



## The Turkish Adaptation of the Teaching Style for Successful Intelligence Questionnaire (TSI-Q): Validity and Reliability Study

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### ABSTRACT

The purpose of this research is to adapt the Teaching Style for Successful Intelligence Questionnaire (TSI-Q) to Turkish. The research was carried out on three separate groups consisting of 305 high school teachers. In the linguistic equivalence study, it was obtained that there were strong, positive and significant correlations between responses of the participants to the English and Turkish forms of the scale. The construct validity of the TSI-Q's Turkish form was tested by means of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). According to the results of EFA, a four-factor structure explaining 61% of the total variance was compatible with the original form of the scale. The fit indices reported in CFA were ratified in this four-factor structure. The emerging factors were named as memory, analytical thinking, reproductive thinking and practical thinking as in the original form of the scale. As for the reliability, Cronbach's Alpha internal consistency coefficient of the TSI-Q was calculated as .95. The item analysis result revealed that item total correlations were over the threshold value of .30. All these results suggest that the Turkish form of the TSI-Q provides valid and reliable measurements, and it can be used to measure teaching style based on the successful intelligence of teachers.

**Keywords:** reliability, teaching styles, scale adaptation, validity

## Başarılı Zekaya Dayalı Öğretme Stili Ölçeğinin Türkçeye Uyarlanması: Geçerlik ve Güvenirlik Çalışması

### Öz

Bu çalışmada Başarılı Zekaya Dayalı Öğretme Stili Ölçeği'nin (BZÖSÖ) Türkçeye uyarlanması amaçlanmaktadır. Araştırma ortaöğretim kademesinde görevli 305 öğretmenden oluşan üç çalışma grubu üzerinde yürütülmüştür. Dilsel eşdeğerlik çalışmasında katılımcıların BZÖSÖ'nün Türkçe ve İngilizce formuna verdikleri cevaplar arasında pozitif yönlü, güçlü ve anlamlı korelasyonlar tespit edilmiştir. BZÖSÖ'nün Türkçe formunun yapı geçerliği açılımlı faktör analizi (AFA) ve doğrulayıcı faktör analizi (DFA) uygulanarak test edilmiştir. AFA'da toplam varyansın %61'ini açıklayan ve ölçeğin orijinal formuyla paralellik gösteren dört faktörlü bir yapı elde edilmiştir. DFA'da rapor edilen uyum indeksi bu yapıyı doğrulamıştır. Faktör analizi sonucunda ortaya çıkan boyutlar, ölçeğin orijinal formundaki gibi, hafıza, analitik düşünme, yaratıcı düşünme ve uygulamalı düşünme olarak adlandırılmıştır. Güvenirlik çalışması çerçevesinde, BZÖSÖ'nün geneli için hesaplanan Cronbach-alfa iç tutarlılık katsayısı .95 olarak saptanmıştır. Madde analizi sonuçları, madde korelasyonlarının BZÖSÖ'deki tüm maddeler için .30 eşik değerinin üzerinde olduğunu göstermiştir. Araştırmaya ilişkin bu sonuçlar, ölçeğin Türkçe formunun geçerli ve güvenilir ölçümler sağladığını ve öğretmenlerin başarılı zekaya dayalı öğretim stillerini ölçmek için kullanılabilirliğini ortaya koymaktadır.

**Anahtar Kelimeler:** güvenirlik, öğretme stili, ölçek uyarlaması, öğretme stili, geçerlik.

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## 1 | INTRODUCTION

Over the last two decades, the world has been witnessing quite swift and dramatic changes in several fields. Rapid digitalization, globalization and technological developments have been altering the definitions and the scopes of the terms in recent years. In this sense, the term, “education”, has been evolving, and is no longer just a process based upon transferring and evaluating the knowledge. It requires determining targets, contents, and implementations, which address innovative, multi-disciplinary and complex skills, so that the students can challenge, keep up with the era, and lead the future. Apart from developing their cognitive skills via maths, science, and language courses; children and teenagers need to improve their several versatile, holistic skills- such as problem solving, critical thinking, communication, collaboration to achieve their full potential, and facilitate practices of these school courses (NRC, 2012). Several organizations, initiatives, such as, OECD (the Organization for Economic Co-operation and Development), and NRC, put forward the frameworks including the skills that are required for the century. These skills are called the 21st century skills and include developing “creativity”, “critical thinking”, “communication”, and “collaboration” skills of the individuals. Although there are some discrepancies in the classification and evaluation of skills in terms of the goals of institutions, there are common points, skills and targets in the reports. For instance, the committee of Partnership for 21st Century Skills points out various sets of terms associated with the 21st century skills, and defines three extensive domains for competence; -cognitive, intrapersonal and interpersonal. While the cognitive domain includes reasoning and memory, the intrapersonal domain covers the capacity to manage one’s behavior and emotions to achieve one’s learning goals. Besides, the interpersonal domain makes up expressing views, and interpreting and reacting to actions and messages from others. These intertwined skills can allow individuals to obtain deeper learning, and transfer what was learned to solve new problems (NRC, 2012).

Furthermore, the OECD emphasizes that education should provide learners with agency and a sense of purpose, and the knowledge and skills they need to shape their own future and contribute to the lives of others (OECD, 2018). Therefore, the OECD launched the Future of Education and Skills 2030 Project in 2018. Education is of vital importance in developing knowledge, skills, and attitudes that prepare young people for unprecedented challenges of future, and help them become active, responsible and engaged citizens (OECD, 2015). In this sense, education systems should become responsive to changes and equip young people with new skills, which let them benefit from the emerging models of social developments and contribute to new economic forms, the main asset of which is generating and applying knowledge. Hence, novel approaches, innovative learning and teaching strategies should be developed and adopted during both the formal education period and lifelong learning processes.

Within this scope, the modern education system is supposed to arrange and update both teacher training programs and the curriculum in order to educate young people who can transfer their learning to their daily life, come up with new ideas and solutions to the problems through devising critical thinking abilities and regulate their learning. In Turkey, participating in international educational research, projects, and assessments, such as PISA, TIMMS, STEM+A, requires not only focusing on analytical skills but also developing productive, creative and practical skills of the students. In this regard, the teaching styles of teachers should guide and facilitate learning process. It is necessary that teachers encourage students to be aware of their strengths and weaknesses, and emerge their potential capacities (Sternberg, 1998). The individual, who is aware of his/her own traits, and takes responsibility for his/her own learning, is eager to construct meaningful knowledge and can be better motivated to become an active learner in learning environments, and assume responsibility for the learning process (Bulut, 2018).

Each student takes part in the learning environment with her/his unique potential. A learner’s contribution to the learning process is vital and valuable in education as it is an interaction and communication process. Learners vary in terms of their socio-economic level, ethnicity, culture, language and learning style (Borich, 2014). In other words, their needs, personalities, interests, abilities, learning styles, and intelligences are the basic factors creating individual differences. Individual differences in learning performances are related to inborn traits, environments and learning capacities of individuals. Kuzgun and Deryakulu (2004) state that individual differences emerge with the interaction between inborn traits and the social environment of a person, and thus this interaction identifies the person’s intelligence, and learning capacity. On the other hand, experimental research on learning and developing

memory clarifies that differences in performances of learners depend on the following four factors (Winert, Helmke & Schneider, 1989): (a) Memory capacity, which is one of the relatively stable individual traits in information processing system (e.g. short-term memory capacity); (b) Intellectual competences, which include general intellectual skills that play an important role in leading learning and memory tasks; (c) Domain-specific knowledge, which covers the quantity and quality of knowledge associated with the content of the information to be learned and recalled; (d) Learning and memory strategies, which are related to the strategies that facilitate and master acquisition, storage, and recalling information.

The concept of intelligence has been debated, and scholars have suggested various theories for ages. Discovering mysterious secrets of the brain, all domains of sciences started to define the term intelligence through multi-disciplinary works. Intelligence is usually defined as the individual's mental capacity. However, a number of scholars now agree that intelligence is a sophisticated concept that comprises a wide range of different competences, and thus is highly difficult to measure and define (Service, 2005). In the 19th century, scientists asserted that intelligence could be measured through standard intelligence tests, and started to design tests to measure traits indicative of intelligence. Along with the beginning of compulsory education in Europe, it was thought that there was a connection between children's school performances and their intelligence. Conventional views favored that intelligence could be measured through standardized IQ tests (Sternberg, 2005). The pioneers of standardized intelligence tests, Binet and Simon focused on the issues not explicitly taught in schools such as attention, memory-based skills, reasoning, analytical thinking, and developed "the Binet-Simon Intelligence Test". They put forward the concept of mental age, based on the average cognitive competencies of children at certain ages (Cianciolo and Sternberg, 2004). Spearman as the representative of psychometric approach to intelligence emphasized the singular nature of intelligence. He highlighted a general factor of intelligence, often referred to as the "g factor", which assumes that the individual has a unique, inborn, and stable capacity. According to Spearman, there is a single cognitive ability standing for an individual's intelligence and correlating with the performances of the individual in the other domains (Sternberg & Grigorenko, 2004; Sternberg, 2019).

The dominance of the psychometric approach over intelligence has declined dramatically since the beginning of the 1970s (Gardner, Csikszentmihalyi & Damon, 2001). Important movements have been witnessed in intelligence theories, research and measurements which point out multiple features of mental capacity predicting individuals' both academic success and life-long skills (Kaufman & Singer, 2004). Contemporary intelligence theories view traditional notion of intelligence as the competence of adaptation to the environment to be defective (Delgoshai & Delavari, 2012). Intelligence, high level of thinking abilities, and meta-cognitive competences enable individuals to transfer, process and apply knowledge for problem solving efficiently (Dochy, Segers, & Bossche, 2003). Considering versatile dimensions and complex structure of intelligence, Gardner introduces multiple intelligence theory and eight different types of intelligence in 1980s. He has argued that conventional concepts and measurements of intelligence are based upon unitary notions in nature, and fail to reflect the structure of intelligence that is far more complex than standardized IQ tests. This sophisticated structure is pluralistic. Intelligence performances form and vary within socio-cultural context, and thus intelligence demands an interdisciplinary approach and sensitivity to culture (Gardner, 1993). This theory expands the domains of intelligence, promotes undiscovered potential, creativity, awareness, emotion, and tacit knowledge of the individuals (Chinowsky & Brown, 2004). Besides, the theory highlights the diversity of the learners in the learning styles, and thus enables teachers to recognize the concept of individualized and independent learning (Sternberg, 2002).

Supporting the multiple nature of intelligence, Sternberg puts forward "successful intelligence theory" which is defined as one's ability to adapt, shape and select her/his socio-cultural environment in order to attain lifelong success (Sternberg, 1999). Sternberg (2005) states that there is no precise definition of success that is confirmed by everyone. Since people have various ambitions in life, education cannot offer the formula of single targeted measures of success. Attaining success depends on empowering one's strengths and making up for one's weaknesses through creating the balance of analytical, creative, and practical abilities. Hence, the theory is referred to as "triarchic skills", depicting analytical, creative and practical aspects of intelligence. Throughout their life-long learning and experiences, people should think;

- (a) creatively to come up with new and valuable ideas,
- (b) analytically to assess whether their ideas and other ideas are valid and worthwhile,
- (c) practically to apply their ideas and to persuade others. People also need

(d) wisdom to ensure that their talents can be devised to attain a common good that balances between their own interests and other people's interests over the long term (Sternberg, 2015).

As Sternberg (2002) points out, analytical thinking ability covers abstract subjects, and requires analyzing, judging, assessing, and critical thinking abilities. This kind of intelligence is particularly displayed in academic settings and represents “g” intelligence. The other type of intelligence, creative thinking ability contains a range of problems and requires coming up with new ideas, formulating strategies to deal with novelty. Practical thinking ability involves individuals' implementing practical solution to difficulties in daily life. Adaptation, shaping and selecting environments are the components of practical thinking, and the balance among these elements helps individuals attain success throughout their life (Sternberg, et al. 2005). Sternberg and Grigorenko (2000) summarize the elements of successful intelligence theory as follows;

1. There is no precise definition of success that is confirmed by everyone, since people have different life styles, expectations, goals or needs that move them away from single targeted measures of success.

2. Individuals should capitalize their strengths and compensate for their weaknesses to attain success. They should be aware of their capacity and skills.

3. Successfully intelligent people can achieve some balance of adapting, shaping and selecting their existing environments.

4. Successfully intelligent people find out a balance in their use of analytical, creative, and practical abilities. They generate ideas to make them work harmoniously (Sternberg and Grigorenko, 2000: 211-215)

The theory of successful intelligence asserts that some students can be more talented in displaying their knowledge when they face the problems within a practical context rather than analytical pattern. Practical ability involves transferring tacit knowledge to daily life. For instance, in the study carried out by Sternberg and his friends (2009), Brazilian children, who dropped out schools due to financial or other reasons, and worked as street vendors, were successful in making trade-related arithmetic operations, but they were unable to solve similar problems in abstract context. Similarly, in the research they carried out in rural Kenya, they found out that the children, who were good at preparing, and using herbal medicine to treat various type of infections, scored quite poorly on academic tests. The families of these children viewed that the children needed to learn this kind of practical skills to survive and attain success in life rather than academic knowledge or analytical skills (Sternberg & Grigorenko, 2002). Sternberg suggests that the same can be said for the children who want to follow careers in art, music, carpentry, and so forth. They need to enhance their practical skills to reach their goals in life rather than spending time developing their academic skills (Sternberg, 2006). In this regard, Sternberg and his colleagues developed “Sternberg Triarchic Abilities Test (STAT)”, and tested validity of successful intelligence theory at schools and colleges. STAT is a test designed to measure analytical, practical, and creative thinking skills of individuals. Hence, students or teachers at schools or colleges formed the participants of Sternberg's research, and he proposed implications for learning styles of students, teaching and assessment method of teachers.

Modern societies require individuals with creative intelligence, who are capable of identifying right patterns, and have problem-solving and analytical thinking skills. Some education systems encourage students to think critically, and solve simulated practical problems to enable them to be more enthusiastic and active learners. Transferring knowledge from schools into real life makes people successful and provides opportunities to implement academic knowledge in society. Therefore, integrated patterns of analytical, critical and practical thinking training in the curriculum bring up educated people to address society's needs (Nyunt Saw & Han, 2021).

In recent years, education systems have been transformed from teacher-centered approach to student-centered approach. Thus, it becomes an obligation to design new curricula considering individual differences of both teachers and students. New curricula based on constructive approach have been designed in Turkey since 2005. Constructivism aims to educate individuals who are capable of expressing their thoughts, communicating, collaborating, taking responsibility, having versatile viewpoints and advanced problem-solving skills, and

generating knowledge via information-communication technologies (ME, 2017). These aims are associated with the elements of successful intelligence theory.

The individual differences and thinking styles of teachers, who play a vital role in implementing the curricula at schools, have a significant impact on learning and teaching process. It is essential that teachers keep up with the latest developments in their teaching domains, revise, update and design their teaching styles in accordance with the needs, and expectations of students. Teachers must be aware of their aptitude and proficiency level, and organize learning environment regarding the differences among students so that they can provide long lasting learning, facilitate acquisition of knowledge, and help students transfer information into real life practice (Bulut, 2014).

In accordance with the context relating to the theory of successful intelligence, it is aimed, in this research, to adapt “Teaching Style for Successful Intelligence Questionnaire (TSI-Q)” developed by Palos and Maricutoui (2013) into Turkish so that it can be used by the researchers in Turkey on Turkish speaking samplings. Adaptation process and the assessment of validity and reliability is conducted on the sample consisting of the teachers working at high school level. It is regarded that Turkish form of TSI-Q can contribute to the literature, and be beneficial measurement tool for the researchers studying assessment and determining teaching styles of teachers in terms of the theory of successful intelligence.

## 2 | METHOD

### STUDY GROUP

In this study, online survey data from 305 teachers working at high schools in provincial centre of Diyarbakır were collected in the first semester of the 2020-2021 academic year. The scale was applied to three study groups. The first group consisted of 32 English language teachers who were applied both the original form of the scale and the translated version of the scale to carry out language equivalence analysis. The rest of the sample (n=273) was randomly divided into two groups as Sample 1 and Sample 2 for the analysis. Sample 1 (n= 136) were comprised of 59 (43.4%) female and 77 (56.6%) male teachers, the data obtained from Sample 1 was used to perform the exploratory confirmatory factor analysis (EFA). Sample 2 (n= 137) was made up of 58 (42.3%) female and 79 (57.7%) male teachers. The data obtained from Sample 2 (n=137) was used for confirmatory factor analysis (CFA). Data from both samples (n=273) were used for Cronbach Alpha reliability coefficient analysis.

The participants from six different teaching domains were included in the study group to gain maximum possible representation in EFA and CFA analyses. These domains were Turkish Language and Literature (n=49), Maths (n=37), Science (n=62), Social Sciences (n=52), Foreign Languages (n=50), and Arts (n=23).

### MEASURING INSTRUMENT AND ADAPTATION PROCEDURE

The data of the original research was collected via “Teaching Style for Successful Intelligence Questionnaire (TSI-Q)” developed by Palos and Maricutoiu. The original scale was implemented on the sample that was comprised of 100 participants (70 females, 30 males), including teachers from high schools, and teaching staff from a university. The scale is a 6-point Likert Scale, from 1-*very strong disagreement* to 6- *very strong agreement*, and consists of 23 items and four sub-scales. These sub-scales are named as *reproductive thinking*, *analytical thinking*, *creative thinking*, and *practical thinking*, which are based on Sternberg’s theory of successful intelligence. The scale does not have any item that has any negative items. There are 5 items for *reproductive thinking* (1-5-9-13-17), 5 items for *analytical thinking* (2-6-10-14-18), 7 items for *creative thinking* (3-7-11-15-19-21-23) and 6 items for *practical thinking* (4-8-12-16-20-22). The original form of the scale indicates common variance of approx. 36-40% (Palos & Maricutoiu, 2006).

In the beginning of adaptation process, the researchers contacted Associate Professor Dr. Ramona Palos via email and obtained permissions to use the original form of the scale for adaptation into Turkish. The most important phase of the scale adaptation studies is considered as the translation process (Hambleton & Bollwark, 1991). During the process of adaptation of a scale, four different designs can be used, which are called single basic translation, backward translation, single basic translation based on statistical analysis, and backward translation based on statistical analysis. The scale is translated from source language to target language by single translator

or preferably a group of translators within single basic translation design. Then, another group of translators assess the equivalence of the original version and the target version of the scale. Revisions can be made to the target version of the scale to make up for ambiguities identified by the translators. On the other hand; in backward design, a group of translators translates the scale from source language to the target language. A second group takes the translated scale, and translates it back to original language of the scale. Afterwards, the original version of the scale and target language version of the scale are compared, and judged whether two versions of the scale are equivalent, or not (Hambleton & Kanjee, 1993).

In this research, the scale was translated from source language to the target language through backward translation design. The original version of the scale was applied to participants in Romanian language, but Palos and Maricutoiu issued the English version of the scale. The researchers requested Romanian version from the developers of the scale. Later, they sent the scale to a translation bureau, and had certified translators translate it from Romanian to Turkish. Then, three experts in English language translated Turkish version of the scale into English. The English version of the scale in the article and the translated version of the scale were compared and revised by experts in English and Turkish languages. Afterwards, the researchers asked for second opinion from experts in educational sciences and another group of experts in Turkish and English languages to determine the best target language expressions that are equivalent and reflect the original version of the scale in Turkish. Even though the original version of the scale is 6-point Likert type, experts in Turkish language advised that 5-point Likert Type would be more appropriate to semantic structure of Turkish. Hence, the researchers preferred 5-point Likert Scale Type, from 1-*strongly disagree* to 5- *strongly agree*.

## DATA COLLECTION

Initially, the translated version of the scale was tested to indicate whether it was equivalent of the original version of the scale. 32 English language teachers answered both the original form and the translated version of the scale. Simple correlation coefficient test was applied between two scales to indicate the equivalence level of the translated form of the scale.

For the adaptation of a scale, construct validity and reliability should be tested through exploratory factor analysis (EFA) or confirmatory factor analysis or both of them together (EFA and CFA) Karadeniz, Büyüköztürk, Akgün, Çakmak & Demirel, 2008; Gülbahar & Büyüköztürk, 2008; Kaya & Dağ, 2013). In this research, both EFA and CFA were conducted. While EFA is used to test the conformity of 4 factors of original version of the scale with a different culture, CFA measures the compliance of the adapted scale by comparing factors, and thus providing similarities and differences between the original and adapted versions of the scale (Tabachnick & Fidell, 2001).

Kaiser-Meyer-Olkin Test (KMO) and Bartlett's Test of Sphericity were carried out on data obtained from 273 teachers whether sample size was acceptable and appropriate for CFA and EFA. In the process of CFA, goodness-of-fit indices are taken into consideration to assess conformity level of the model (Şenel, Pekdağ & Sarıtaş, 2018). In CFA process of this research, goodness-of-fit indices -  $\chi^2/sd$  (Chi-Square/Degrees of Freedom), RMSEA (Root Mean Square Error of Approximation), NFI (Normed Fit Index), NNFI (Non-Normed Fit Index), CFI (Comparative Fit Index) and RMR (Root Mean Square Residual) were determined as criteria, and sufficiency levels of these goodness-of-fit-indices were tested for model-data fitness.

Internal consistency reliability analysis was performed for the reliability of the Turkish version of the scale. Cronbach's alpha coefficient was calculated to test internal consistency of the items and each subscale. The analyses were conducted through such computer softwares as SPSS.22 for KMO, Bartlett's Tests, EFA and internal consistency test (Cronbach's alpha), and AMOS.24 for CFA. Though reliability test was performed on 273 participants of data set, the data set was randomly divided into two groups for EFA and CFA. Data set with 136 participants was used for EFA whereas CFA was conducted on the data set with 137 participants. Fabrigar, Wegener, MacCallum and Strahan (1999) postulate that calculating EFA and CFA on different data sets obtained from different samples is suitable choice for testing validity of a measurement tool.

## RESEARCH ETHICS

After preparing the necessary documents concerning the research and ethics committee approval necessary documents, including the research process and publication process, the research measurement tools, research data and all processes were submitted to the Dicle University Research Ethical Committee. The ethics committee approval was received with the protocol number 32977, dated 16.03.2020. Research Ethics Permission was obtained from Provincial Directorate of National Education, dated 22.10.2020, numbered 30769799-44-E.15393017.

## 3 | FINDINGS

### LINGUISTIC EQUIVALENCE

The original form and the translated version of the scale were applied to 32 participants to indicate an evidence of the linguistic equivalence between two forms, and linear correlation coefficients of two forms were calculated and compared. The correlation coefficients for each item are given in the Table 1:

Table 1. Correlation coefficients between original and Turkish forms of the TSI-Q

Number of Items	r	Number of Items	r	Number of Items	r	Number of Items	r
Item 1	.58	Item 7	.52	Item 13	.79	Item 19	.94
Item 2	.80	Item 8	.50	Item 14	.49	Item 20	.59
Item 3	.47	Item 9	.60	Item 15	.45	Item 21	.91
Item 4	.55	Item 10	.46	Item 16	.90	Item 22	.45
Item 5	.83	Item 11	.48	Item 17	.62	Item 23	.92
Item 6	.68	Item 12	.73	Item 18	.52		
Factor 1: .78		Factor 2: .87		Factor 3: .88		Factor 4: .93	
Total of the scale: .83							

In Table 1, correlation coefficients for each item of the original and translated versions of the scale were calculated between .45 and .94. The correlation value for the total of the scale was .83. Correlation coefficients for each sub-scale ranged from .78 to .93. The value of correlation coefficient is expected to be .70 and above, and the value .70 and above is defined as high level (Büyüköztürk, 2017). In this sense, both the total and sub-scales of the English and Turkish versions of the TSI-Q were covered within this high level value. It can be claimed that original and translated versions of the TSI-Q are equivalent.

### EFA

Initially, KMO and Bartlett's Test of Sphericity were calculated to determine whether data set would be acceptable and appropriate for factor analysis. The results of these two tests were presented in Table 2:

Table 2. The Result of the KMO and Bartlett's Tests

Kaiser-Meyer-Olkin Sample Size Test		.957
Bartlett's Test of Sphericity	$\chi^2$	4155.001
	sd	253
	p	.000

As seen in Table 2, Kaiser-MeyerOlkin (KMO) test was calculated as 0.957, which is considered to be a high value for factor analysis of this data set. Tavşancıl (2010) points out that a value of 0.90 or higher obtained from KMO test can be interpreted as a perfect value for sample size in order to perform factor analysis. Besides, findings

in Table 2 shows a normal distribution based on Bartlett's Test of Sphericity ( $\chi^2 = 4155.001$ ,  $p < 0.01$ ), which also indicates that factor analysis can be carried out (Tabachnick & Fidell, 2001).

EFA is used to test the conformity of factor structure of the scale. The results of EFA test are given in Table 3 and Table 4:

Table 3. Initial Eigenvalues and Variances of the TSI-Q

Factors	Initial Eigenvalues	% of Variance	Cumulatives %
Reproductive Thinking	10.60	46.11	46.11
Analytical Thinking	1.40	6.11	52.23
Creative Thinking	1.20	5.24	57.47
Practical Thinking	1.006	4.11	61.59

As presented in Table 3, the results of EFA tests show that the data obtained from adapted scale is coherent to original form. Adapted scale includes 23 items and 4 factors, initial eigenvalues are above 1. The number of factors in the adapted scale is compatible to the original version of the scale. In other words, the results of EFA test supported the four-dimensional factor structure of the original scale. It also explains 61% of cumulative variance. Büyüköztürk (2017) states that 30% of explained variance is sufficient for the scale with single factor, yet explained variance for the scale with multiple factors ought to be over 30%. Moreover, Yaşaroğlu (2007) claims that the explained variance exceeding 50 % of total variance is a significant criteria for factor analysis.

Table 4. Factor Loadings of the TSI-Q

Items	F1	F2	F3	F4	Items	F1	F2	F3	F4
1	.65				13	.44			
2		.35			14		.48		
3			.48		15			.70	
4				.46	16				.67
5	.74				17	.67			
6		.69			18		.34		
7			.43		19			.63	
8				.74	20				.87
9	.67				21			.46	
10		.63			22				.59
11			.47		23			.39	
12				.52					

In table 4, it can be observed that factor loads range from .35 to .87. As stated in references, factor loads should be at least .30 (Büyüköztürk, 2017; Can, 2017). In this sense, the items of the adapted scale covers required factor loads. It can be suggested that EFA result of the adapted version of the TSI-Q confirms the factor structure in the original form of TSI-Q, and proves conformity with Turkish culture in terms of internal and structural validity.

#### CFA

In order to determine that the original structure of TSI-Q is confirmed with the sample of Turkish participants, construct validity of the scale was examined using confirmatory factor analysis. Initially in confirmatory factor analysis, the model fit indicators were checked. The results for the indices emerged for TSI-Q with excellent and acceptable fitness values are shown in Table 5.





In Figure 1, it is seen that the factor loads of the scale change between 0.30 to 1.02. Some standardized coefficient values were found above 1. However, there is a misunderstanding that coefficient values should be below 1. Jöreskog (1999) states that this misunderstanding results from multiple covariances between items and factors. The number of the items defining factors is inversely correlated with multiple covariance, and thus multiple covariance increases as the number of items declines (Deegan, 1978; Jöreskog, 1999). The reason why factor loadings concerning four-dimensional factor model is over 1 depends on this inverse correlation. As seen in the diagram, modification covariance was made between item 19 -21, and between item 20-22 to attain acceptable fitness value (Bentler & Bonett, 1980; Schermelleh-Engel & Moosbrugger, 2003; Marsh, Hau, Artelt, Baumert & Peschar, 2006). All these CFA fit indices and factor loads shown in diagram suggest that the Turkish version of TSI-Q is confirmed in the data set of this research, and valid to be used within the framework of its purpose in Turkey.

## RELIABILITY

Reliability analysis of the TSI-Q is calculated by using Cronbach Alpha internal consistency coefficients. In a study of measuring reliability, Cronbach's Alpha internal consistency coefficients range from 0 to 1. As values get closer to 1.0, it means that the variables in the scale show greater reliability. Based on Cronbach's Alpha coefficient values ( $\alpha$ ), is interpreted as follows (Fraenkel & Wallen, 2009):

$0.00 \leq \alpha < 0.40$  indicates no reliability.

$0.40 \leq \alpha \leq 0.60$  represents poor reliability.

$0.60 \leq \alpha < 0.80$  shows high reliability.

$0.80 \leq \alpha < 1$  indicates excellent reliability.

The Cronbach's Alpha internal consistency coefficients are calculated for both the total and sub-scales of the TSI-Q. Reliability coefficients of TSI-Q are presented in Table 6.

Table 6. Reliability Coefficients of TSI-Q

Sub-scales	Item No	Cronbach's Alpha of Translated Form	Cronbach's Alpha of Original Form
Reproductive Thinking	1,5,9,13,17	.82	.86
Analytical Thinking	2,6,10,14,18	.83	.76
Creative Thinking	3,7,11,15,19,21,23	.86	.83
Practical Thinking	4,8,12,16,20,22	.87	.85
Total of the Scale	1 - 23	.95	.93

As shown in Table 6, Cronbach's alpha reliability is found as .95 for the total scale including 23 items. This value indicates that the adapted version of the TSI-Q has quite a high reliability and internal consistency. Besides, reliability coefficients of sub-scales of the TSI-Q range from .82 to .87. It can be said that the internal consistency of the scale is excellent, and so reliable measurements can be performed by means of this scale.

## 4 | DISCUSSION & CONCLUSION

In this research, validity and reliability study of the adapted version of TSI\_Q (Palos and Maricutoui, 2013), which aims at determining self-perceptions of teachers on their teaching styles was carried out. The adapted scale was implemented on 305 teachers working at high schools. The results of KMO and Bartlett's Test of Sphericity showed that the data set obtained from the study group was appropriate for testing structural validity and reliability of the scale. EFA result of the adapted version of the TSI-Q confirmed the factor structure in the original form of TSI-Q, and proved conformity with Turkish culture in terms of internal and structural validity. The construct validity of the TSI-Q was analyzed through CFA, and a four- factor structure of the scale (Reproductive Thinking, Analytical Thinking, Creative Thinking, Practical Thinking) with 23 items was in conformity with acceptable

model fit indices in the adapted version of the scale. In other words, in the research four-factor structure of the original form was confirmed with the sample in Turkey. When Cronbach's Alpha internal consistency coefficients of the adapted scale were compared with those of the original version of the scale, it was discovered that Cronbach's Alpha inner consistency coefficients of the adapted scale were as high as those of the original form. All these findings point out that the adapted scale suggests similar results with the original form, and the model is found to be valid and reliable in Turkish sampling in case the measurement tool is used in line with its original objectives.

Reliability of the scale was calculated through the Cronbach's Alpha internal coefficients. The Cronbach's alpha internal consistency reliability coefficient for the whole TSI-Q scale was .95. Internal consistency reliability coefficients for subscales ranged between .82 and .87. Özdamar (1999) states that the scales with reliability coefficient .60 and more are regarded as reliable, and over .80 are accepted as highly reliable. In this sense, these results denote that reliability of the adapted scale is quite high for both its total and sub-scales.

Unlike conventional ones, modern education systems are supposed to address the challenges of the 21<sup>st</sup> century. Along with memory-based and analytical knowledge, teaching creative thinking abilities can help individuals generate new ideas, find out and solve problems in unusual ways (Hassan, Alghamdi & Al-Hattami, 2020). As Torrance (1965) states; unless we give up insisting on thinking statically we cannot keep up with the changes. Hence, teachers provide opportunities for their students to think flexibly, critically, and creatively (Kim, 2011).

Developing thinking skills intertwined with reproductive, analytical, creative and practical abilities not only brings out undiscovered potentials of the individuals, but also ensures to increase the quality of education (Sak & Maker, 2004). The education based on improving thinking skills both enables the individuals to find out their capacities, and contribute to shape their social and cultural environment (Sternberg & Grigorenko, 2000). In this sense, the individuals can learn deeper thinking skills, choose and transform required knowledge, and transfer it into their daily life. Teachers play a significant role in developing these skills and making them prevalent in education systems.

Teaching styles of teachers can vary in learning-teaching process due to the features of learning environment, individual differences, learning content, and so on. Sternberg (1997) claims that the ways of problem-solving, applying activities, making decisions are unique to each teacher, and teaching styles vary across teachers, age groups, and schools. In this regard; considering the variances teachers encounter in learning environment, teachers should adopt the most appropriate teaching style in order to contribute to students' success, make the content explicit and attain objectives of lessons. Several studies have been performed on determining correlation between teaching styles of teachers and academic achievement of students. These studies demonstrate that the coherence between learning styles of students and teaching styles of teachers contributes to increase the academic achievement of students, and enables students to discover their learning styles, and realize self-efficiencies, strengths and weaknesses during learning process (Kolb, 1984; Felder, 1988; Sternberg & Grigorenko, 2004; Bulut, 2018). In this context, measurement tools are needed for the research on determining self-perceptions of teachers relating to their teaching styles. In this research, the researchers carried out validity and reliability studies of the Turkish adaptation of TSI-Q, which aims to determine teachers' teaching styles based on successful intelligence theory.

The significant limitation of this research is to perform EFA, CFA and internal consistency coefficients on the data obtained from the same sampling. Further studies to be carried out on different sampling groups could reinforce validity and reliability of the scale.

The following research would be carried out via this adaptation version of TSI-Q:

- By means of this adapted scale, comprehensive research with several variables could be performed to identify teachers' teaching style based on successful intelligence.
- The adapted version of this scale could be used in different education levels and several different courses in order to contribute to evaluation of curriculum.

#### STATEMENTS OF PUBLICATION ETHICS

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully. Ethical approval (approval date: 16.03.2020, and number: 32977) was taken from Dicle University.

#### RESEARCHERS' CONTRIBUTION RATE

The study was conducted and reported with equal collaboration of the researchers.

#### CONFLICT OF INTEREST

There is no conflict of interest to disclose.

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## APPENDIX A.

## BAŞARILI ZEKA ÖĞRETİM STİLİ ÖLÇEĞİ (BZÖSÖ)

	Kesinlikle Katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle Katılıyorum
1. Derslerimde öğrencilerimin hafızalarını geliştirebileceğim durumların üzerine odaklanırım.					
2. Öğretme sürecimde, öğrencilerimin kendilerine sunulan bilgiyi (bir şeyin neden öyle olduğunu) analiz edebilme kapasitelerine önem veririm.					
3. Derslerimde öğrenmeyi kolaylaştırmak için değişik oyunlar (rol yapma, şakalar vb.) kullanırım.					
4. Dersten sonra öğrencilerimi, sınıfta öğrendikleri teorik bilgileri pratikte uygulamaları konusunda teşvik ederim.					
5. Öğrencilerimin sınıfta özümstedikleri bilgiyi tekrarlayabilecekleri öğrenme ortamlarını tercih ederim.					
6. Öğrencilerimin öğrendikleri konu ile ilgili ortaya atılan bir problemi değerlendirebildikleri öğrenme ortamlarını tercih ederim.					
7. Öğretme etkinliklerimde öğrencilerimin bilgiyi yeniden yorumlamaları, yeni yöntemler keşfetmeleri konusunda teşvik ederim.					
8. Sınıfta öğrencilerimin uygulamalı etkinlikler (projeler, hareket planı, vb.) yapmalarına önem veririm.					
9. Öğretme stilim öğrencilerimi hafızalarını geliştirmeleri konusunda teşvik eder.					
10. Etkinlikleri uygulama sürecinde öğrencilerimin olgu ve kavramları açıklama kapasitelerine önem veririm.					
11. Sınıfıçi etkinliklerde öğrencilerimin problem çözmek için hayal gücünü kullanmasına (o durumları hayal etme, yeni fikirler üretme vb.) önem veririm.					

12. Öğretim stilimde öğrencilerimin sınıfta doğruluğu onaylanan plan ve stratejileri, uygulamaya koymaları konusunda teşvik ederim.					
13. Öğretme sürecimde öğrencilerimin daha kapsamlı, detaylı bilgileri özümseme kapasitelerine önem veririm.					
14. Öğrencilerin edindiği yeni bilgileri farklı kuram ve modeller ile değerlendirmelerini tercih ederim.					
15. Öğretme etkinliklerinde öğrencilerimin varsayımda bulunmaları ve varsayımlar üzerinden neler olabileceğini düşünmeleri konusunda teşvik ederim.					
16. Öğretme yöntemim öğrencilerimi, farklı problemler çözerken öğrenilmiş teorik bilgileri kullanma yönünde teşvik eder.					
17. Öğretme etkinliklerinde öğrenme sürecinde öğrencilerimin hafızalarını kullanmalarını kolaylaştırır ve takdir ederim.					
18. Öğretme sürecimde öğrencilerimin sistematik analiz, mantıksal düşünme kapasitesinin geliştirilmesine önem veririm.					
19. Öğretme etkinliklerimde, öğrencilerimi farklı durumlara uygulanabilen yeni çalışma ilke ve yöntemleri keşfetmeleri konusunda teşvik ederim.					
20. Öğretme stilimle öğrencilerimi, teoriden öğrendikleri bilgileri pratikte uygulamaları konusunda cesaretlendiririm.					
21. Öğretim etkinliğimde öğrencilerimi, başkalarından farklı bir şekilde çalışmaları ve düşünmelerini, hatta bazen de mantıksal olan bilgiye karşı çıkmaları konusunda teşvik ederim.					
22. Dersin sonunda öğrencilerimi öğrendikleri bilgiler için pratik uygulamalar bulma konusunda teşvik ederim.					
23. Öğretme sürecinde kullandığım yöntem öğrencilerimi yaratıcı düşünmeye teşvik eder.					