

Adaptation of the Science, Technology, Engineering, and Mathematics Career Interest Survey (STEM-CIS) into Turkish

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Abstract

Problem Statement: Science, technology, engineering, and mathematics (STEM) education has recently become a remarkable research topic, especially in developed countries as a result of the skilled workforce required in the fields of the STEM. Considering that professional tendencies are revealed at early ages, determining students' interest in STEM careers is important for Turkey's workforce. The question, "How can Turkish middle school students' interest in STEM careers be determined?" constitutes the problem statement of this study.

Purpose of the Study: The aim of this study is to adapt the STEM Career Interest Survey (STEM-CIS), which is a type of 5-point-Likert scale, into Turkish. The survey consists of 44 questions, and includes science, technology, mathematics, and engineering sub-dimensions.

Method: Items were independently translated into Turkish by the authors after necessary permissions were received. Afterwards, the authors reached a consensus about the Turkish meanings of each item. The items were reviewed and edited by English and Turkish field experts to ensure validity. The survey was administered to 1,033 middle school students (grades 5-8). The data were analyzed by the Confirmatory Factor Analysis (CFA) in the AMOS program. The reliability of the scale, as well as its sub-

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dimensions, was calculated in the SPSS program (Cronbach's alpha and Mc-Donald's omega). To test criterion validity, correlation values were calculated between scores of the STEM-CIS and Interest in Science Scale (ISS). The test-retest method and item analysis were carried out. Also corrected item-total correlation values were determined.

Findings: A scale, which consists of 40 items and four sub-dimensions including science, mathematics, engineering, and technology, was obtained as a result of the analysis. The Cronbach's alpha internal consistency coefficient was calculated as 0.93 for the whole scale, 0.86 for the science sub-dimension, 0.88 for the technology sub-dimension, 0.94 for the engineering sub-dimension, and 0.90 for its mathematics sub-dimension.

Conclusion and Recommendations: The scale adapted into Turkish can be used to assess middle school students' interest in science, technology, mathematics, and engineering careers. However, each sub-dimension of the scale can also be administered separately to determine middle school students' interest.

Keywords: Interest in STEM careers, middle school students, adaptation of scale, confirmatory factor analysis

Introduction

From a historical perspective, it can be stated that, indirectly, STEM education is originally based on the space race that began with the Soviet Union's launch of the Sputnik satellite in 1957. This event caused many innovations and reforms, to be developed and put into practice in the United States of America, especially in the field of science education (Wissehr, Barrow, & Concannon, 2011). Many long-term reform attempts, which focused on teaching science through inquiry, contributed to innovations and covered issues such as: science curricula and quality of science instruction, students' interest in science, teacher competence, teacher training as well as students' achievements in science and mathematics, and the participation of female students in science (Matthews, 2007). However, certain reports (Anderson & Byrne, 2004; Department of Education, 1983; Kirsch, Braun, Yamamoto, & Sum, 2007; Matthews, 2007; Thornburgh, 2006) pointed out that serious shortages were still evident in the achievements of American students who studied in the fields of science and mathematics at precollege level schools (Matthews, 2007). Both the necessity of overcoming these shortages and the fact that the future workforce requires skills in the fields of science and mathematics enabled an inquiry-based perspective in science education to broaden with STEM education. In its January 2006 report, the National Science Foundation (NSF) stated:

If the U.S. is to maintain its economic leadership and compete in the new global economy, the Nation must prepare today's K-12 students better to be tomorrow's productive workers and citizens. Changing workforce

requirements mean that new workers will need ever more sophisticated skills in science, mathematics, engineering and technology . . . In addition, the rapid advances in technology in all fields mean that even those students who do not pursue professional occupations in technological fields will also require solid foundations in science and math in order to be productive and capable members of our nation's society (NSB, 2006, p. 2).

Educators who think that STEM education is important argue that students should perform well in STEM education and careers as a result of introducing the concepts of technology and engineering into science and mathematics education at schools (Brown, Brown, Reardon, & Merrill, 2011). The combination of engineering and the educational process in the first stages can boost demand in careers choices in this field, as well as enables talented students to be noticed at an early ages so they can develop their skills. The integration of engineering into the science learning-teaching process does not mean that a new subject will arise, it means teaching present science concepts within the context of engineering by increasing awareness of this subject (Mann, Mann, Strutz, Duncan, & Yoon, 2011). Taking STEM courses and performing relevant activities at the primary school level excites students and enables them to develop confidence and self-sufficiency in their science and mathematics courses; it also raises their interests in these courses (Dejarnette, 2012).

Scientific and educational institutions suggest that an interest in STEM careers begins to develop during middle school (Kier, Blanchard, Osborne, & Albert, 2013). Some studies reveal that, when started at early age, STEM activities affect primary school students' perceptions and career interests positively (Dejarnette, 2012). In this respect, determining students' STEM careers and guiding them is important. Certain scales were developed to determine students' STEM careers at the middle school level. Tyler-Wood, Knezek, and Christensen (2010) developed a semantic scale to assess the perception of STEM disciplines and professional interests. Guzey, Harwell, and Moore (2014) developed a four-factor scale (which include personal and social implications of STEM, learning of science and engineering and the relationship to STEM, learning of mathematics and the relationship to STEM, and learning and use technology) to determine interest in STEM and STEM careers. Kier, Blanchard, Osborne, and Albert (2013) developed the STEM-CIS which consists of science, technology, mathematics, and engineering sub-dimensions. In addition Unfried, Faber, Stanhope, and Wiebe (2015) developed a four-factor (science, math, engineering/technology, and 21st century skills) STEM attitude scale. It is possible to determine students' affective characteristics and the predictors of these features with these scales.

In Turkey, the Ministry of National Education prepares school courses and curricula at the precollege level, and different types of schools should be implemented in these curricula. The Turkish Ministry of National Education put inquiry-based science curriculum into effect with the educational reform movement (MEB, 2005, 2013). This brought radical changes in every aspects of science education, such as teaching methods, teaching materials, assessments and evaluations, class environment, etc. There are no STEM schools in Turkey; however

in the event that a broadening of inquiry-based perspectives with STEM education can be outlined as follows:

(1) In inquiry-based science education, students use active performance to rediscover present scientific knowledge as scientists do. However, in STEM education, students should benefit from scientific knowledge that they learn in the fields of science and mathematics and make an active efforts to implement this knowledge into technology and engineering. Rediscovering the present knowledge is important for the former, while putting existing knowledge into practice is essential for the latter.

(2) The knowledge creating process has particular importance in pure inquiry-based education. However, in STEM education, this takes a back seat, the process of developing products from scientific knowledge or engineering design processes should be in the forefront.

(3) Educational curricula related to STEM education should require more intense theoretical science and mathematics knowledge acquisition than pure inquiry-based education. Moreover, expectations from students regarding the technological and engineering applications of this knowledge should be included in the science curriculum.

(4) Inquiry is crucial in STEM education. However, technology and engineering through inquiry should be more privileged than science through inquiry. Inquiry-based learning focuses on real-word issues and problems. STEM education also focuses on real-world problems, but students should also address real social, economic, and environmental problems and seek solutions. More specifically, problems do not enables scientific knowledge to be discovered, but problems related to its production are the focus of STEM education. Therefore, the engineering design process holds an important place in STEM education.

(5) In STEM education, students meditate scientific knowledge, relate scientific knowledge to other disciplines, and discover the hidden causes of real-world scientific knowledge while still learning science.

Based on the requirements stated above, determining Turkish students' career interests is an important issue. Therefore, the aim of this study is to adapt the STEM-CIS developed by Kier, Blanchard, Osborne, and Albert (2013) in order to contribute to STEM education in Turkey.

Method

Research Design

The aim of this study is to adapt STEM-CIS into Turkish and determine the validity and reliability of the Turkish version of the scale. For this reason, the survey method was used. The aim of a survey is to explain the characteristics of a specific

group, such as their abilities, opinions, attitudes, beliefs and knowledge (Frankeal & Wallen, 2003).

Participants

The study's participants consisted of 1,033 students studying at 18 different middle schools located in four cities in Turkey (164 in fifth grade, 214 in sixth grade, 447 in seventh grade, and 208 in eighth grade). Of the participants, 569 students were female and 464 were male students. Thirty-four students participated in the study to determine the reliability of the test-retest method and criterion validity. The study used criterion sampling, which is a purposeful sampling method. In criterion sampling, the observation units can be persons, phenomena, objects or situations with specific characteristics (Patton, 2002).

Data Collection Tools

STEM-CIS. The STEM-CIS was developed by Kier, Blanchard, Osborne, and Albert (2013). The authors developed the STEM-CIS according to the social cognitive career theory (SCCT) developed by Lent and others. The SCCT is based on Bandura's social cognitive learning theory. The authors also followed six steps determined by Clark and Watson (1995) in order to develop the scale: (1) review literature to develop scale items, (2) form a wide item pool, (3) conduct the pilot study of the test, (4) carry out the structural analysis to determine which items will be removed from the item pool, (5) perform factor analysis, and (6) determine sub-dimensions.

The scale developed by the authors was administered to 1,061 middle school students in grades 6-8. Students completed the survey online. The STEM-CIS consists of four sub-dimensions; science, technology, mathematics, and engineering. Each sub-dimension has 11 items. The entire scale consists of 44 items, and is in a type of 5-point Likert scale. Possible answers include strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). The sub-dimensions were analyzed separately. The modification indices were taken into account and covariances were formed between certain error terms in the sub-dimensions. The researchers stated that the fit indices were better as a result of the covariances formed between the error terms. Cronbach's alpha values for science, technology, mathematics, and engineering sub-dimensions were calculated as 0.77, 0.89, 0.85, and 0.86, respectively (Kier, Blanchard, Osborne, & Albert, 2013).

Adaptation of STEM-CIS into Turkish. The STEM-CIS was adapted into Turkish by the researchers. After necessary permissions were received from the corresponding author (Meredith Kier), the researchers translated the scale into Turkish independently. Afterwards, the authors reached a consensus regarding the Turkish translations of the questions. The Turkish version of the scale was examined by 12 field experts, all of who have a good command of their native language (English) and work in the education field. Taking feedback into account, the researchers edited the scale items. Three Turkish language experts examined the form, and necessary editing was done. The scale was translated into English by three language experts using the retranslation method. The extent to which the translation conveyed the

accurate meaning of its original translation was examined. The removal of the 11th item of each sub-dimension was deemed suitable, considering the fact that they were not appropriate to Turkish, and could cause contradictions in terms and did not serve the purpose of the assessment. However, these items were also translated because the adaptation study was conducted. The pilot study of the scale was conducted with 30 individuals to determine points that were not understood by the students. Afterwards, the scale was administered to 1,033 middle school students.

The Interest in Science Scale (ISS). The Interest in Science Scale (ISS) (Bozdogan, 2007) was used to ensure criterion validity. The ISS includes 20 items (12 positive and eight negative); its reliability is 0.80.

Data Analysis

The confirmatory factor analysis (CFA) was performed to test the four-factor structure of the STEM-CIS as well as examine and evaluate the extent to which structure of the scale is valid for Turkish culture. Performing the CFA for the factor pattern of the tool in target culture is recommended in the intercultural adaptation of scale studies (Cokluk, Sekercioglu, & Buyukozturk, 2014). The CFA, indicated that the error coefficients of four items which were proposed to be removed from the scale by the experts were high, and these four items gathered under another factor when the exploratory factor analysis (EFA) was conducted as a controlling in the SPSS program. After considering the experts' opinions these four items were excluded from the analysis. The CFA results of each sub-dimension, which consist of 10 items, were provided in the findings section.

Before the analysis was carried out, the data set was checked. Missing data, outliers, and normality were controlled. The CFA was performed using AMOS 21. The chi-square goodness (χ^2/df), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), normed fit index (NFI), comparative fit index (CFI) and root mean square error of approximation (RMSEA) values were calculated for the entire scale and its sub-dimensions, as is done in the original scale. These values were indicated in the findings section. The measurement reliability of the scale (Cronbach's α and McDonald's ω) and its sub-dimensions were calculated in the SPSS 21 program. To test criterion validity, correlation values were calculated between the scores on the STEM-CIS and ISS. The test-retest method and item analysis was carried out. Corrected item-total correlation values were also determined.

Results

Results of the CFA

The original structure of the STEM-CIS, which consists of four sub-dimensions including science, technology, mathematics, and engineering, was tested using the CFA. First, the fit values of each factor (χ^2/df , GFI, AGFI, NFI, CFI, and RMSEA) were calculated separately, as they were calculated in the original scale. Then the secondary level CFA was performed.

High error correlations, which were observed between certain items, were added to the model for the science sub-dimension based on expert opinions (e1-e2, e1-e8, e5-e7, and e9-e10). The fit indices were observed to be appropriate to the model after the change was made ($\chi^2/df=3.86$, GFI=0.95, AGFI=0.91, NFI=0.83, CFI=0.83 and, RMSEA=0.53). As seen in Figure 1, the factor loading values of the science sub-dimension items range between 0.32 and 0.83, and all loading values are statistically significant ($p<.01$).

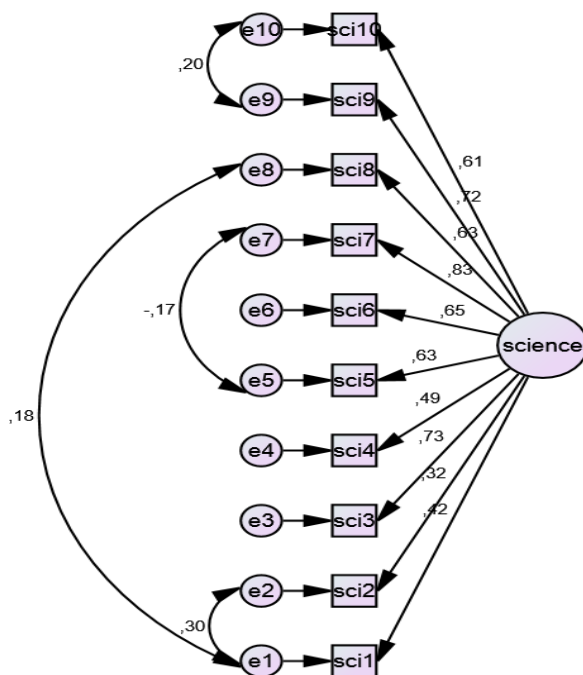


Figure 1. The factor loading values of the science sub-dimension

High error correlations, which were observed between certain items, were added to the model based on experts' opinions because the fit indices calculated for the technology sub-dimension indicated that the model did not show a good fit (e1-e2, e4-e5, e8-e9, and e9-e10). The fit indices were observed to be appropriate for the model after the change was made ($\chi^2/df=2.14$, GFI=0.95, AGFI=0.92, NFI=0.86, CFI=0.91, and RMSEA=0.33). As seen in Figure 2, the factor loading values of the technology sub-dimension items range between 0.53 and 0.72, and all loading values are statistically significant ($p<.01$).

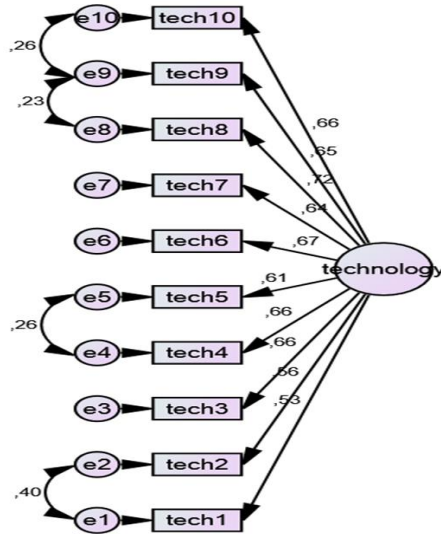


Figure 2. The factor loading values of the technology sub-dimension

High error correlations, which were observed between certain items, were added to the model based on experts' opinions because the fit indices calculated for the engineering sub-dimension would fit the better model (e1-e2, e5-e6, and e9-e10). The fit indices were observed to be appropriate for the model after the change was made ($\chi^2/df=2.27$, GFI=0.96, AGFI=0.94, NFI=0.91, CFI=0.94, and RMSEA=0.35). As seen in Figure 3, the factor loading values of the engineering sub-dimension items range between 0.73 and 0.86, and all loading values are statistically significant ($p<.01$).

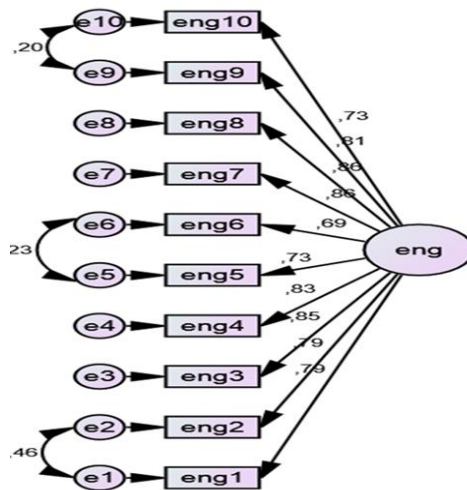


Figure 3. The factor loading values of the engineering sub-dimension

High error correlations, which were observed between certain items, were added to the model based on experts' opinions because the fit indices calculated for the mathematics sub-dimension would fit the model better (e1-e2, e1-e3, e1-e8, e2-e8, and e9-e10). The fit indices were observed to be appropriate for the model of the mathematics sub-dimension ($\chi^2/df=3.96$, GFI=0.94, AGFI=0.90, NFI=0.85, CFI=0.88, and RMSEA=0.54) after the change was made (e1-e2, e1-e3, e1-e8, e2-e8, and e9-e10). As seen in Figure 4, the factor loading values of mathematics sub-dimension items range between 0.55 and 0.82, and all loading values are statistically significant ($p<.01$).

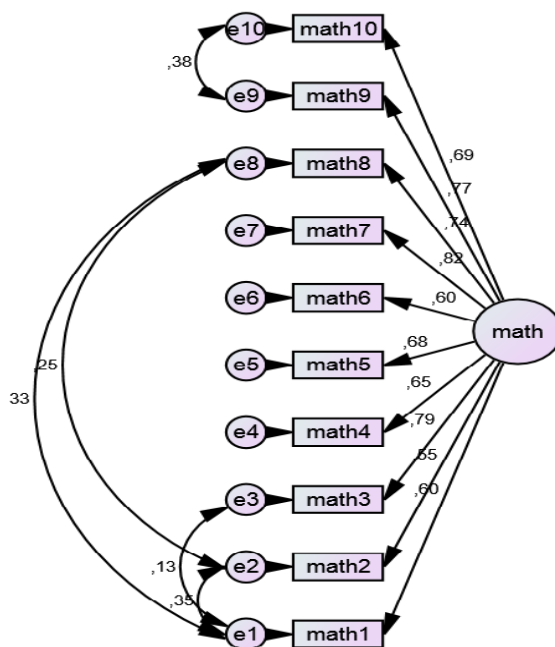


Figure 4. The factor loading values of the mathematics sub-dimension

When all GFI values for the science, technology, mathematics, and engineering sub-dimensions are considered generally, it can be concluded that the Turkish version of the scale shows an acceptably good fit for the original scale (Kline, 2005). It was observed that the GFI values calculated for the sub-dimensions of the original scale are better than those calculated for the scale. This is also similar for the adapted Turkish version of the scale. Because the items of each factor have a high factor loading in these factors can be suggested as evidence for convergent validity.

Criterion Validity

To test criterion validity, correlation values were calculated between the scores on the STEM-CIS and ISS. The results show that there was a moderate, significant and positive correlation between them ($n=34$, $r=.47$, $p<.001$). These results indicate that the STEM-CIS has criterion validity.

Findings Related to the Test-Retest Method

To determine the reliability of the test-retest method, the STEM-CIS was administered to 34 students at a 1-month interval, and Pearson product-moment correlation coefficients were calculated. These correlation coefficients were 0.87 for the entire scale, 0.67 for the science sub dimension, 0.73 for the technology sub dimension, 0.89 for the engineering sub dimension and, 0.85 for the mathematics sub dimension.

Item Analysis

Testing the significance of the difference scores of the bottom and top 27% of the participants was another method that was used to identify how well an item could distinguish between participants with higher and lower interest. The t-test and corrected item-total correlation values given in Table 1 were all found to be significant at the level of 0.01.

Table 1.

Corrected Item-Total Correlation and T-Tests Values of the Bottom and Top 27% of Participants for Each Item of STEM-CIS

Factor	Item	Corrected Item-Total Correlation	t value (bottom and top 27%)	Factor	Item	Corrected Item-Total Correlation	t value (bottom and top 27%)
Science	s1	0.34	9.87**	Engineering	e1	0.57	21.1**
	s2	0.3	8.72**		e2	0.6	21.83**
	s3	0.35	11.34**		e3	0.59	22.47**
	s4	0.32	10.68**		e4	0.6	23**
	s5	0.36	10.83**		e5	0.6	21.47**
	s6	0.4	13.76**		e6	0.54	19.56**
	s7	0.42	15.2**		e7	0.6	23.76**
	s8	0.33	10**		e8	0.6	24.44**
	s9	0.45	15.84**		e9	0.62	28.4**
	s10	0.4	14.9**		e10	0.58	25.67**
Technology	t1	0.4	11.46**	Mathematics	m1	0.35	10.97**
	t2	0.42	11.38**		m2	0.38	9.87**
	t3	0.43	14.24**		m3	0.48	18.41**
	t4	0.48	13.48**		m4	0.37	12.14**
	t5	0.46	13.94**		m5	0.43	12.22**
	t6	0.48	17.75**		m6	0.47	15.43**
	t7	0.43	13.06**		m7	0.54	21.14**
	t8	0.53	18.8**		m8	0.43	13.36**
	t9	0.53	20.7**		m9	0.52	18.6**
	t10	0.5	18.25**		m10	0.48	17.61**

* $p<.01$

The results in Table 1, indicate that the STEM-CIS items' corrected item-total correlation ranged from 0.3 to 0.62. This suggests that there was no need to eliminate any item from the scale, and all items worked well. T-tests comparing the total scores of the bottom and top 27% of each item indicate that there is a significant difference in scores in all items. This finding also shows that each item included in the adapted STEM-CIS worked efficiently.

Results of Reliability Analysis

In the STEM-CIS, existing options are; strongly agree (5), agree (4), neutral (3), disagree (2), and strongly disagree (1). Cronbach's alpha and Mc-Donald's omega values were calculated for the scale and its sub-dimensions. The Cronbach's alpha values of the original scale were calculated at 0.77 for the science sub-dimension, 0.89 for the technology sub-dimension, 0.86 for the engineering sub-dimension and 0.85 for the mathematics sub-dimension. The Cronbach's alpha values of the scale adapted into Turkish were calculated at 0.86 for the science sub-dimension, 0.88 for the technology sub-dimension, 0.94 for the engineering sub-dimension and 0.90 for the mathematics sub-dimension, and 0.93 for the scale. These values are above 0.70 (Nunally, 1978). The Mc Donald's omega values were calculated at 0.85 for the science sub-dimension, 0.86 for the technology sub-dimension, 0.92 for the engineering sub-dimension, and 0.88 for the mathematics sub-dimension.

Conclusion and Discussion

The adaptation procedure was followed in this study, the aim of which is to adapt the STEM-CIS developed by Kier, Blanchard, Osborne, and Albert (2013). According to the GFI statistics, it can be stated that this scale, which was adapted into Turkish, formed a good model with all GFI statistics and is a valid scale with its factor structures. A valid and reliable scale, which consists of 40 items and has four factors including science, mathematics, engineering, and technology was obtained as a result of the analysis.

There are some variables affect students' STEM self-selection. These variables can be sorted by gender, race/ethnicity, achievement, socio-economic level, and personality type (Chachashvili-Bolotin, Milner-Bolotin, & Lissitsa, 2016; Chen & Simpson, 2015). These variables can be tolerated by training. For example, a study revealed that after receiving specific training, female students' STEM dispositions were found to be higher than male (Christensen, Knezek, & Tyler-Wood, 2015).

STEM education contributes to enhancing the skills of students, such as problem solving, critical thinking, and analytical thinking. It also creates an authentic learning environment. A recent study conducted on principals, teachers, and students for STEM education at the university level showed that STEM education is not well understood; different types of teaching are implemented in line with different purposes, and teachers within the STEM field do not cooperate with each other (Brown, Brown, Reardon, & Merrill, 2011). Dejarnette (2012) made suggestions for the development, inveteracy, and popularization of STEM education. First,

improvements can be carried out in teacher education. In this respect, courses related to scientific research, problem-based learning, engineering design, and technological activities can take place in teacher education programs. Second, teachers can be provided with help to acquire positive self-efficacy to implement STEM activities. Third, students should gain experience by engaging in the STEM disciplines at an early ages. This can be accomplished by participating in the STEM discipline and content by means of summer camps and classes, hands-on scientific research, and technological design activities. Students should be provided with equal and ample opportunities on this subject.

Recommendations

The scale adapted into Turkish can be used together with or separate from the sub-dimension in order to assess middle school students' interests in science, technology, mathematics, and engineering careers. Researchers can determine relationships between the demographic characteristics of students, such as age, gender, and settlement, as well as their interests in the science, technology, mathematics, and engineering professions in different countries. Another recommended research topic is the examination of how STEM practices affect interest in STEM careers.

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Özet

Problem Durumu: Fen, Teknoloji, Matematik ve Mühendislik (FeTeMM) alanlarında ihtiyaç duyulan nitelikli işgücü nedeniyle FeTeMM eğitimi son yıllarda özellikle gelişmiş ülkelerde öne çıkan bir araştırma konusu haline gelmiştir. FeTeMM eğitiminde öğrenciler fen ve matematik bilgilerini kullanarak bu bilgileri teknoloji ve mühendisliğe uygulamak için aktif performans harcamalıdır. FeTeMM eğitiminin önemli olduğunu düşünenler, okullarda fen ve matematik eğitimine teknoloji ve mühendislik kavramlarını aşılıyarak öğrencilerin bu alanlardaki mesleklerde daha iyi performans göstereceklerini savunmaktadırlar. Mesleki eğilimlerin küçük yaşlarda başladığı göz önünde bulundurulduğunda öğrencilerin FeTeMM mesleklerine yönelik ilgilerinin belirlenmesi ülkemiz için de oldukça önem teşkil etmektedir. Milli Eğitim Bakanlığının 2006 ve 2013 yıllarında öğretim programlarında yaptığı radikal değişikliklerle Türkiye'de araştırma-sorgulamaya dayalı fen öğretim programları uygulanmaya konulmuştur. Halen bu programın

öngördüğü fen öğretimi ilk ve orta öğretim kademelerinde uygulanmaktadır. Türkiye’de FeTeMM okulları yoktur ancak araştırma-sorgulamaya dayalı perspektifin FeTeMM eğitimi ile genişletilmesine ilişkin gereksinimler (makalenin giriş kısmında bu gereksinimler detaylandırılmıştır) FeTeMM eğitimini ve bu alanda yapılan araştırmaları kaçınılmaz kılmıştır. Bu gereksinimler ışığında öğrencilerin FeTeMM mesleklerine ilgisini belirlemek bu konuda yapılacak araştırmalara yeni ufuklar açacaktır. Bu çalışma “Türkiye’de ortaokul öğrencilerin FeTeMM mesleklerine yönelik ilgileri nasıl belirlenir?” problemine yanıt bulmak için tasarlanmıştır.

Araştırmanın Amacı: Bu araştırmanın amacı Fen, Teknoloji, Matematik ve Mühendislik mesleklerine yönelik ilgi ölçeğini (FeTeMM-MYİÖ) Türkçeye uyarlamaktır.

Araştırmanın Yöntemi: FeTeMM Mesleklerine Yönelik İlgili Ölçeği 44 maddeden oluşmaktadır. Ölçeğin fen, teknoloji, mühendislik ve matematik alt boyutları bulunmaktadır. Her alt boyutta 11 madde yer almaktadır. Ölçek Bandura’nın sosyal bilişsel öğrenme teorisine dayanmaktadır. FeTeMM Kariyer İlgili Ölçeği 5’li likert tipindedir. Gerekli izin alındıktan sonra ölçekte yer alan maddeler yazarlar tarafından ayrı ayrı Türkçeye çevrilmiştir. Daha sonra yazarlar maddelerin Türkçe karşılığı konusunda fikir birliğine varmışlardır. Geçerliliğin sağlanması için maddeler, İngilizce ve Türkçe alan uzmanları tarafından incelenmiş ve gerekli görülen düzeltmeler yapılmıştır. Her bir alt boyutun 11. sorusunun Türkçeye uygun olmadığı, kavram kargaşasına neden olabileceği ve ölçme amacına hizmet etmediği düşüncesi ile bu maddelerin dil uzmanları tarafından çıkarılması uygun görülmüştür. Fakat uyarılama çalışması yapıldığı için bu maddelerin de çevirisi yapılmış ve analize dahil edilmiştir. Ölçeğin öncelikle 30 öğrenci üzerinde pilot uygulaması yapılmış daha sonra ölçek 1033 ortaokul öğrencisine (5, 6, 7 ve 8. sınıf) uygulanmıştır. Katılımcıların 569’u kız ve 464’ü erkek öğrencidir. Elde edilen veriler, AMOS 21 programında Doğrulayıcı Faktör Analizine (DFA) tabi tutulmuştur. Ölçeğin tümü ve alt boyutları için χ^2/df , iyilik uyum indeksi (GFI), düzeltilmiş iyilik uyum indeksi (AGFI), normlaştırılmış uyum indeksi (NFI), karşılaştırmalı uyum indeksi (CFI) ve yaklaşık hataların ortalama karekökü (RMSEA) hesaplanmıştır. DFA gerçekleştirildikten sonra uzmanlar tarafından çıkarılması önerilen dört maddenin hata katsayılarının yüksek olduğu görülmüştür. SPSS programında kontrol amaçlı açımlayıcı faktör analizi (AFA) yapıldığında bu dört maddenin ayrı bir faktör altında toplandığı ortaya çıkmıştır. Bu dört madde uzman görüşü alınarak analiz dışı tutulmuştur. Ölçeğin tamamı ve alt boyutlarının ölçüm güvenilirliği değerleri hesaplanmıştır. Ölçüt geçerliği ve test tekrar-test güvenilirliği için çalışmalar yapılmış ayrıca düzeltilmiş madde toplam korelasyon değerleri hesaplanmış ve %27’lik alt ve üst gruplara ait madde ortalama puanları arasındaki farkın anlamlılığı t-testi ile incelenmiştir.

Araştırmanın Bulguları: Fen ($\chi^2/df=3.86$, GFI=0.95, AGFI=0.91, NFI=0.83, CFI=0.83, RMSEA=0.53), teknoloji ($\chi^2/df=2.14$, GFI=0.95, AGFI=0.92, NFI=0.86, CFI=0.91, RMSEA=0.33), mühendislik ($\chi^2/df=2.27$, GFI=0.96, AGFI=0.94, NFI=0.91, CFI=0.94, RMSEA=0.35) ve matematik ($\chi^2/df=3.96$, GFI=0.94, AGFI=0.90, NFI=0.85, CFI=0.88,

RMSEA=0.54) alt boyutları için uyum indeksi değerlerinin bütünü göz önüne alındığında, ölçeğin Türkçe formunun orijinal ölçekle kabul edilebilir düzeyde iyi uyum verdiği söylenebilir. Faktör yük değerleri fen alt boyutu için 0.32 ile 0.83, teknoloji alt boyutu için 0.53 ile 0.72, mühendislik faktörü için 0.73 ile 0.86 ve matematik alt boyutu için 0.55 ile 0.82 arasında değişmektedir ve tüm yük değerleri istatistiksel olarak anlamlıdır. Orijinal ölçekte alt boyutlar için hesaplanan uyum indeksleri değerlerinin ölçeğin tümü için hesaplanan değerlerden daha iyi olduğu görülmüştür. Bu durum uyarlaması yapılan Türkçe form için de benzerdir. Ayrıca her bir faktör altındaki maddelerin, o faktörde oldukça yüksek bir yüke sahip olması yakınsak geçerliliğe kanıt olarak öne sürülebilir. FeTeMM-MYİÖ ile Fene Yönelik İlgi Ölçeği arasında pozitif yönde, orta düzeyde, anlamlı bir ilişki olduğu görülmüştür ($n=34$, $r=.47$, $p<.001$). Test tekrar test yöntemi ile hesaplanan korelasyon katsayıları ölçeğin tümü için 0.87, fen alt boyutu için 0.67, teknoloji alt boyutu için 0.73, mühendislik alt boyutu için 0.89 ve matematik alt boyutu için 0.85 olarak hesaplanmıştır. %27'lik alt ve üst grupların madde ortalama puanları arasında anlamlı farklılık bulunmuştur. FeTeMM-MYİÖ'nün ölçüm güvenirliği 0.93, fen alt boyutu için 0.86, teknoloji alt boyutu için 0.88, mühendislik alt boyutu için 0.94 ve matematik alt boyutu için 0.90 olarak hesaplanmıştır. Analizler sonucunda fen, matematik, mühendislik ve teknoloji olmak üzere dört alt boyuttan ve 40 maddeden oluşan bir ölçek elde edilmiştir.

Araştırmanın Sonuçları ve Önerileri: Bu çalışmada; Türkiye'deki ortaokul öğrencilerinin Fen Teknoloji Matematik ve Mühendislik mesleklerine yönelik ilgilerini belirlemek amacıyla Amerika Birleşik Devletlerinde hazırlanmış FeTeMM-MYİÖ Türkçeye uyarlanmıştır. Fen, teknoloji, mühendislik ve matematik olmak üzere dört alt boyuttan ve 40 maddeden oluşan bir ilgi ölçeği elde edilmiştir. Türkçeye uyarlaması yapılan ölçek ortaokul seviyesindeki öğrencilerin fen, teknoloji, matematik ve mühendislik alanlarındaki mesleklere olan ilgilerini ölçmek amacıyla ayrı ayrı veya birlikte kullanılabilir. Araştırmacılar öğrencilerin yaş, cinsiyet, yerleşim birimi gibi demografik özelliklerin fen, teknoloji, matematik ve mühendislik alanlarındaki mesleklere olan ilgi ile arasındaki ilişkiyi inceleyebilirler. Ayrıca, FeTeMM uygulamalarının FeTeMM mesleklerine olan ilgiyi nasıl etkilediği de önerilen bir diğer araştırma konusudur.

Anahtar Kelimeler: FeTeMM mesleklerine yönelik ilgi, ortaokul öğrencileri, ölçek uyarlama, doğrulayıcı faktör analizi.