sıkıcıdır.					
2	Fen dersindeki deneyler zordur.					
3	Fen dersinde öğretilenleri genellikle anlarım.					
4	Fen dersinde yaptığım deneyler yararlıdır.					
5	Fen çalışma kitabındaki sorular benim için kolaydır.					
6	Fen ders kitabını okumaktan hoşlanırım.					
7	Fen çalışma kitabındaki soruları cevaplamaktan hoşlanmam.					
8	Fen ders kitabındaki etkinlikler benim için zordur.					
9	Fen dersi olmasaydı okul daha çok hoşuma giderdi.					
10	Fen dersindeki soruları cevaplamaktan korkarım.					
11	Fen dersinde, fenle ilgili posterleri okumaktan hoşlanırım.					
12	Fen dersi ilginçtir.					
13	Fen dersi benim için zordur.					
14	Fen dersinde, dersle ilgili bir film izlemek sıkıcıdır.					
15	Fen dersi zaman kaybıdır.					
16	Fen dersi bana günlük yaşamımda kullanacağım bilgileri kazandırır.					
17	Fen dersinde genellikle iyi notlar alırım.					
18	Fen dersinde hazırlanan posterler dersi öğrenmemde yardımcı olmaz.					
19	Fen dersinde deneyler yapmayı severim.					
20	Fen dersinden hoşlanmam.					
21	Fen ders kitabındaki etkinlikler dersi öğrenmemde yardımcı olur.					
22	Fen çalışma kitabındaki sorular dersi öğrenmemde yardımcı olmaz.					
23	Fen dersinde, konuyla ilgili film izlemek dersi öğrenmemde yardımcı olur.					
24	Fen dersi kapsamında yapılan alan gezilerinden hoşlanmam.					
25	Fen dersinde öğretmenin anlattıklarını kolaylıkla anlarım.					
26	Fen dersini sabırsızlıkla beklerim.					

İlköğretim Öğrencileri için Geliştirilmiş Fen Tutum Ölçeğinin Türkçeye Uyarlanması: Geçerlik ve Güvenirlik Çalışması

Cemal TOSUN [1] & Murat GENÇ [2]

Öz. Bu araştırmanın amacı, Wang & Berlin, (2010) tarafından geliştirilen "Fen Tutum Ölçeği'nin Türkçeye uyarlanarak geçerlik ve güvenirlik çalışmasını yapmaktır. Orijinal ölçek tek faktörlü yapıda toplam 30 maddeden oluşmaktadır. İlk olarak ölçeğin geliştiricilerinden izin alınmıştır. Daha sonra, ölçek maddeleri araştırmacılar tarafından Türkçeye tercüme edilmiştir. Takiben, İngilizce ve Türkçe dil uzmanlarının görüşlerine başvurularak ölçeğin dilsel eşdeğerliği incelenmiştir. Türkçe form son halini aldıktan sonra, bir İngiliz dili uzmanı ölçeğin Türkçe maddelerinin İngilizce geri çevirisini yapmıştır. Bu aşamalardan elde edilen sonuçlar, ölçek maddelerinin Türkçe tercümesinin İngilizce orijinal maddelerle yüksek oranda örtüştüğünü göstermiştir. Böylece ölçeğin tercüme ve dil geçerliği tamamlanmıştır. Ölçeğin Türkçe formu Bartın ve Düzce illerinde MEB'e bağlı ilköğretim okullarında öğrenim gören toplam 1013 öğrenciye uygulanmıştır. Ölçeğin yapı geçerliği açımlayıcı ve doğrulayıcı faktör analizi ile incelenmiştir. Analiz sonucunda adapte edilen ölçek ilköğretim öğrencileri için tek faktörlü ve 26 maddelik olarak bulunmuştur. Son olarak ölçeğin ilköğretim öğrencileri için hesaplanan güvenirlik iç tutarlılık katsayısı (Cronbach-Alpha) toplam ölçek için .916 olarak hesaplanmıştır. Bu ölçek ilköğretim öğrencilerinin fen derslerine karşı tutumlarını belirlemek için faydalı ve araştırmacılar için ise alternatif bir ölçme aracı olarak kullanılabilir.

Anahtar Kelimeler: Açımlayıcı faktör analizi, doğrulayıcı faktör analizi, fen tutum ölçeği, geçerlik ve güvenirlik

ÖZET

Araştırmanın Amacı: Wang & Berlin, (2010) tarafından geliştirilen Fen Tutum Ölçeği'nin Türkçeye uyarlanarak geçerlik ve güvenirlik çalışmasını yapmaktır.

Yöntem: Örneklem seçiminde uygulamaya katılacak bireylerin ya da grupların araştırma sürecine katılmalarının daha kolay ya da ulaşılabilir olmaları durumları göz önünde bulundurulmuştur. Uygunluk örnekleme yöntemi kullanılarak Bartın ve Düzce illerinde öğrenim görmekte olan toplam 1013 öğrenciden veri toplanmıştır.

Sonuç ve Tartışma: Bu araştırmada, Wang & Berlin (2010), tarafından geliştirilen "Science Attitude Scale" (Fen Tutum Ölçeği) isimli ölçeğin Türkçeye uyarlama çalışması yapılmıştır. Ölçek, tek boyutlu kuramsal bir çerçeveye sahiptir. Ölçek verilerinin tek boyutluluğu açımlayıcı ve doğrulayıcı faktör analizi ile başarılı bir şekilde saptanmıştır. Bu boyutlar ilköğretim düzeyinde öğrenim gören öğrencilerin okuldaki fen derslerine yönelik bir ölçüm yapma olanağı vermektedir.

Ölçeğin dilsel eşdeğerlik çalışmasından elde edilen bulgular Türkçe ve orijinal formda bulunan maddeler arasındaki korelasyonun oldukça yüksek olduğunu göstermiştir. Bu sonuca göre ölçeğin dilsel eşdeğerliğinin sağlandığı söylenebilir.

Ölçekte yer alan her bir maddenin puanları anket puanı ile yüksek derecede korelasyon göstermektedir. Ancak 3. maddenin madde-toplam korelasyon değeri .30'dan küçük olduğundan bu aşamada ölçekten çıkartılmasına karar verilmiştir. Faktör analizi sonucunda faktör yük değeri .30'un altında olduğu tespit edilen bir madde de (7. madde) ölçekten çıkartılmıştır. 2 maddenin de Paired samples t- testi sonucu ölçekten çıkartılmasıyla toplamda ölçekten çıkartılan 4 maddeden sonra geriye kalan 26 maddelik tek boyutlu yapı toplam varyansın %30.840'ını açıklamaktadır. Ölçek geliştirme ve uyarlama çalışmalarında açıklanan varyans oranı için %30 ve üzeri ölçüt olarak alındığı düşünüldüğünde, ölçeğin yapı geçerliğinin örneklem grubu içinde sağlandığı görülmektedir (Ural ve Kılıç, 2006). Verilerin tek boyutu doğrulayıp doğrulamadığı test etmek için 503 ilköğretim öğrencisinden elde edilen verilere doğrulayıcı faktör analizi yapılmıştır. Uyum iyiliği istatistiklerine göre Türkçeye çevrilerek uyarlaması yapılan bu ölçeğin, bütün uyum iyiliği istatistikleriyle iyi bir model oluşturduğu ve faktör yapılarıyla geçerli bir ölçek olduğu söylenebilir. Ölçeğin tamamı için Cronbach-Alpha güvenirlik katsayısı .916 olarak tespit edilmiştir. Bu araştırma kapsamında kız ve erkek öğrencilerin fen bilimleri dersine karşı tutum düzeyleri arasında anlamlı bir farklılığın olduğu tespit edilmiştir. Ayrıca öğrencilerin 7. ve 8. sınıf düzeyi dışındaki tüm sınıf düzeyleri arasında fen bilimleri dersine karşı tutum düzeyleri arasında anlamlı bir farklılığın olduğu belirlenmiştir. Bu ölçek ilköğretim öğrencilerinin fen derslerine karşı tutumlarını belirlemek için faydalı ve araştırmacılar için ise alternatif bir ölçme aracı olarak kullanılabilir.

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