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ADAPTATION OF STEM ATTITUDE SCALE TO TURKISH*

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STRUCTURED ABSTRACT

Since the beginning of the 20th century the need for individuals who are well-educated in science (natural sciences and social sciences), technology, engineering and mathematics areas increased. Main reasons underlying such a need are economy, technology and innovation. For all these reasons, many countries tried and are still seeking to improve quality of the education given in subjects such as science, technology engineering and mathematics. Countries developed different methods, ways and projects to increase the number of well-educated people in these areas and started competing among themselves.

The term or concept of STEM was firstly suggested in 2001 by one of the NSF (National Science Foundation) directors, J. Ramaley (Yıldırım and Altun, 2014; Voutour, 2014). Although it was suggested in 2001 by the NSF, the history of STEM concept goes back to the beginning of the 19th century (Ostler, 2012).

STEM is an abbreviation formed using the first letters of Science, Technology, Engineering and Mathematics words (Yıldırım and Altun, 2014; Gonzalez and Kuenzi, 2012; Voutour, 2014; Moomaw, 2013).

For the last 10 years STEM education is considered as a vital subject for the researchers. STEM plays an important role for economic competition (Erdoğan et al., 2013). The relation between the workforce and STEM areas has been emphasized in the recent years and the importance of encouraging and preparing the future generations to choose these areas has been highlighted. In spite of this, many countries failed and keep failing at this. PISA (International Student Assessment) results show that both Turkey and the western countries are not at a sufficient level in terms of science and mathematics (OECD, 2010). Researchers and countries have made some efforts to increase the interest in STEM areas and the number of people who want to have careers in such areas (Maltese and Tai, 2010). Therefore, this study

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aims to adapt the Sources of Middle School Mathematics STEM Attitude Scale developed by Faber et al. (2013) for the Turkish context.

The first step of the study was to get permission were taken by means of e-mail from Faber et al., (2013) who developed the scale, the original form of which is in English, to be applied on middle school students and the scale development process has been started. Thereafter, SAS was translated into Turkish by four experts who have a good command of English and Turkish. Turkish draft, which is formed by considering the common points in the translations of four experts, was translated back into English by an expert on both languages. A scale form of 37 items, the original and Turkish translation of which are in compliance with each other, was prepared as a result of this procedure. Opinions of experts in the area were taken in order to ensure the concept validity of SAS. After the necessary arrangements were made according to the opinions of the experts, the scale was applied on 30 students attending 6th, 7th and 8th grades. Later, The sample consisted of totally 1350 students, attending 6th, 7th and 8th grades in Ankara and Mus, Turkey. Overall 1360 students 48% of participants are male (n=653), 52% of participants are female (n=707). One hundred and fifty students did not provide any information about this section. 29 % of participants are 6th grade (n=395); 31% of participants 7th grade (n=422), and 40% of participants are 8th grade students (n=543). Exploratory and confirmatory factor analysis and some descriptive analysis were conducted.

EFA was applied to investigate the structural validity of the scale. After that, CFA was conducted in order to test the structure with theoretical basis. Factors determined with EFA were named as Mathematics, Science, Engineering, Technology and 21st Century Skills as it is with the original scale. The structure of STEM attitude scale with four factors was tested by means of CFA. When the fit values obtained ($x2/df = 4.72$; RMSEA=0.063, SRMR=0.053, CFI=0.96, GFI=0.87, AGFI=0.85, NFI=0.95, IFI=0.95) are investigated, it can be said that the scale featured a good level of fit.

When the other fit indices are investigated, the fact that GFI and AGFI values are higher than 0.90 (Hooper, Coughlan and Mullen, 2008; Sümer, 2000) and RMR and RMSEA values are lower than 0.05 indicates that there is a good model-data fit (Jöreskong and Sörbom, 1993; Sümer, 2000). On the other hand, the fact that GFI was determined to be higher than 0.85 while AGDI was determined to be higher than 0.80 and RMR and RMSEA values were determined to be lower than 0.080 are acceptable for model and data fit (Anderson and Gerbing, 1984; Hooper, Coughlan and Mullen, 2008; Sümer, 2000; Hu and Bentler, 1999). It can be said that GFI (0.87) and AGFI (0.85) values obtained in this study are at an acceptable level for fit since they are close to 0.90.

The other fit indices are NFI and CFI fit indices. Increasing fit indices NFI and CFI fit indices were used in the study. The fact that these index values are above 0.95 indicates a very good fit (Hu and Bentler, 1992; Sümer, 2000). It can be said that NFI (0.95) and CFI (0.96) values obtained in this study are in a very good fit.

According to the results of the t test of the scores of those in the lower %27 band and in the higher 27% band, there is a significant difference between means scores for each item. According to this, it can be said that items in the scale are distinctive. Cronbach Alpha reliability coefficient values calculated for the dimensions of STEM attitude scale vary between 0.86 and 0.89. This indicates that these values are close to the alpha values calculated for the original form of the scale. This indicates that Turkish adaptation and the original scale has a high level of fit.

In conclusion, it was understood that STEM attitude scale had a structure with four factors as the case with the original scale. EFA and CFA results of the scale factors were sufficient and the scale served its purpose. In the light of these results, it is understood that Turkish version of the STEM (Science, Technology, Engineering and Mathematics) attitude scale for secondary school student can be used.

Key Words: STEM, STEM Attitude Scale, Middle School

STEM TUTUM ÖLÇEĞİNİN TÜRKÇEYE UYARLANMASI

ÖZET

Bu çalışmanın amacı, Faber vd (2012) tarafından geliştirilen STEM Tutum Ölçeğini (STEM Attitude Scale) Türkçeye uyarlamak ve ölçeğin geçerliliğini ve güvenirliğini araştırmaktır. Türkçe form, eş-değerlik sınamasının ardından 6, 7 ve 8. sınıflarında öğrenim gören 1360 ortaokul öğrencisine uygulanmıştır. Öğrencilerin sınıflarına göre dağılımları incelendiğinde; %29'nu (n=395) altıncı, %31'i (n=422) yedinci ve %40'ı (n=543) sekizinci sınıfta okumaktadır. Ölçeğin yapı geçerliliğini incelemek için açımlayıcı ve doğrulayıcı faktör analizi yapılmıştır. STÖ' nün güvenirliğinin belirlenmesi için ise Cronbach Alfa iç tutarlık katsayısı, düzeltilmiş madde toplam korelasyonu ve %27'lik üst ve alt grupların madde ortalamaları arasındaki farkların anlamlılığı t testi ile incelenmiştir. Sonuçlar göstermiştir ki STEM Tutum Ölçeği'nin Türkçe versiyonu dört faktörden oluşmaktadır. Faktörlerin Cronbanch alfa değerleri 0.86 ile 0.89 arasında, düzeltilmiş madde toplam puan korelasyonları 0.38 ile 0.78 arasında değişmektedir. Ölçüt geçerliği sonuçları, ölçeğin amacına hizmet ettiğini göstermiştir. T testi sonuçları ise %27'lik alt ve üst grupların madde ortalamaları arasındaki tüm farkların anlamlı olduğunu göstermiştir. Açımlayıcı faktör analizinin ardından ortaya çıkan yapı 1360 ortaokul öğrencisine uygulanarak doğrulayıcı faktör analizi (RMSEA, 0,063; GFI, 0.87; AGFI, 0,85; SRMR, 0.053; NFI, 0.95; CFI, 0.96; IFI, 0.96) yapılmış ve STEM Tutum Ölçeğinin yapısının doğrulandığı belirlenmiştir. Bu sonuçlara göre, STEM Tutum Ölçeği'nin Türkçe versiyonu, STEM' e karşı öğrenci tutumların ölçülmesi için geçerli ve güvenilirdir.

Anahtar Kelimeler: STEM, STEM Tutum Ölçeği, Ortaokul

Introduction

Since the beginning of the 20th century the need for individuals who are well-educated in science (natural sciences and social sciences), technology, engineering and mathematics areas increased. Main reasons underlying such a need are economy, technology and innovation. For all these reasons, many countries tried and are still seeking to improve quality of the education given in subjects such as science, technology engineering and mathematics. Countries developed different methods, ways and projects to increase the number of well-educated people in these areas and started competing among themselves.

The first leadership competition between countries in economy and technology areas started with Russia sending a satellite to the Moon in 1957 (Woodruff, 2013; Gonzalez and Kuenzi, 2012). In response to that, thinking that it had fallen behind in science, technology, engineering and mathematics areas, the USA established NASA in 1958. In fact, this is the event that caused the emergence of STEM education understanding.

The term or concept of STEM was firstly suggested in 2001 by one of the NSF (National Science Foundation) directors, J. Ramaley (Yıldırım and Altun, 2014; Voutour, 2014). Although it was suggested in 2001 by the NSF, the history of STEM concept goes back to the beginning of the 19th century (Ostler, 2012).

STEM is an abbreviation formed using the first letters of Science, Technology, Engineering and Mathematics words (Yıldırım and Altun, 2014; Gonzalez and Kuenzi, 2012; Voutour, 2014; Moomaw, 2013). There is no clear definition for it, although the term STEM is the abbreviation of the first letters of these four basic areas (Longdon et al., 2011). In addition to that, STEM suggests that although four basic disciplines are considered, STEM concept is not clear and it is problematic for some areas to be included to or excluded from this concept (Koonce, Zhou and Anderson, Hening and Conley, 2011; Zhou, 2010).

Within this context, this subject is discussed in a report published by APA in 2009 titled "Psychology as a core Science, Technology, Engineering and Mathematics (STEM) Discipline". According to APA, it is said that psychology was also within STEM and it was even at the very center of it. On the other hand, According to Yıldırım and Altun (2013), the word "science", the first letter of which formed one of the letters in the abbreviation "STEM", contains a more comprehensive meaning than science. In the study titled as " "S" is for Science" by Breckler (2007) it is stated that Science had a broader meaning including all disciplines and STEM has a broader meaning which includes not only mathematics, physics, biology, engineering and computer engineering but also behavioral sciences (psychology) and social sciences. This is in parallel with the opinions suggested by Yıldırım and Altun.

He argued that the word "Science" had a broader meaning including all disciplines and STEM had a broader meaning that includes mathematics, physics, biology, engineering, computer engineering, behavioral sciences (psychology) and social sciences. Some other scientists think the same about the situation. Price clearly stated in his article titled "Promoting Psychology as a STEM Discipline" (2011) that STEM also includes Psychology and that STEM could not be considered without psychology.

STEM education is an approach that encourages students for direct learning, makes them reach their dreams and ensures that they transfer such learning to new and different problems (Yıldırım, 2013a, 2013b). Individuals with adequately informed and equipped with regard to STEM use what they learn, science and the nature of science by sieving them through the schemes in their minds. They solve the problems they encounter in their daily lives and make plans, assessments and criticism about ideas the thoughts. STEM is an approach that encourages students

for direct learning, makes them reach their dreams and ensures that they transfer such learning to new and different problems (Yıldırım, 2013a, 2013b).

For the last 10 years STEM education is considered as a vital subject for the researchers. STEM plays an important role for economic competition (Erdoğan et al., 2013). The relation between the workforce and STEM areas has been emphasized in the recent years and the importance of encouraging and preparing the future generations to choose these areas has been highlighted. In spite of this, many countries failed and keep failing at this. PISA (International Student Assessment) results show that both Turkey and the western countries are not at a sufficient level in terms of science and mathematics (OECD, 2010). Researchers and countries have made some efforts to increase the interest in STEM areas and the number of people who want to have careers in such areas (Maltese and Tai, 2010). Therefore, this study aims to adapt the Sources of Middle School Mathematics STEM Attitude Scale developed by Faber et al. (2013) for the Turkish context.

Method of the Study

Participants

Participants of research are consisted of 1360 6th-8th grade students. In 7 different middle schools. Overall 1360 students 48% of participants are male (n=653), 52% of participants are female (n=707). One hundred and fifty students did not provide any information about this section. 29 % of participants are 6th grade (n=395); 31% of participants 7th grade (n=422), and 40% of participants are 8th grade students (n=543).

The instrument

Researchers piloted the four attitudes toward science, math, engineering and mathematics, and 21st Century Skills subscales of the Middle/ High S-STEM Survey using the items in Friday Institute for Educational Innovation (2012) survey. The English version of the Sources of Middle School Mathematics STEM Attitude Scale (SAS thereafter) was taken from the article by Faber et al. (2013). STEM attitude scale is generally formed of three parts. The first part is formed of Mathematics, Science, Engineering, Technology and the 21st Century Skills. Researchers added 12 areas which included Physics, Environmental Works, Biology and Zoology, Veterinary Works, Mathematics, Medicine, Earth Science, Computer Science, Medical Science, Chemistry, Energy and Engineering to the second part in order to learn towards which careers the students are inclined to. In the third part, information about the students was gathered. STEM attitude scale in the first part of the scale is structured as 5 point likert scale. Answer choices for the items in the scale are organized as "5= I certainly agree", "4= I agree", "3= I am neutral", "2= I do not agree" and "1= I certainly disagree". 4 point likert scale was used in order to determine students' interest in the professions specified in the second part of the scale. Answer choices for the items in the scale are organized as "1= I am not interested at all", "2= I am not interested", "3= I am interested" and "4= I am very interested".

Researchers applied the scale on 9081 students between 6th and 12th grades during the fall semester of 2012-2013. Under the light of data obtained, the scale is formed of 37 items and 4 sub-dimensions. The highest point that can be obtained with this scale is 185 while the lowest is 37. Cronbach Alpha values were considered in order to calculate the reliability coefficients of each dimension of the scale. There are 4 negative items in this scale. Cronbach Alpha values for each sub-dimension that the researchers named by considering the content are specified below. Those values that are given are approximate values (Faber et al., 2013):

1. Mathematics: 0.83 and above

2. Science: 0.83 and above
3. Engineering and Technology: 0.83 and above
4. 21st Century Skills: 0.83 and above

As a result of the analyses made in the second part of the scale, it was determined that 29.8% of the students were interested in physics while 51.4% of them were interested in Veterinary Works.

Analysis of the Data and Procedures

Translating STEM Attitude Scale into Turkish

Necessary permissions were taken by means of e-mail from Faber et al., (2013) who developed the scale, the original form of which is in English, to be applied on middle school students and the scale development process has been started. SAS was translated into Turkish by four experts who have a good command of English and Turkish. Turkish draft, which is formed by considering the common points in the translations of four experts, was translated back into English by an expert on both languages. A scale form of 37 items, the original and Turkish translation of which are in compliance with each other, was prepared as a result of this procedure. Opinions of experts in the area were taken in order to ensure the concept validity of SAS. After the necessary arrangements were made according to the opinions of the experts, the scale was applied on 30 students attending 6th, 7th and 8th grades. When necessary corrections were made on the points that were not understood by the students during this pilot study. The scale was prepared as a result of the corrections that were made.

Result of Exploratory Factor Analysis

Factor analysis is a statistical technique that aims to explain measurement with fewer variables by bringing together variables that measure the same structure or the same quality "(Büyüköztürk, 2006). Exploratory factor analysis was used in order to determine the factoring situation of the items in the scale and their factor loads.

It was conducted in order to reveal the factor analyses of the data given by the researchers before making a confirmatory factor analysis regarding the scale. For this reason, the scale's compliance with the factor analysis was assessed with Kaiser-Meyer-Olkin (KMO) and Barlett test (Sevim, 2012; Balcı, 2013; Sevim, 2014). KMO value of the scale formed of 37 items was calculated as 0.94 and the Bartlett test was determined to be significant ($\chi 2 = 18802.521$, df=666, $p<.05$). As a result of the analyses, it was seen that the data was appropriate for factor analysis since KMO coefficient was bigger than 0.60 and the Bartlett test was significant (Büyüköztürk, 2006).

Reliability Analysis

The SAS's internal consistency coefficient was calculated for reliability study. Cronbach Alpha values for Turkish and the original scale are presented in table 1.

Table 1: Cronbach Alpha values of STEM Attitude Scale

	Turkish Form	Original Form
STEM Attitude Scale	0.94	0.83 and above
Mathematics	0.89	0.83 and above
Science	0.86	0.83 and above
Engineering and Technology	0.86	0.83 and above
21st century skills	0.89	0.83 and above

According to Table1, Cronbach Alpha values The Turkish version ranged between 0.86 and 0.89. Alpha internal coefficients calculated for the scores obtained from the scale were determined above 0.70 (Tavşancıl, 2002) for "mathematics", "science", "engineering and technology", and "21st century skills" factors.

Table 2 : Results of the exploratory Factor Analysis of STEM Attitude Scale

Items No	Factor Loading Value				Common factor variance
	1	2	3	4	(h^2)
YY 4				**,708**	.554
YY 5				**,708**	.544
YY 10				**,685**	.515
YY 8				**,673**	.532
YY 11				**,622**	.460
YY 2				**,614**	.464
YY 6				**,609**	.431
YY 9				**,603**	.448
YY 7				**,585**	.468
YY 1				**,574**	.442
YY 3				**,526**	.452
MAT 1			**,784**		.632
MAT 3			**,783**		.644
MAT 8			**,754**		.643
MAT 5			**,732**		.563
MAT 7			**,679**		.591
MAT 4			**,668**		.534
MAT 6			**,566**		.481
MAT 2			**,533**		.400
MT 3		**,729**			.554
MT 5		**,713**			.557
MT 4		**,694**			.519
MT 7		**,692**			.549
MT 9		**,687**			.532
MT 6		**,647**			.469
MT 2		**,610**			.490
MT 8		**,502**			.417
MT 1		**,446**			.317
FEN 2	**,771**				.623
FEN 7	**,700**				.563
FEN 3	**,698**				.540
FEN 5	**,674**				.535
FEN 4	**,639**				.436
FEN 9	**,633**				.512
FEN 6	**,592**				.485
FEN 1	**,576**				.429
FEN 8	**,351**				.239
Eigen value	**2.297**	**10.796**	**2.293**	**2.033**	
Total Variance Explained (%) 48.967	**12.679**	**13.424**	**11.711**	**11.152**	

*****± factor loads value is lower than .32 were not shown in table (Çokluk, Şekercioğlu ve Büyüköztürk, 2014).

The variance quantities that the factors explain are in rank: for mathematics is 13.424%, for science is 12.679%, for engineering and technology is 11.711%, and for 21st Century skills are 11.152%. after factor rotation, mathematic is formed from 8 items whose factor loads ranged from 0.533 to 0.729, Science is formed from 9 items whose factor loads ranged from 0.351 to 0.771, Engineering and Technology is formed from 9 items whose factor loads ranged from 0.446 to 0.729, and 21st Century skills are formed from 11 items whose factor loads ranged from 0.526 to 0.708.

Table 3: Corrected item-total correlation and t-tests values of the total scores of bottom 27% and top 27% of participants for each item of STEM attitude scale

Factor Name	Item no	Corrected item-total correlation	t value (Bottom 27%, Top 27%)	Factor Name	Item no	Corrected item-total correlation	t value (Bottom 27%, Top 27%)
Mathematics	MAT 1	.558	16.317**	Science	FEN 1	.507	17.584**
	MAT 2	.394	17.776**		FEN 2	.480	16.413**
	MAT 3	.567	19.129**		FEN 3	.495	17.041**
	MAT 4	.457	19.518**		FEN 4	.415	14.549**
	MAT 5	.494	16.144**		FEN 5	.539	18.813**
	MAT 6	.518	20.746**		FEN 6	.542	19.414**
	MAT 7	.589	22.024**		FEN 7	.537	18.802**
	MAT 8	.614	20.649**		FEN 8	.380	14.413**
					FEN 9	.553	18.847**
Engineering and Technology	MT 1	.459	15.320**	21st Century Skills	YY 1	.569	21.209**
	MT 2	.545	20.924**		YY 2	.537	18.789**
	MT 3	.448	15.680**		YY 3	.586	22.455**
	MT 4	.466	16.794**		YY 4	.509	16.143**
	MT 5	.497	18.417**		YY 5	.521	16.181**
	MT 6	.458	16.488**		YY 6	.387	16.880**
	MT 7	.518	18.781**		YY 7	.563	20.194**
	MT 8	.561	22.307**		YY 8	.557	19.407**
	MT 9	.508	20.178**		YY 9	.422	19.230**
					YY 10	.511	17.247**
					YY 11	.522	18.215**

*p<0.05, **p<0.001

The results indicate that the SAS's items corrected item-total correlation ranged between 0.38 to 0.78. T-tests comparing the total scores of bottom 27% and top 27% for each item indicate that there is a important difference in scores from all items.

In the next step, mean values and standard deviation of the SAS's four factors were calculated (Table 4). Correlation values between its factors were also calculated. The correlation values between the SAS's four factors ranged from 0.37 to 0.58. The mean and standard deviation value for the Mathematics was 29.44 (sd=6.76), for Science 34.66 (sd=6.26), for Engineering and Technology 35.21(sd=6.39), and for 21st Century skills 45.24 (sd=6.72).

Table 4: STEM Attitude Scale's Correlation values between its components and mean values and standard deviation of its components

	$\bar{X}$	Ss	MAT	FEN	MT	YY
MAT	**29.44**	**6.76**	**-**			
FEN	**34.66**	**6.26**	**0.49****	**-**		
MT	**35.21**	**6.39**	**0.37****	**0.44****	**-**	
YY	**45.24**	**6.72**	**0.44****	**0.52****	**0.58****	**-**

**p<0.01

The Results of Confirmatory Factor analysis

Confirmatory factor analysis (CFA) established on the structural equation model was made to determine the existing structure of the scale and the structure was presented in the Figure 1.

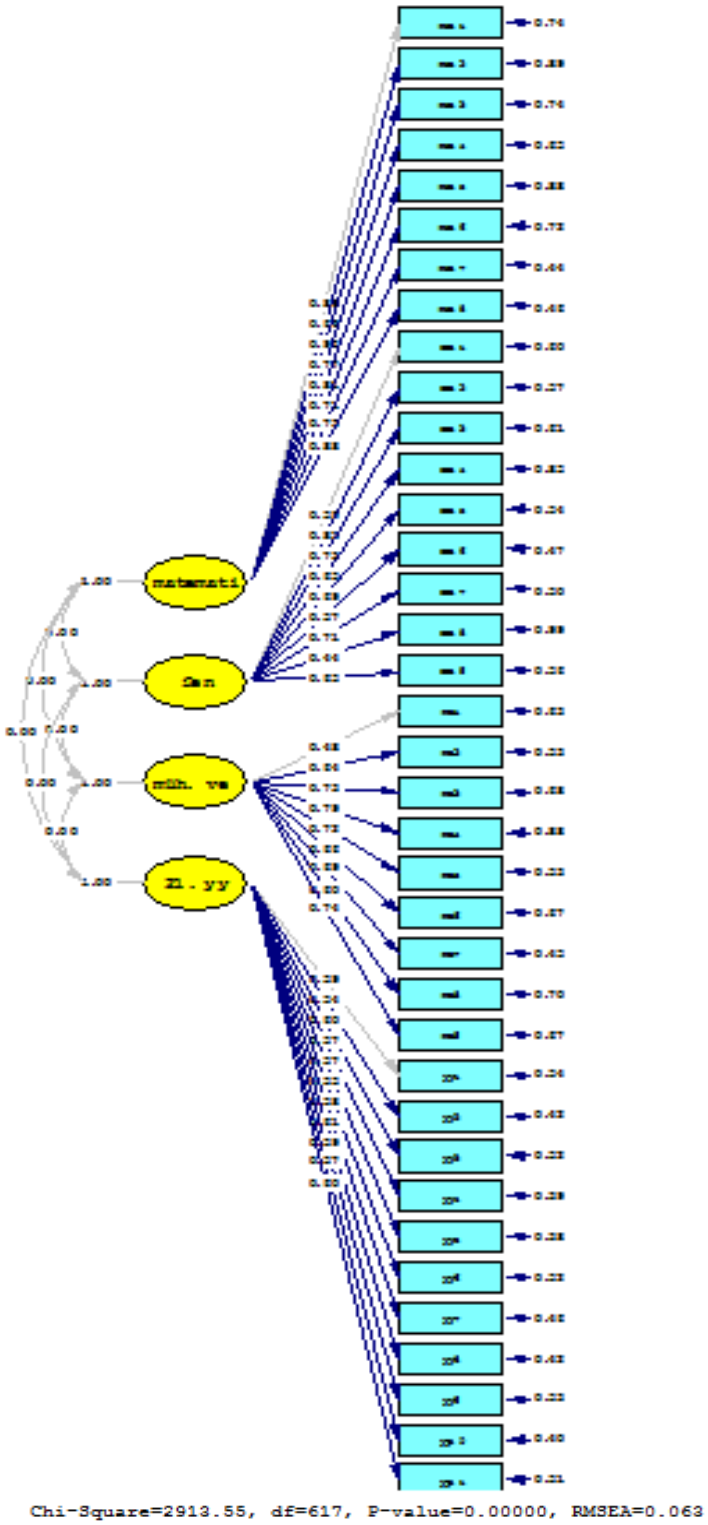

Figure 1. CFA Result of The Four Factor Model

The fit of the model was tested by means of Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index, AGFI, Root Mean Square Error of Approximation, RMSEA, Comparative Fit Index, CFI and Normed Fit Index, NFI and Root Mean Square Residuals, RMR criteria.

Fit index values of the results of STEM Attitude Scale confirmatory factor analysis and the statistics regarding the acceptance limits of the fit indexes are given in the table below.

Table 5. Fit Indices of STEM Attitude Scale and Acceptable Fit Indices Values

Fit Indices	Turkish Scale	Acceptable Indices Values	Sources
$\chi 2/df$	4.72	≤ 5	(Sümer, 2000)
IFI	0.96	≥ 90	(Sümer, 2000)
RMSEA	0.063	≤ 0.07	(Steiger, 2007)
SRMR	0.053	≤ 0.06	(Sümer, 2000; Hu ve Bentler, 1999)
GFI	0.87	≥ 85	(Anderson ve Gerbing 1984; Cole, 1987)
AGFI	0.85	≥ 80	(Anderson ve Gerbing 1984; Cole, 1987)
NFI	0.95	≥ 95	(Sümer, 2000; Hu ve Bentler, 1999)
CFI	0.96	≥ 95	(Sümer, 2000; Hu ve Bentler, 1999)

Structural equation model regarding the theoretical structure of STEM Attitude Scale is given in Figure 1. According to fit index results that are obtained with the statistical analyses conducted for the fit of this model, the fit between the structural equation model and the date is at a high level. In addition to that, chi-square value was determined to be significant. As it is known, $\chi 2$ value is dependent on the sampling size and it causes significance level to increase as its size increases. In parallel with this, when $\chi 2$ value is divided into degree of freedom in order to correct the dependency of chi-square value on the degree of freedom, the results that are obtained indicate the model-data fit. In addition to that, the fact that CFI, NFI and AGFI values are above 0.95 is a sign that the model and data fit is at a high level.

On the other hand, since RMSEA value is larger than 0.07 (Steiger, 2007) and the confidence interval of the RMSEA value with a 90% probability covers the values between 0.06 and 0.065, it indicates that the model-data fit is high. The results we obtained from the Confirmatory Factor Analysis show that STEM Attitude Scale can be explained well under five sub-dimensions and the model-data fit is at a good level.

Discussion

In this study, validity and reliability of SAS developed by Faber et al. (2013) were investigated on a group of students attending 6th, 7th and 8th grades in Turkey. EFA was applied to investigate the structural validity of the scale. After that, CFA was conducted in order to test the structure with theoretical basis.

As it was with the original scale, a structure with four factors was determined when EFA results of the STEM attitude scale were investigated. Factors determined with EFA were named as Mathematics, Science, Engineering, Technology and 21st Century Skills as it is with the original scale. The structure of STEM attitude scale with four factors was tested by means of CFA. When the fit values obtained ($\chi 2/df$ = 4.72; RMSEA=0.063, SRMR=0.053, CFI=0.96, GFI=0.87, AGFI=0.85, NFI=0.95, IFI=0.95) are investigated, it can be said that the scale featured a good level of fit.

When the other fit indices are investigated, the fact that GFI and AGFI values are higher than 0.90 (Hooper, Coughlan and Mullen, 2008; Sümer, 2000) and RMR and RMSEA values are lower than 0.05 indicates that there is a good model-data fit (Jöreskong and Sörbom, 1993; Sümer, 2000). On the other hand, the fact that GFI was determined to be higher than 0.85 while AGDI was

determined to be higher than 0.80 and RMR and RMSEA values were determined to be lower than 0.080 are acceptable for model and data fit (Anderson and Gerbing, 1984; Hooper, Coughlan and Mullen, 2008; Sümer, 2000; Hu and Bentler, 1999). It can be said that GFI (0.87) and AGFI (0.85) values obtained in this study are at an acceptable level for fit since they are close to 0.90.

The other fit indices are NFI and CFI fit indices. Increasing fit indices NFI and CFI fit indices were used in the study. The fact that these index values are above 0.95 indicates a very good fit (Hu and Bentler, 1992; Sümer, 2000). It can be said that NFI (0.95) and CFI (0.96) values obtained in this study are in a very good fit.

According to the results of the t test of the scores of those in the lower %27 band and in the higher 27% band, there is a significant difference between means scores for each item. According to this, it can be said that items in the scale are distinctive. Cronbach Alpha reliability coefficient values calculated for the dimensions of STEM attitude scale vary between 0.86 and 0.89. This indicates that these values are close to the alpha values calculated for the original form of the scale. This indicates that Turkish adaptation and the original scale has a high level of fit.

In conclusion, it was understood that STEM attitude scale had a structure with four factors as the case with the original scale. EFA and CFA results of the scale factors were sufficient and the scale served its purpose. In the light of these results, it is understood that Turkish version of the STEM (Science, Technology, Engineering and Mathematics) attitude scale for secondary school student can be used.

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