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Araştırma Makalesi / Research Paper

Development of the Teacher - Student Interaction Scale[1]

Öğretmen - Öğrenci Etkileşimi Ölçeğinin Geliştirilmesi

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Abstract. This research was conducted to develop a scale to measure the interaction between students and teachers. Two different study groups were created with the convenience sampling technique. EFA was performed with 346 students and CFA was performed with 394 students. T-test, EFA and CFA tests were used in the analyses. As a result of EFA, a two-factor structure was found for three scales measuring teacher-student interaction in the classroom, in-school and out-of-school environments. After EFA, CFA analysis was performed to measure the psychometric properties of the scale, and it was seen that the results met the criteria in the literature. The three subscales created (in-class, school environment, out-of-school) consist of two subdimensions each. Expert opinion was received for the content validity, KGI and KGI values were examined and it was seen that the content validity of the items was significant. The reliability of the scale (Cronbach alpha) verified with CFA was calculated as .86 for in-class, .74 for in-school and .79 for out-of-school teacher-student interaction. The obtained data show that the scale is reliable. This scale has a modular structure. It can be used to determine teacher-student interaction for three different environments.
Keywords: Scale development, Teacher-student interaction, School environment, Classroom environment, Out-of-school environment, High school students

Öz. Bu araştırma öğrenciler-öğretmen arasındaki etkileşimi ölçmek için bir ölçme aracı geliştirmek amacı ile gerçekleştirilmiştir. Kolay ulaşılabilir örneklem tekniği ile iki farklı çalışma grubu oluşturulmuştur. 346 öğrenci ile AFA, 394 öğrenci ile DFA gerçekleştirilmiştir. Analizlerde t-testi, AFA ve DFA testleri kullanılmıştır. AFA sonucunda sınıf içi, okul içi ve okul dışı ortamlardaki öğretmen-öğrenci etkileşimini ölçmeye yönelik üç ölçek için iki faktörlü yapı bulunmuştur. AFA sonrasında ölçeğin psikometrik özelliklerini ölçmek için DFA analizi gerçekleştirilmiş, elde edilen sonuçların Alanyazındaki ölçütleri sağladığı görülmüştür. Oluşturulan üç alt ölçek (sınıf içi, okul ortamı, okul dışı) ikişer alt boyuttan oluşmaktadır. Kapsam geçerliliği için uzaman görüşü alınmış, KGİ ve KGÖ değerleri incelenmiş ve ölçekteki maddelerin kapsam geçerliliğinin anlamlı olduğu görülmüştür. DFA ile doğrulanan ölçeğin güvenilirliği (Cronbach alpha) hesaplanmış sınıf içi .86, okul içi .74 ve okul dışı öğretmen-öğrenci etkileşimi için .79 olarak bulunmuştur. Elde edilen veriler ölçeğin güvenilir olduğunu göstermektedir. Bu ölçek modüler bir yapıdadır ve öğretmenler ile öğrenciler arasındaki etkileşimi değerlendirmek için kullanılabilir.
Anahtar Kelimeler: Ölçek geliştirme, Öğretmen-öğrenci etkileşimi, Okul ortamı, Sınıf içi ortam, Okul dışı ortam, Lise öğrencileri

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Genişletilmiş Özet

Amaç. Bu araştırmanın amacı öğretmen-öğrenci etkileşimini üç farklı ortamda ölçmeye yönelik bir ölçme aracı geliştirmektir. Alanyazın incelendiğinde öğretmen-öğrenci etkileşimini ele alan farklı çalışmalara rastlanmış olsa da öğrenci gözü ile ortaöğretim kademesindeki öğrenciler ile sınıf içi, okul ortamı ve okul dışı üç farklı ortam için öğretmen-öğrenci etkileşimini ölçmeye yönelik herhangi bir ölçeğe rastlanmamıştır. Öğretmen-öğrenci etkileşimi, öğrenme sürecinin kalitesini ve öğrencilerin akademik başarısını etkileyen bir unsurdur. Bu etkileşim, sosyal yapılandırmacılık, bağlanma teorisi, öz-belirleme teorisi gibi kavramsal temellere dayanarak öğrencilerin bilişsel, duygusal ve sosyal gelişimlerini destekler. Etkili bir öğretmen-öğrenci ilişkisi, öğrencilerin öğrenme motivasyonunu artırır, özgüvenlerini geliştirir ve onları yaşam boyu öğrenmeye hazırlar. Dolayısıyla öğretmen-öğrenci etkileşimi eğitim sürecinin arka planında yer alan ve örtük olarak tüm süreci etkileyen bir bileşendir.

Öğretmen-öğrenci etkileşiminin bu nedenle önemli olduğu ve bu etkileşimi ölçmek için kapsamlı bir ölçeğe ihtiyaç olduğu görülmektedir. Bu amaçla üç farklı ortam için öğretmen-öğrenci etkileşimi ölçmek için bir ölçme aracı hazırlanması amaçlanmıştır.

Araştırma deseni. Bu çalışmada nicel araştırma yöntemlerinden tarama deseni kullanılmıştır. Bu model çalışmalarda eskiden veya günümüzde var olan bir durumun mevcut şekliyle betimlenmesini amaçlar. Nicel araştırmanın temel fikri, bir grup insanı ilgilendikleri değişkenlere göre ölçmek ve bu değişkenlerin birbirleriyle nasıl ilişkili olduğunu ortaya çıkarmaktır (Punch, 2003).

Verileri farklı katılımcı gruplarından iki aşamada toplanmıştır. AFA için veriler Sivas merkezde bulunan dört farklı Anadolu Lisesinden toplanmıştır. AFA verileri 346 lise öğrencisinden toplanmıştır. DFA verileri, AFA için verilerin toplandığı okullar dışında dört farklı lisedeki 394 öğrenciden toplanmıştır.

Taslak ölçek 80 madde içermektedir. Taslak ölçekten toplanan veriler SPSS 24 aracılığıyla AFA için kullanılmıştır. KMO ve Bartlett küresellik testi sonuçları veri setinin analiz için uygun olup olmadığını belirlemek için yapılmıştır. Veri seti değerlerinin uygun olduğu anlaşıldıktan sonra AFA yapılmıştır. AFA'da oluşturulan faktörlerin doğruluğunu test etmek amacıyla Lisrel Programı üzerinden birinci ve ikinci düzey DFA gerçekleştirilmiştir. AFA ve DFA ile yapı geçerliği incelenmiş ve Cronbach alfa güvenirlik katsayısı hesaplanmıştır. Üst ve alt %27'lik gruplar arasında madde korelasyon değerleri ve ilişkisiz örnekler t-testi uygulanmıştır ve ayırt edicilik hesaplanmıştır.

Bulgular. Öğretmen-öğrenci etkileşimi ölçeği üç farklı ortam için beşli likert tipte hazırlanmıştır (okul, sınıf içi, okul dışı). Bilişsel, güdüsel ve duyuşsal boyutlar her bir ölçek için madde havuzu oluşturma esansında dikkate alınmıştır. Ölçeğin yapı geçerliğini değerlendirmek amacıyla on sekiz uzman görüş bildirmiştir. Öğretmen-öğrenci etkileşimi ölçeğinin her alt boyutuna yönelik AFA ve DFA gerçekleştirilmiştir. Analiz sonuçlarına göre (AFA) tüm ölçeklerde iki faktörlü bir yapı belirlenmiş olup, sınıf içi öğretmen-öğrenci etkileşimi ölçeğinden (Sİ-ÖÖEÖ) 9 madde, okul içi öğretmen-öğrenci etkileşimi ölçeğinden (Oİ-ÖÖEÖ) 10 madde ve okul dışı öğretmen-öğrenci etkileşimi ölçeğinden (OD-ÖÖEÖ) 12 madde çıkarılmıştır.

ÖÖEÖ üzerinde yapılan geçerlik ve güvenirlik analizlerinin istatistiksel sonuçları, alt ölçeklerin kullanım için uygun olduğunu güçlü bir şekilde desteklemektedir. Sİ-ÖÖEÖ'de yer alan iki boyut toplam varyansın %55.66'ını, Oİ-ÖÖEÖ'de yer alan iki boyut toplam varyansın %60.60'ını ve OD-ÖÖEÖ'de yer alan iki boyut da toplam varyansın %53.83'ünü açıklamaktadır. Elde edilen bu analiz

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sonuçları alt ölçeklerin her birinin öğretmen-öğrenci etkileşimini kabul edilebilir düzeyde ölçtüğünün bir göstergesi olarak kabul edilebilir.

AFA sonrasında, faktör yapılarını farklı bir örneklem üzerinde test etmek için DFA uygulanmıştır. Analizlerde, LISREL 8.71 paket programı ve maksimum olabilirlik yöntemi kullanılarak gerçekleştirilmiştir. DFA sırasında her bir ölçek için iki farklı model değerlendirilmiştir. Model 1'de, her ortamın ölçeği fizyolojik, güdüsel ve duygusal olmak üzere üç faktörlü bir yapı çerçevesinde ele alınmıştır. Model 2 ise ikinci dereceden bir hiyerarşik faktör yapısını temel almıştır. Bu modelde, etkileşimin gerçekleştiği ortam sıralayıcı faktör, fizyolojik, duyuşsal ve güdüsel boyutlar birinci dereceden faktör, ölçek maddeleri ise bu faktörlerin göstergeleri olarak tasarlanmıştır. Her iki model de dikkate alınarak DFA analizleri yapılmış, ancak Model 2'nin her üç ölçek için de uygun olmadığı görülmüştür.

Model 1'in kabul edilebilirlik düzeyleri, model uyum göstergeleri kullanılarak değerlendirilmiştir. Bu kapsamda RMSA, CFI, IFI, NNFI, NC, NFI, AGFI ve GFI gibi uyum göstergeleri analiz edilmiştir. Analiz sonuçları, literatürde belirtilen kriterlerle karşılaştırıldığında, ölçeklerin bu kriterleri karşıladığı belirlenmiştir. Bu durum, elde edilen model uyum göstergelerinin ölçeği doğruladığını göstermektedir. DFA analizinde ayrıca t değerleri incelenmiş ve maddeler için t değerlerinin 2,56'nın üzerinde olduğu görülmüştür. Bu, maddelerin .01 düzeyinde anlamlı olduğunu göstermektedir. Sonuç olarak, DFA analizinde Model 1'in, Model 2'ye kıyasla daha iyi uyum değerleri sağladığı tespit edilmiştir.

Ölçeğin güvenilirliği Cronbach Alpha katsayısı ile değerlendirilmiş ve Sİ-ÖÖEÖ için .86, Oİ-ÖÖEÖ için .74 ve OD-ÖÖEÖ için .79 olarak hesaplanmıştır. Ayrıca ölçeğin genelinde Cronbach Alpha güvenirlik katsayısı .96 olarak tespit edilmiştir. Bu sonuçlar, ölçeğin yüksek düzeyde güvenilir olduğunu ortaya koymaktadır.

Ölçeklere yer alan boyutlar öğretmen ve öğrencilerin etkileşimine yönelik alanyazında yapılan çalışmalar ile örtüşmektedir. Ayrıca çalışma öncesi öğretmen ve öğrenciler ile gerçekleştirilen odak grup görüşmelerinden elde edilen veriler de fizyolojik, duyuşsal ve güdüsel olarak üç farklı boyutun olabilirliğini desteklemekte, bunun yanı sıra etkileşimin üç faklı ortamda gerçekleştiğine yönelik olarak güçlü kanıtlar sunmaktadır. Bu bağlamda araştırma kapsamında gerçekleştirilmiş olan öğretmen-öğrenci etkileşimi ölçeğinin alanyazında öğretmen-öğrenci etkileşimi sürecinde bulunması gereken etkileşimsel özellikler bakımından kapsam geçerliliğinin oldukça yüksek olduğu söylenebilir.

Analizler sonucunda, Sİ-ÖÖEÖ ölçeğinin duyuşsal ve güdüsel boyutlardan oluştuğu ve toplamda 11 madde içerdiği belirlenmiştir. Ölçekten alınabilecek minimum puan 11, maksimum puan 55'tir. Oİ-ÖÖEÖ ölçeğinin güdüsel ve fizyolojik boyutlarda 7 maddeden oluşmaktadır. Ölçekten alınabilecek minimum puan 7, maksimum puan 35'tir. OD-ÖÖEÖ ölçeğinin ise güdüsel ve fizyolojik boyutlarda 9 maddeden oluştuğu tespit edilmiştir. Ölçekten alınabilecek minimum puan 9, maksimum puan 45'tir. Ölçekte ters madde yoktur. Ölçek modüler olarak tasarlanmıştır. İhtiyaçlara göre sınıf içi, okul içi ve okul dışı gibi farklı ortamlardaki öğretmen-öğrenci etkileşiminin belirlenmesi amacıyla kullanılabilir. Ölçekte ters madde yoktur. Ölçeklerden alınan puanlar yükseldikçe öğretmen-öğrenci etkileşimi artacaktır.

Araştırma sınırlılıkları. Araştırma, Sivas'taki çeşitli Anadolu liselerinde öğrenim gören katılımcılarla sınırlıdır. Çalışmanın katılımcıları ortaöğretim seviyesindedir. Bu nedenle çalışma ortaöğretim öğrencileri ile sınırlıdır. Bu nedenle çalışmanın genellenmesi konusunda sınırlılıklar vardır.

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Özgünlük/Değer. Literatürdeki çalışmalar değerlendirildiğinde öğretmen-öğrenci etkileşiminin öğrenci perspektifinden ele alınması önemli bir gereklilik olarak görülmüştür. Bu bağlamda etkileşim kalitesinin öğretmen bakış açısına göre öğrenci bakış açısına göre ele alınmasının daha etkili sonuç vereceği ve sadece sınıfın değil okul dışı ve ev ortamlarının da dikkate alınması gerektiği görülmüştür. Bunun yanı sıra öğrencilerin duyuşsal, fizyolojik ve güdüsel özelliklerinin de dikkate alınması gerektiği düşüncesiyle yeni bir ölçek geliştirme çalışmasına ihtiyaç duyulmuştur. Ayrıca lise öğrencileriyle daha önce böyle bir çalışmanın yapılmamış olması yeni bir ölçeğin geliştirilmesi için önemli bir neden olmuştur. Dolayısıyla öğrenci bakışı ile üç farklı ortam için fizyolojik, duyuşsal ve güdüsel alt boyutlarına göre hazırlanan öğretmen-öğrenci etkileşimi ölçeğinin özgün bir ölçek olduğu görülmektedir.

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Introduction

Students encounter many aspects of the school environment (Gordon, 1982). These include the physical environment, the social environment, which consists of the relationships and social structures among the people in the school, and the symbolic and cognitive environment, which encompasses the concepts, issues, and information that students learn independently as well as the mindsets they pick up from their interactions with teachers and other students in the classroom. (Gordon, 1982). Among these, the social environment of the classroom and school is a crucial component that addresses teacher-student contact and communication. As Freire (Freire, 1974) stated, human beings are not only living in the world, but also beings with the world, and communication is the reason and result of human existence in this world. According to this, interaction is unavoidable in social settings, and all interactions in the class are thought to have an important role in their academic performance (Chaudron, 2012; Hashash et al., 2018; Wentzel, 2002).

Communication is a process that makes the effort to understand the person who is addressed, sharing mutual knowledge and emotion and life meaningful (Çamdereli, 2008). Interaction is a state of mutual knowledge, emotion or thought transmission, mutual action and influence between people who communicate within a certain time and space (Bakırcıoğlu, 2012). In general, teaching is the result of an interaction pattern between teachers, students and content (Kane et al., 2014; Klauer, 1985). This pattern is shaped based on interpersonal interaction, affecting classroom processes and emotional development of students (Fraire et al., 2013; Klauer, 1985). The attachment theory helps explain this. Bowlby says that attachment is a basic component that influences a person's relationships throughout his life (Bowlby, 1969). Teachers have a crucial role, particularly in the early years and school years. Teachers can help students feel safe, address their emotional needs, and create a secure learning environment. Students' affective, physiological, and motivational aspects may be impacted by this contact. Students' emotional responses and sense of trust in their teachers are linked to the affective dimension of teacher-student interaction. Bowlby asserts that a person with a safe attachment style might find a "safe port to take refuge in stressful situations" (Bowlby, 1969). Teachers can assist children feel emotionally supported and establish this safe environment for them. Students' self-confidence may rise as a result, enabling them to engage more constructively in the learning process. Stress and anxiety levels in students are linked to the physiological aspects. Students can become calmer and more focused, through a stable teacher-student connection (Pianta, 1999). Warm, encouraging attitudes from teachers can make pupils feel more at ease and encourage better participation in the learning process. Students' motivation for learning is correlated with the motivational dimension. Students who have a stable teacher-student relationship are more likely to be internally motivated to learn (Deci and Ryan, 2000). Students may be able to engage more actively in the learning process and obtain better academic results if their teachers have a positive and supportive attitude toward them. Many studies in the field show that the quality of teacher-student relations is a decisive factor in the adequacy of students' social-emotional, behavioural functionality and academic skills (Baker, 2006; Birch and Ladd, 1997; Burchinal et al., 2002; Hamre and Pianta, 2001; Murray et al., 2008; O'Connor and McCartney, 2007).

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The interactions that take place in classroom environments have two aspects: teacher-student and student-student. The traits of both parties have a significant impact on how well students and teachers communicate (Dhillon and Kaur, 2023). The ability of students to express their ideas openly is related to the individual characteristics (Veznedaroğlu, 2007). Some studies have found that some teachers may produce a poor classroom environment (Çelik and Onay, 2017; Deveci et al., 2008; Gözütok et al., 2006; Mahiroğlu and Buluç, 2003; Tekke et al., 2018). For example, a teacher who gives mostly negative feedback to students causes an increase in students' attention problems and negative behaviors in students (Reinke et al., 2016) and has a detrimental effect on children's social and intellectual behaviour (Wentzel, 2002). Similarly, negative teacher behaviors will suppress learning. (Chaudron, 2012).

Research on teacher-student interaction shows that teachers' behaviour affects student behaviour and is also related to their academic success (Alderman and Green, 2011; Burchinal et al., 2002; Pianta and Stuhlman, 2004). Furthermore, teachers' assistance has a beneficial impact on students' motivation, raises the value they place on the lesson, helps them adjust to school, and improves their academic performance. (Lynch and Cicchetti, 1997; Pianta, 2006; Wentzel, 1997). Students' academic progress is therefore greatly influenced by a healthy school and classroom environment (Alderman and Green, 2011; MacNeil et al., 2009; Pianta and Stuhlman, 2004). Good classroom interactions have also been shown to be beneficial in fostering in students a positive attitude toward learning and the curriculum, which in turn has a favourable impact on students' academic and social achievement (Landrum, 2015).

Students who are in a negative classroom environment will not be able to acquire values such as critical thinking, creativity, mutual love, and respect (Calp, 2020; Dhillon and Kaur, 2023; Pasi, 2001; Veznedaroğlu, 2007; Vincent-Lancrin et al., 2019). It will be effective in students gaining negative personality traits, being disobedient, being prone to violence, etc., which are not included in the official curriculum (Veznedaroğlu, 2007). In addition, the emotions that students experience will be negative. Negative achievement emotions including boredom, wrath, worry, pessimism, and shyness will have a detrimental effect on academic progress (Pekrun et al., 2011).

Student-to-student relationships are another facet of the interactions that occur in the classroom. These interactions can affect students' learning processes, and their feelings and thoughts related to the school and the course. The quality of this interaction will also be effective in acquiring values such as love, respect and tolerance expected from students in official programs (Veznedaroğlu, 2007). Competition in a classroom environment with negative interaction characteristics will lead students to show disrespect and be intolerant to them (Çengel, 2008; Veznedaroğlu, 2007). Since these students will negatively affect the classroom atmosphere, it will also affect the emotions students experience in that environment and cause them to have negative emotions in general. According to related studies, creating strong connections helps adolescents succeed academically and rise their aspirations to participate in school-related activities (Wentzel, 1997; Wentzel et al., 2004). The factors that have an impact on student-teacher interaction are stated as the teacher who is full of love, respect and compassion, the teacher who is democratic and fair, the teacher who is patient and understanding, the teacher who knows the student and the teacher who uses body language effectively (Davis et al., 2006). These environments are the

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classroom environment where instructional processes are carried out and the teaching content is presented to the students and the in-school environment (canteen, corridor, gym, school garden, etc.) where interactions within the implicit program develop between students and teachers, and social media and various activities where interactions outside the school take place (sports competitions, scientific activities, etc.).

To evaluate the interaction of teacher-student, a variety of scales have been created. These scales are shown in Table 1.

Table 1.
Teacher-Student Interaction Scales Prepared from The Student's Perspective

Name of scale	*Author*	*Number of items*	*Number of subdimensions*	*Sub-dimensions*
Teacher Interaction Scale	Wubbes and Levy (Wubbels and Levy, 1991)	77	8	Leadership, Helpful/Friendly, Understanding, Student Freedom/Responsibility, Uncertainty, Dissatisfaction, Advising and Strict
Relatedness Questionnaire	Lynch and Cicchetti (Lynch and Cicchetti, 1997)	17	2	Emotional quality Psychological convergence
Classroom Communication Level Determination Scale	Bayraktutan (2008)	31	3	Factors that facilitate communication in the classroom Factors that make communication in the classroom difficult Non-classroom factors of classroom interaction

From Table 1, Wubbes and Levy (Wubbels and Levy, 1991) created a model of interpersonal behaviour in teachers that has eight items and two key dimensions. Based on this model, Wubbes and Levy developed the "Teacher Interaction Scale" to demonstrate interpersonal behaviour. The Teacher interaction scale has been adapted to 15 languages (Fraser and Walberg, 2006). The adaptation form to Turkish culture is by Telli et al (Telli et al., 2007).

Lynch and Cicchetti (Lynch and Cicchetti, 1997) prepared a two-dimensional scale called "relatedness questionnaire" consisting of 17 items. The dimensions of this scale are emotional quality and seeking psychological convergence. Another scale prepared from the student's perspective was prepared by Bayraktutan (Bayraktutan, 2008). To assess the degree of communication in the classroom, a scale of 31 components and three sub-dimensions was developed by Bayraktutan. The scale consists of three dimensions: factors that facilitate in-class communication, factors that make in-class communication difficult, and out-of-class factors of in-class interaction.

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In addition to these studies, there is a five-point Likert-type teacher-student interaction scale designed to evaluate students' interactions with their teachers in an online environment (Xu, 2016). This scale has six sub-dimensions: "amount of interaction, form of interaction, distance of interaction, content of interaction, duration of interaction, and motivation for interaction."

The student-teacher interaction scale was created by Pianta and Steinberg (Pianta and Steinberg, 1992) to determine how teachers felt about their interactions with particular students. Fraire et al. (Fraire et al., 2013) translated the scale into Italian. Additionally, Settanni et al. (Settanni et al., 2015) translated this scale into Italian, while Patrício et al. (Patrício et al., 2015) translated it into Portuguese. Additionally, a brief form of the scale was created for Portuguese (Patrício et al., 2015).

The most crucial component of student-teacher interaction is determined by the traits of the pupils. Self-regulation abilities, responsibility, and the student's perspective on learning are a few of these traits (Englehart, 2009; Harper, 2018; Pianta, 2015). An overall assessment of these studies indicates that taking into account teacher-student interaction from the viewpoint of the students is crucial. In this context, looking at the interaction from the student's point of view will produce a better outcome than looking at it from the teacher's. Additionally, the study's scope considers the affective, physiological, and motivational traits of the students. This is one of the important issues for this study because no prior study considers these dimensions before. Besides, this new scale tries to identify the teacher-student interactions in three different learning environments, and this provides a broad view for interactions between student and teacher, and no prior studies have taken this into account before. Another significant factor is that no prior study of this kind has been done with high school students. All these new insights provide a new perspective from the high school students' view.

Method

This study aims to create a measurement instrument that can assess teacher-student interaction with demonstrated validity and reliability. During the research process, the researcher followed ethical principles and ethics committee permission was taken before the study. It first applied to Anadolu University Social and Humanities Scientific Research and Publication Ethics Board in October 2021, and ethics committee permission was taken from Anadolu University in the same month.

Participants

Participants in this study came from two different groups. Explanatory factor analysis (EFA) was utilized for the data collected from the first group, while confirmatory factor analysis (CFA) was used for the data collected from the second group.

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EFA Participants

A convenient sampling procedure was employed. Since the aim of scale to evaluate the interactions between student and interaction in high school level, while defining the sample high school students were selected. Data were gathered in Anatolian high schools in Sivas. The survey included 346 students enrolled in four distinct Anatolian High Schools. Table 2 displays demographic data pertaining to the study participants.

Tablo 2.
Demographic Information of the Students

		f	%	$\bar{x}$
Age				15.82
Gender	Male	116	33.5	
	Female	230	66.5	
Grade	9th grade	61	17.6	
	10th grade	77	22.3	
	11th grade	60	17.3	
	12th grade	148	42.8	
	Total	346	100	

The students' average age is 15.82. 116 of the students are male (33.5%) and 230 are female (66.5%). 61 (17.6%) of the students are 9th-grade students, 77 (22.3%) are 10th-grade students, 60 (17.3%) are 11th-grade students and 148 (42.8%) are 12th-grade students.

DFA Participants

To perform confirmatory factor analysis, data were collected in Anatolian high schools located in the city of Sivas. While collecting data, schools different from those from which data were collected for EFA were preferred. 394 students participated in the study. Table 3 displays the students' demographic data who took part.

Tablo 3.
Demographic Information about the Students

		f	%	$\bar{x}$
Age				15.57
Gender	Male	214	54.3	
	Female	180	45.7	
Grade	9th grade	113	28.7	
	10th grade	59	15	
	11th grade	129	32.7	
	12th grade	93	23.6	
	Total	394	100	

The study participants' average age is 15.57 years old. 214 of them are male (54.3%) and 180 are female (45.7%). 113 (28.7%) of the students are 9th-grade students, 59 (15%) are 10th-grade students, 129 (32.7%) are 11th-grade students and 93 (23.6%) are 12th-grade students.

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Scale development process

A five-step process was used when developing the measurement tool (DeVellis, 2016). These stages are presented below:

- Literature review to reveal what is intended to be measured through the scale.
- Evaluating current scales and interviewing educators and learners to generate an item pool.
- Taking professional advice to guarantee the scale items' construct validity.
- Submitting the scale items to expert opinion in terms of language and structure for face validity.
- Conducting a pilot study and conducting validity and reliability studies

The literature review was done and the scales measuring teacher-student interactions were investigated. After this process, it was seen that the scales in literature were not prepared for a distinct area as in-class, out of class and out of school. Besides this, the subdimensions in the scales not related to affective, motivational and physiological, but both these subdimensions and the environments are important during the teacher-student interaction process. Thus, it was thought that a new scale needs to be developed consisting of these three different settings and sub-dimensions.

The second step in developing a scale is to create an item pool. In this process, Anderson and Bourke (Anderson and Bourke, 2000) emphasized the need to include students in the item pool creation process. Focus groups with fifteen different secondary education teachers and twenty-five secondary school students were conducted for this reason. For this purpose, open-ended questions for two different groups were prepared. The interviews focused on the factors that affect or may affect the interactions. Teachers' and students' focus group interviews took place in separate sessions. As a result of the interviews, 48 different opinions affecting teacher-student interaction were reached. An item pool was then prepared. Following the researchers' examination of the original item pool for clarity, expressiveness, repeatability, and suitability for the intended use, 80 items were submitted for expert assessment. Total of eighteen academics with experience in curriculum and instruction and measurement and evaluation assessed the items. The researchers examined the reviews and evaluations, made the necessary adjustments, and ultimately created a draft 5-point Likert scale with 65 items (5-strongly agree / 1-strongly disagree). Finally, Table 4 shows the number of items.

Tablo 4.
Number of Items Based on Expert Opinions

Scales	**Sub-dimensions**			
	Affective	Motivational	Physiological	Total
IC-TSIS	11	10	5	26
IS-TSIS	6	5	7	18
OS-TSIS	5	5	11	21
Total				65

IC-TSIS= In-class teacher-student interaction scale,
IS-TSIS= In-school teacher-student interaction scale,
OS-TSIS= Out-of-school teacher-student interaction scale.

As seen in Table 4, a total of 65 items were prepared for the scale.

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Data collection

The data for this study were gathered from several participant groups in two stages. Data for EFA were collected from 346 high school students in four different high schools. CFA data was collected from 394 students in four different high schools.

Data Analysis

With SPSS 24, the KMO and Bartlett's sphericity tests were used to determine whether the data set was appropriate for EFA. To assess the accuracy of the factors produced in EFA, first and second-order CFA were performed using LISREL. Following the EFA and CFA, the Cronbach alpha reliability coefficient was calculated to assess the scale's reliability. To determine if the higher and lower 27% groups could be distinguished from one another, item correlation values and the unrelated samples t-test were employed.

Findings

To examine the validity and reliability of the scale, EFA and CFA were conducted for each sub-scale. The results of the analyses are shown below, respectively.

Exploratory factor analysis

Before proceeding with the EFA analysis, the reverse items in the scales were reverse-scored. (IC-TSIS: 4, 17, 20 and 25. items, IS-TSIS: 14 and 16. items and OS-TSIS: 1 and 17. items)

IC-TSIS EFA results

The Kaiser-Meyer Olkin (KMO) sample adequacy evaluation was used to assess if the data set was suitable for factor analysis before EFA. The study found that the sample size was sufficient for exploratory factor analysis, with a KMO value of.867 (Field, 2005; P. Kline, 1994). According to the results of the Bartlett Sphericity Test, the chi-square value was significant [$\chi 2$ =1256,768, sd=300, P<.001] (Çokluk et al., 2010; DeVellis, 2016; Field, 2005; P. Kline, 1994) (Table 5). The data was appropriate for factor analysis, as demonstrated by the statistically significant chi-square value, which also indicated that several items in the correlation matrix were highly connected. These results show that the data set was appropriate for factorization (Table 5).

Table 5.
Data Regarding the Suitability of IC-TSIS for Factor Analysis

Kaiser-Meyer-Olkin Sampling Adequacy Criterion		.867
Bartlett's Test of Sphericity	Approximate Chi-Square	1256,768
	df	300
	sig	.000

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In exploratory factor analysis, there are seven different ways to extract factors. Among them, the principal components technique was mostly used one (Büyüköztürk, 2002), and for this reason, in this study, this technique was used to determine the factor structure of IC-TSIS. As a result of the implementation of this technique, the variance ratios explained by factors with eigenvalues greater than 1 were examined with the Total Variance Explained table by the Kaiser-Guttman principle (Zwick and Velicer, 1986). When the factors with eigenvalues of 1 and greater than 1 were examined, the 5-factor structure of the scale emerged. These five factors explained 51.137% of the total variances. However, in the literature, it is emphasized that determining the number of factors cannot be done only according to the Kaiser-Guttman principle, that examining according to this principle will lead to the production of more factors than the existing factors, and therefore it is important to understand the factors theoretically (Çokluk et al., 2010; Zwick and Velicer, 1986). The research revealed that there were very few items gathered under factors other than the first two components.

Each factor's contribution to the overall variation should be considered when calculating the number of factors. According to the analysis, the first factor's eigenvalue is 6.421, and it accounts for 25.686% of the total variance explained. The second factor's eigenvalue is 2.737, and it accounts for 10.947% of the total variance explained. Apart from these factors, there are three more factors. However, the eigenvalues of these factors are 1.294, 1.218 and 1.114, respectively, and their contribution to the total variance is 5.175%, 4.874% and 4.456%, respectively. To make a more accurate decision regarding the number of factors, the scree plot, which was considered other than the eigenvalue, was examined (Figure 2).

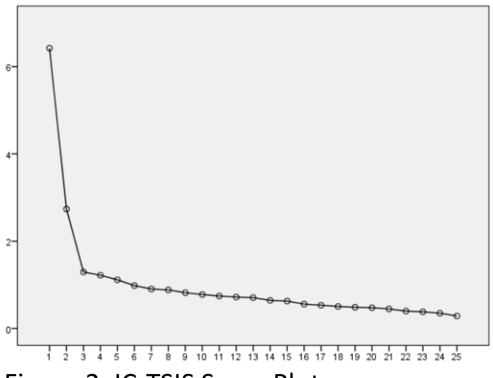

Figure 2. IC-TSIS Scree Plot

The point where the slope begins to disappear or becomes horizontal in the scree plot can be used as a criterion for determining the appropriate factor number. (Kalaycı, 2005). It is seen that the points become horizontal after the third point. For this reason, it was thought that the factor structure of IC-TSIS could be limited to two.

For the two-factor structure, it was observed that the scale items were collected in a statistically significant way under the factor structures by removing the items with low loading values and/or overlapping (loading on more than one factor). Theoretically, it was seen that the pertinent items were gathered within the aforementioned criteria. This conclusion is further supported by the scree plot, eigenvalue, and percentage contribution to total variance.

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The varimax rotation technique was used to gather the items that were significantly linked with one another in a factor and to ensure that the factor structures could be interpreted in the study of the two-factor structure of the IC-TSIS, which was made visible by the principal components technique. First of all, considering that the factor structures may not be related to each other, it was decided that it would be appropriate to use the varimax (maximum variability) technique, one of the orthogonal rotation techniques (Tabachnick and Fidell, 2007). The rotational correlation matrix revealed that factor loading was surpassed for every item .32 (Tabachnick and Fidell, 2007).

As a result of Varimax Orthogonal Rotation, some criteria have been established to identify the elements that make up the two-factor structure from the rotation components matrix. According to the adopted criteria, each item's load value must be at least .40 or higher, and the difference between an item's load value in two separate factors must be at least .20. Table 6 displays the steps taken in the EFA procedure.

Table 6.
The Method Followed When Performing EFA for A Two-Factor Structure

	Deleted item	Factor loadings	Item total correlation	Alpha after deletion	KMO after deletion	Variance after deletion
				.868	.904	52.634
1	4	.353-.355	.44	.861	.904	53.889
2	6	.420-.455	.40	.855	.903	54.828
3	25	.-494-546	.68	.863	.907	51.908
4	17	.530-.547	.60	.880	.911	52.942
5	20	.479-.555	.61	.888	.912	49.644
6	24	.-303-.339	.53	.883	.911	50.042
7	16	.427-.480	.42	.883	.910	51.096
8	23	.515-.534	.56	.878	.907	51.916
9	19	.374-.460	.38	.876	.906	53.427
10	21	.410-.528	.51	.871	.905	47.909
11	22	.300	.09	.875	.905	50.791
12	5	.316-.452	.30	.875	.906	52.966
13	7	.354-.604	.64	.867	.897	54.061
14	11	.641	.42	.856	.890	55.663

* The items shown in dark colour are the items removed from the item pool because they did not load on the expected factor.

Because they didn't fit the requirements, nine articles were removed. Five items were removed from the analysis because they did not load on the expected factors. Afterwards, the analyses were repeated. In the first version of the analysis, all items and two factors explained 38.492% variance. After the study was completed, it was found that 11 items accounted for 55.663% of the variation. This criterion demonstrated that the two-factor scale structure was sufficient for gauging teacher-student interactions in the classroom. Table 7 presents the findings of the orthogonally rotated main components analysis using the varimax approach after the items were eliminated.

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Tablo 7.
Factor Loading Values of 10 Items Of IC-TSIS

Sub-dimension	Items	Communalities	Factor Loadings	
Affective	1	.717	.857	
	2	.703	.832	
	8	.675	.709	
	3	.735	.690	
	9	.704	.661	
	10	.567	.525	
Motivational	12	.572		.783
	13	.695		.745
	14	.626		.719
	15	.606		.713
	18	.493		.524
	Variance %		42.110	13.554
	Total variance		42.110	55.663

The "affective" dimension, which has six items and accounts for 42.110% of the total variance, has factor loading values that range from .525 to .857. The elements in this dimension have common variances that range from .567 to .735. The five-item "motivational" dimension, which accounts for 13.554% of the total variance, with factor loading values ranging from .524 to. 783. The common variances of the items in this dimension vary between .493 and .695.

Item validity was examined to determine the ability to discriminate between individuals in terms of the IC-TSIS sub-dimensions and each item. Based on the difference between the 27% lower and 27% upper group averages, which were calculated using the sum and individual item scores of the scale's sub-dimensions, item testing was done using an independent samples t-test. Table 8 displays the values for the sub-dimensions.

Table 8.
t-Test Results for The Upper And Lower Group Averages of The IC-TSIS Sub-Dimensions

Sub-dimension	*Group*	*N*	*X*	*SS*	*sd*	*t*	*p*
Affective	Lower Group	90	2.81	.50	178	-26.110	.000
	Upper Group	90	4.48	.33			
Motivational	Lower Group	90	3.24	.54	178	-26.016	.000
	Upper Group	90	4.80	.15			

The study produced a significant difference ($p<0.05$) in the scale sub-dimension total scores between the top 27% and lower 27% groups, as shown in Table 8. Individuals in the lower and upper groups are distinguished by the sum scores on each of the scale's subdimensions.

IS-TSIS EFA results

The Kaiser-Meyer Olkin (KMO) sample adequacy evaluation was used to assess if the data set was suitable for factor analysis before EFA. With a KMO value of .832 for the research group, the investigation showed that there was sufficient sample size for exploratory factor analysis (Field,

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2005; P. Kline, 1994). According to the results of the Bartlett Sphericity Test, the chi-square value was significant [$\chi 2$ =1763,036, sd=136, P<.001] (Çokluk et al., 2010; DeVellis, 2016; Field, 2005; P. Kline, 1994) (Table 9). These results show that the data set was appropriate for factorization (Table 9).

Tablo 9.
Data Regarding Suitability for Factor Analysis of IS-TSIS

Kaiser-Meyer-Olkin Sampling Adequacy Criterion		.832
Bartlett's Test of Sphericity	Approximate Chi-Square	1763,036
	df	136
	sig	.000

To ascertain the factor structure of IS-TSIS, the Principal Components Analysis technique was employed in EFA. The variance ratios explained by variables with eigenvalues greater than 1 were analyzed using the Total Variance Explained table in compliance with the Kaiser-Guttman principle as a consequence of using this technique without a cycle (Zwick and Velicer, 1986). The scale's 4-factor structure became apparent when the factors with eigenvalues of 1 and higher than 1 were investigated. These four factors explained 56,340 of the total variances. The Kaiser-Guttman principle alone, however, cannot be used to determine the number of factors; doing so will result in the creation of more factors than the ones that already exist, so it is crucial to have a theoretical understanding of the factors (Çokluk et al., 2010; Zwick and Velicer, 1986). The study revealed that the items gathered under the factors other than the first three were either extremely rare or had factor loading values more than .30 in the other components.

When determining the number of factors, the contribution of each factor to the total variance should be considered. The eigenvalue of the first factor as a result of the analysis is 4.806 and its contribution to the total variance explained is 28.270%. The eigenvalue of the second factor is 2.225 and its contribution to the total variance explained is 13.090%. Apart from these factors, there are two more factors. The eigenvalues of these factors are 1.523 and 1.024, respectively, and their contribution to the total variance is 8.958% and 6.021%, respectively. When these values are examined, it is thought that the scale may have a two or three-factor structure. To make a more accurate decision, the scree plot was examined (Figure 3).

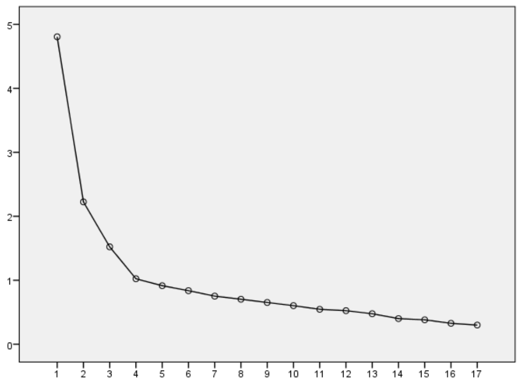

Figure 3. IS-TSIS Scree Plot

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The point where the slope begins to disappear or becomes horizontal in the scree plot can be used as a criterion in determining the appropriate factor number. (Kalaycı, 2005). The points become horizontal after the fourth point. For this reason, the factor structure of IS-TSIS could be limited to three.

By eliminating the items with low loading values and/or loading on many factors, the EFA for the assessment tool's two-factor structure revealed that the scale items were gathered statistically substantially under the factor structures. Theoretically, it was seen that the pertinent items were gathered under the relevant criteria. This conclusion is further supported by the scree plot, eigenvalue, and percentage contribution to total variance.

In the analysis of the three-factor structure of IS-TSIS, revealed by the principal components technique, the varimax rotation technique was used to enable the interpretation of the factor structures and to bring together the items that are highly correlated with each other in a factor. First of all, it was decided that it would be appropriate to use the varimax technique, one of the orthogonal rotation techniques, considering that the factor structures may not be related to each other (Tabachnick and Fidell, 2007). From the rotated correlation matrix, it was observed that all items factor loading exceeded .32 (Tabachnick and Fidell, 2007).

The items that make up the two-factor structure as a result of Varimax Orthogonal Rotation have been identified using a set of criteria derived from the rotation components matrix. It was decided that each item's load value must be at least.40 or higher, and that the load value difference between two separate components must be at least.20. Table 10 displays the EFA process steps that were completed.

Tablo 10.
The Method Followed When Performing EFA for A Two-Factor Structure

	Deleted item	Factor loadings	Item total correlation	Alpha after deletion	KMO after deletion	Variance after deletion
				.754	.832	56.340
1	3	.398-.420	.611	.738	.833	51.493
2	5	-.474-.562	.590	.719	.823	51.709
3	16	.411-.501	.588	.763	.834	52.638
4	7	.475-.482	.482	.745	.824	54.381
5	17	-.366-.442	.369	.738	.823	57.147
6	2	.382-.548	.448	.710	.813	59.659
7	1	.369-.564	.513	.677	.790	61.875
8	4	.-357-.696	.653	.639	.761	52.694
9	11	-.369	.205	.735	.752	54.493
10	14	-.439	.193	.703	.721	60.602

* The items shown in dark colour are the items removed from the item pool because they did not load on the expected factor.

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5 items in the study were deleted because they did not meet the above-mentioned criteria. The analyses were then conducted again. The analysis was rerun after the remaining five elements were eliminated since they failed to load on the anticipated criteria. Seven items explained 60.602 percent of the variance in the final version of the analysis, compared to 41.360 percent in the original version, which included all items and two factors. To quantify teacher-student interaction in a classroom setting, the two-factor scale structure proved adequate. Following the items' removal, Table 11 presents the findings of the varimax method orthogonally rotated main components analysis.

Table 11.
Factor Loading Values of 9 Items of IS-TSIS

Factor	Items	Communalities	Factor Loadings	
Motivational	Item 8	.649	.805	
	Item 9	.597	.769	
	Item 6	.529	.710	
	Item 10	.400	.632	
Physiological	Item 13	.746		.862
	Item 15	.641		.793
	Item 12	.681		.761
	Variance %		36.079	24.523
	Total variance		36.079	60.602

The factor loading values of the "motivational" dimension, which comprises four items and accounts for 36.079% of the total variance, range from .632 to .805 when Table 11 is analyzed. The items in this dimension often have variations ranging from.400 to.649. The three-item "physiological" dimension, which accounts for 24.523% of the total variance, has factor loading values that range from .761 to. 862. The components in this dimension have common variances that range from.681 to.746.

The capacity to distinguish between people based on the IS-TSIS sub-dimensions and each item was assessed by looking at item validity. Based on the difference between the 27% lower and 27% upper group averages, which were calculated using the sum and individual item scores of the scale's sub-dimensions, item testing was done in this case using an independent samples t-test. Table 12 displays the values for the sub-dimensions.

Table 12.
t-Test Results for Lower-Upper Group Averages of IS-TSIS Sub-Dimensions

Sub-dimensions	*Group*	*N*	*X*	*SS*	*sd*	*t*	*p*
Motivational	Lower Group	91	3.11	.50	180	-29.559	.000
	Upper Group	91	4.80	.19			
Physiological	Lower Group	91	1.53	.39	180	-36.281	.000
	Upper Group	91	3.72	.42			

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The analysis revealed a significant difference (p<0.05) between the lower 27% and upper 27% groups and the scale sub-dimension total scores, as shown in Table 12. Individuals in the lower and upper groups are distinguished by the sum of their scores on each of the scale's sub-dimensions.

OS-TSIS EFA results

KMO sample adequacy evaluation was used to assess if the data set was suitable for factor analysis before EFA. With a KMO value of.876 for the research group, the investigation showed that there was sufficient sample size for exploratory factor analysis (Field, 2005; P. Kline, 1994). The Bartlett Sphericity Test findings showed that the chi-square value was significant [χ2 =2526,311, sd=210, p<.001] (Çokluk et al., 2010; DeVellis, 2016; Field, 2005; P. Kline, 1994) (Table 13). The data was appropriate for factor analysis, as demonstrated by the statistically significant chi-square value, which also indicated that several items in the correlation matrix were highly connected. These results led to the conclusion that the data set was appropriate for factorization (Table 13).

Table 13.
Data Regarding Suitability for Factor Analysis of OS-TSIS

Kaiser-Meyer-Olkin Sampling Adequacy Criterion		.876
Bartlett's Sphericity Test	Approximate Chi-Square	2526,311
	df	210
	sig	.000

The factor structure of OS-TSIS was ascertained in the study using the Principal Components Analysis technique, which is frequently employed in EFA analysis. The variance ratios explained by variables with eigenvalues greater than 1 were analyzed using the Total Variance Explained table in compliance with the Kaiser-Guttman principle as a consequence of using this technique without a cycle (Zwick and Velicer, 1986). Examining the factors with eigenvalues of 1 and above revealed the scale's 5-factor structure. 51.137 percent of the variance was explained by these five factors. Examining the literature, however, highlights the fact that the Kaiser-Guttman principle alone cannot be used to determine the number of factors; doing so will result in the creation of additional factors beyond those that are already present, so it is crucial to have a theoretical understanding of the factors (Çokluk et al., 2010; Zwick and Velicer, 1986). According to the research, there were either relatively few items gathered under factors other than the first two components or the factor loading value for the other components was greater than .30.

Each factor's contribution to the overall variation should be considered when calculating the number of factors. According to the analysis, the first factor's eigenvalue is 6.519, and it accounts for 31.041% of the total variance explained. The second factor's eigenvalue is 1.871, and it accounts for 8.907% of the total variance explained. There are three other criteria in addition to these. Nevertheless, these components' respective eigenvalues are 1.539, 1.236, and 1.129, and they account for 7.330%, 5.885%, and 5.376% of the total variance, respectively. It is believed that the scale may have a two-factor structure when these values are analyzed generally. To make a more accurate decision regarding the number of factors, the scree plot, which was considered other than the eigenvalue, was examined (Figure 4).

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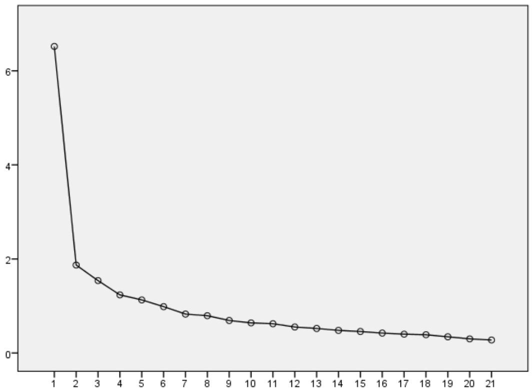

Figure 4. OS-TSIS Scree Plot

It is stated in the literature that the point where the slope begins to disappear or becomes horizontal in the scree plot can be used as a criterion in determining the appropriate factor number (Kalaycı, 2005). The graph shows that the points become horizontal after the fourth point. For this reason, according to this graph, it was thought that the factor structure of OS-TSIS could be limited to three.

By eliminating items with low loading values and/or overlap, the EFA for the assessment tool's two-factor structure revealed that the scale items were gathered in a statistically significant manner under the factor structures. Theoretically, it was seen that the pertinent items were gathered under the relevant criteria. This conclusion is further supported by the scree plot, eigenvalue, and percentage contribution to total variance.

To comprehend the factor structures and bring together the items that are highly related to one another in a factor, the varimax rotation approach was employed in the analysis of the OS-TSIS's two-factor structure, which was made visible by the main component's technique. First, given that the factor structures might not be related to one another, it was determined that the varimax technique, one of the orthogonal rotation techniques, would be suitable (Tabachnick and Fidell, 2007). Examining the rotational correlation matrix in this case revealed that factor loading was surpassed for every item .32 (Tabachnick and Fidell, 2007).

As a result of Varimax Orthogonal Rotation, some criteria have been established to identify the items that make up the two-factor structure from the rotated components matrix. The following criteria were adopted in this context: Each item must have a load value on the factor in which it is included of at least.40 or higher, and the factor loading value of an item with a load value of.40 or higher on one factor must differ by at least.20 from the load value on the other factor. Table 14 shows the steps taken in the EFA process.

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Table 14.
The Method Followed When Performing EFA for A Two-Factor Structure

	Deleted item	Factor loadings	Item total correlation	Alpha after deletion	KMO after deletion	Variance after deletion
				.824	.876	58.539
1	17	-.336-.304	.519	.845	.877	59.967
2	14	.446-.477	.618	.839	.875	60.835
3	4	-.400-.420	.495	.831	.876	61.964
4	15	.445-.422	.649	.825	.874	58.097
5	19	.359-.370	.638	.816	.876	59.135
6	13	-.360- -.377	.647	.803	.873	53.829
7	18	-.348-.401	.560	.791	.869	54.849
8	21	-438- -.422	.673	.776	.867	47.939
9	3	-.301-.659	.525	.748	.853	48.314
10	1	-.572	.403	.825	.841	49.903
11	2	.607	.414	.811	.820	51.612
12	5	.617	.387	.793	.806	53.836

* The items shown in dark colour are the items removed from the item pool because they did not load on the expected factor.

When Table 14 is examined, 8 items in the study were deleted because they did not meet the above-mentioned criteria. Four items were removed from the analysis because they did not load on the expected factors. Afterwards, the analyses were repeated. In the first version of the analysis, all items and two factors explained 39.949 percent of the variance; In the final form of the analysis, 9 items explained 53.836 percent of the variance. It was found that the two-factor scale structure was sufficient to measure teacher-student interaction outside of school. After the items were eliminated, the results of the orthogonally rotated principal component analysis using the varimax method are given in Table 15.

Table 15.
Factor Loading Values of 10 Items of OS-TSIS

Factor	Items	Communalities	Factor Loadings	
Motivational	Item 7	.679	.818	
	Item 8	.570	.753	
	Item 10	.600	.748	
	Item 6	.490	.677	
	Item 9	.440	.624	
Physiological	Item 11	.622		.763
	Item 12	.655		.727
	Item 16	.408		.619
	Item 20	.400		.543
	Variance %		39.863	13.973
	Total variance		39.863	53.836

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When Table 15 is examined, the factor loading values of the "motivational" dimension, which consists of 5 items and explains 39.863% of the total variance, vary between .624 and .818. The common variances of the items in this dimension are between .440 and .679. The factor loading values of the "physiological" dimension, which consists of 4 items and explains 13.973% of the total variance, vary between .543 and .763. The common variances of the items in this dimension vary between .400 and .622.

The capacity to distinguish between people based on the OS-TSIS sub-dimensions and each item was assessed by looking at item validity. Based on the difference between the 27% lower and 27% upper group averages, which were calculated using the sum and individual item scores of the scale's sub-dimensions, item testing was done in this case using an independent samples t-test. Table 16 displays the values for the sub-dimensions.

Table 16.
t-Test Results for Lower-Upper Group Averages of the OS-TSIS Subscales

Sub- dimension	*Group*	*N*	*X*	*SS*	*sd*	*t*	*p*
Motivational	Lower Group	90	2.39	.58	178	-28.485	.000
	Upper Group	90	4.39	.33			
Physiological	Lower Group	90	1.98	.46	178	-29. 671	.000
	Upper Group	90	3.83	.35			

The analysis revealed a significant difference ($p<0.05$) between the lower 27% and upper 27% groups and the scale sub-dimension total scores, as shown in Table 16. Individuals in the lower and upper groups are distinguished by the sum of their scores on each of the scale's sub-dimensions.

The study investigated whether there was a correlation between the three subscales' total scores and their subdimensions to determine whether the teacher-student interaction scale could be assessed using the total score. Table 17 presents the findings.

Table 17.
The correlations of subdimensions

		IC-TSIS		***IS-TSIS***	***OS-TSIS***		
Subscales	***Subdimensions***	***A***	***M***	***M***	***P***	***M***	***P***
IC-TSIS	A	1					
	M	.756**	1				
IS-TSIS	M	.748**	.855*	1			
		.442**	.431**	.518**	1		
OS-TSIS	M	.642**	.592**	.655**	.574**	1	
	P	.470**	.398**	.427**	.550**	.538**	1

p<.01, Af= Affective, Mot= Motivational, Ph= Physiological

On table 17, it is seen that there are high or moderate and positive correlations between all subdimensions of all subscales. This shows that total points can be taken from both subscales and the whole scale.

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Confirmatory factor analysis (CFA)

After the factor structure of a scale is determined, it is recommended to perform CFA to test the factor structures by collecting data from a new sample (R. B. Kline, 2011; Tabachnick and Fidell, 2007).

In data analysis, the maximum likelihood method was used as an estimator with the LISREL 8.71 package program. To use this method, it is necessary to first examine the multiple normality assumptions and multiple extreme values that may affect the research results (Harrington, 2008). In multiple normality, in addition to the univariate and bivariate distributions being normal, the distributions of all pairs of variables must be linear and homoscedastic. Kline (2016, p. 74) states that the biggest limitation of approaches testing multivariate normality (e.g., Mardia Test) is that they are affected by the number of samples, and states that examining the univariate normality and univariate outlier assumptions will help identify many of the problems related to multivariate normal distribution. Using a box plot, extreme values were examined, and 12 data were found to be extreme values and these extreme values were removed from the data set.

Mahalanobis distance is one method for identifying numerous extreme values (Esen and Timor, 2019). Mahalanobis distance was also used to analyze several extreme values, and at the.001 significance level, no extreme values were discovered that could have an impact on the results.

The univariate normality of the data distribution was examined using skewness and kurtosis values. OS-TSIS skewness values range from.12 to.90, kurtosis, IS-TSIS skewness values range from -.25 to 1.50, kurtosis values range from -1.26 to 1.87, and IC-TSIS skewness values range from.75 to 1.68, kurtosis values range from -.01 to 2.78. Its value is between -1.35 and .003. It is acknowledged that the normality assumption is satisfied because the skewness and kurtosis values are less than 3.0 and 10.0, respectively (R. B. Kline, 2011).

Two distinct models were utilized for each context (in-class, school environment, and out-of-school) when conducting CFA analysis. In Model 1, the sub-scales are examined in a two-factor structure. The factor structure of Model 2 is second-order hierarchical. In this case, the first ordinal element and the scale items are indications of physiological, motivational, and affective states, whereas the context in which the interaction occurs is the sequential factor. These two models were taken into consideration when performing CFA analyses. But not all three scales were compatible with Model 2. Using IC-TSIS, the model 1 test example is shown in Figure 5.

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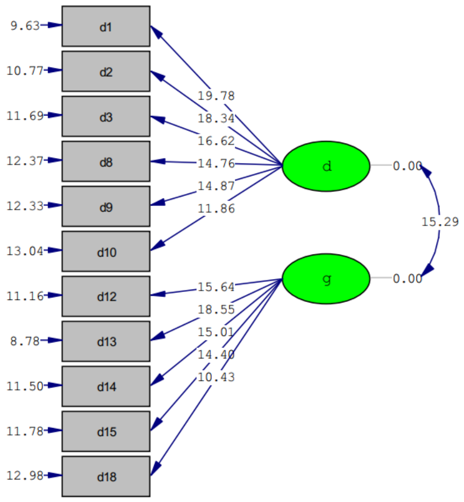

Figure 5. Model 1 for IC-TSIS

Acceptability levels for all models were evaluated with model goodness indicators. In this process, model goodness indicators and acceptability criteria suggested by the literature are given in Table 18.

Table 18.
Model Goodness Indicators Acceptability Criteria

Model Goodness Indicator	*Perfect Fit Criteria*	*Acceptable Compliance Criteria*
RMSEA	.00 ≤ RMSEA ≥ .05	.05 ≤ RMSEA ≥ .10
CFI	.95 ≤ CFI ≥ 1.00	.90 ≤ CFI ≥ .95
IFI	.95 ≤ IFI ≥ 1.00	.90 ≤ IFI ≥ .95
NNFI	.95 ≤ NNFI ≥ 1.00	.90 ≤ NNFI ≥ .95
NC	0 ≤ NC ≥ 2	2 ≤ NC ≥ 5
NFI	.95 ≤ NNFI ≥ 1.00	.90 ≤ NNFI ≥ .95
AGFI	.90 ≤ AGFI ≥ 1.00	.85 ≤ AGFI ≥ .90
GFI	.95 ≤ GFI ≥ 1.00	.90 ≤ GFI ≥ .95

Reference: (Bentler and Bonett, 1980; Çokluk et al., 2010; Jöreskog and Sörbom, 1993; R. B. Kline, 2011; Marsh et al., 1988; Şimşek, 2007; Tabachnick and Fidell, 2007; Wang and Wang, 2020a; Yılmaz and Çelik, 2009)

CFA analyses were performed for both models determined. The analysis results are presented in Table 19.

Table 19.
CFA Results for TSIS Sub-Scales

Scales	**X^2**	**df**	**NC**	**GFI**	**AGFI**	**CFI**	**RMSEA**	**IFI**	**NFI**	**NNFI**
IC-TSIS	150,09	43	3.49	.93	.90	.97	.080	.97	.96	.96
IS-TSIS	34.32	12	2,86	.95	.90	.97	.097	.97	.95	.94
OS-TSIS	102.97	26	3.96	.94	.89	.95	.094	.95	.93	.92

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CFA analysis was performed for model 1 and model 2 for IC-TSIS, and sufficient goodness of fit data was obtained for model 1, but model 2 did not work. The results revealed that, for model 1, the model goodness values were mainly within the acceptable and excellent range (Table 18).

CFA analysis was performed for model 1 and model 2 for IS-TSIS, but model 2 did not work. It was observed that the goodness of fit indicators for Model 1 were outside the value determined as the criterion. The modification suggestions produced were examined, and it was seen that they produced modifications between items 13 and item 15 for the physiological sub-dimension. After the theoretical review, it was found appropriate to make this modification and it was carried out. It was discovered that, after the adjustment, the goodness of fit values were typically in the range of acceptable to excellent (Table 17).

CFA analysis was performed for model 1 and model 2 for OS-TSIS, but model 2 did not work. It was found that the goodness of fit values obtained in Model 1 were generally between acceptable and excellent levels (Table 18).

Another important criterion in CFA analysis is the t values for the items. The calculated t-value indicates the degree to which the latent variable predicts the observed variable. The threshold level for the t value is 1.96 at a significance level of.05. At a significance level of.01, it is 2.58, and so on (Çokluk et al., 2010; Şimşek, 2007). Table 20 shows the values of the t.

Tablo 20.
t-Values That Were Acquired Using CFA

		Lowest t value	*Highest t value*
IC-TSIS	Model 1	10.43	19.78
IS-TSIS	Model 1	4.60	12.84
OS-TSIS	Model 1	4.87	16.36

Because they are higher than 2.56, the t-values for the items in this study are significant at the.01 level. According to the CFA analysis, model 1 produced more values than model 2.

Reliability

The Cronbach Alpha and Stratified Alpha values were computed to determine the TSIS's dependability. In the TSIS, "Cronbach's Alpha" was computed for three distinct settings and their subdimensions. Each sub-scale's stratified alpha value was determined. The obtained findings are shown in Table 21.

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Table 21.
TSIS Cronbach Alpha Reliability Coefficients

Sub-Scale	Sub dimensions	Cronbach Alpha	Stratified Alpha
IC-TSIS		.86	.87
	Affective	.84	
	Motivational	.78	
IS-TSIS		.74	.76
	Motivational	.75	
	Physiological	.73	
OS-TSIS		.79	.79
	Motivational	.74	
	Physiological	.71	

The Cronbach Alpha reliability coefficients, as seen in Table 19, are above .70. The data show that the scale is reliable (Büyüköztürk, 2018). Besides the Stratified Alpha was calculated for each subscale and all the reliability coefficients are above .70. This shows that the scale is reliable.

Conclusion, Discussion and Recommendations

A 5-point Likert-type tool with two sub-dimensions for three distinct environments (in-class, school environment, and out-of-school) and a total of 27 items was created as a result of the study's goal of creating a scale to measure the interaction between teacher and student. The scale is designed as modular and, depending on its intended use, the interactions of teachers and students can be measured in three different environments: in-class, in-school and out-of-school. Eleven items make up the affective and motivational sub-dimensions of IC-TSIS, seven items make up the IS-TSIS motivational and physiological sub-dimensions, and nine items make up the OS-TSIS motivational and physiological sub-dimensions. There are no reverse items in the scales. As the scores from the scales increase, teacher-student interaction will increase.

The dimensions included in the scales overlap with studies conducted in the literature on the interaction of teachers and students. For example, it is seen that the individual characteristics of teachers are important in creating a positive classroom climate (Alderman ve Green, 2011; MacNeil et al., 2009; Pianta ve Stuhlman, 2004), and as a result, they are effective in both the academic success and development of positive attitudes of students (Landrum, 2015). In addition, it has been stated in the literature that there are factors affecting student-teacher interaction such as the teacher being loving and compassionate, being democratic and fair towards students, using body language well, motivating his students, and knowing his students well (Davis et al., 2006). In addition, it is considered important to create a bond of love between the student and the teacher and to have an interaction focused on tolerance and trust (Selimhocaoğlu, 2004). Sönmez (Sönmez, 1997) stated that the teacher should value the students and make them feel that he/she loves and tolerates them through the interaction between them. Similarly, teachers' involvement in students' problems will strengthen the bond of compassion and love between them and increase the quality of the interaction between them (Landrum, 2015; McLeod et al., 2004). In addition to the literature, data obtained from focus group interviews conducted with teachers and students before the study also

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support the possibility of three different dimensions: affective, motivational, and physiological, and also provide strong evidence that interaction takes place in three different environments. In this context, it can be said that the content validity of the TSIS conducted within the scope of the research is quite high in terms of the interactional features that should be present in the teacher-student interaction process in the literature.

Strong evidence that the subscales are appropriate for usage may be found in the findings of the statistical validity and reliability analyses conducted for the TSIS. Of the overall variation, 55.66% can be explained by the two dimensions in the IC-TSIS, 60.60% by the two dimensions in the IS-TSIS, and 53.83% by the two dimensions in the OS-TSIS. Each of the subscales evaluates teacher-student interaction at an appropriate level, according to the analysis's findings.

CFA analysis was performed to test whether the three different subscales developed through exploratory factor analysis were confirmed as a model. Two different models were used for the three subscales. Model 1 looks at each environment's scale using a three-factor structure: emotive, motivational, and physiological. The factor structure of Model 2 is second-order hierarchical. In this case, the first ordinal element and the scale items are indications of physiological, motivational, and affective states, whereas the context in which the interaction occurs is the sequential factor. But not all three scales were compatible with Model 2. Therefore, Model 1 was considered. When the CFA analysis results of the scales developed for all three environments are examined, it shows that the goodness of fit indicators is generally between acceptable and excellent levels (Çokluk et al., 2010; Jöreskog and Sörbom, 1993; Wang and Wang, 2020b). These results can be considered as evidence that the factor structure obtained as a result of EFA for the three environments of TSIS is strongly confirmed.

Item validity was examined to determine the subdimensions of each subscale in the TSIS and the ability to distinguish individuals for each item. Based on the difference between the 27% lower and 27% upper group averages, which were calculated using the sum and individual item scores of the scale's sub-dimensions, item testing was done using an independent samples t-test. The analysis revealed a significant difference ($p < 0.05$) between the lower 27% and upper 27% groups, as well as between the overall scores for each dimension and item. This indicates that people in the lower and upper groups are distinguished by the dimensions of each subscale and the sum of the scores of each item.

The CFA analysis also examined the items' t values. Since the t-values were more than 2.56, they were deemed significant at the.01 level. According to the CFA analysis, model 1 produced more values than model 2.

The split-half method and Cronbach's alpha coefficient were used to assess the TSIS's dependability. The TSIS developed for the three contexts has strong internal consistency coefficients. It has been stated in the literature that an internal reliability coefficient calculated for a psychological test of .70 or above would be sufficient (Büyüköztürk, 2018). In this case, it can be said that each subscale is a reliable tool.

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Testing the validity and reliability studies of the TSIS with different techniques has made the scale development process stronger. The results of the analyses demonstrate that TSIS is a valid and reliable measurement tool that analyzes secondary school students' interactions with their teachers in three distinct situations. It also has a stable structure that can be applied to a variety of research projects.

Every subscale has modular applications. The overall score for each scale indicates how often the teacher and student interact. The in-class teacher-student interaction scale has the lowest possible score of 11, the highest possible score is 55; the in-school teacher-student interaction scale has the lowest possible score of 7, the highest possible score is 35; and the out-of-school teacher-student interaction scale has the lowest possible score of 9, the highest possible score is 45. The interaction increases with the score.

It can be used for future research to evaluate the interactions of secondary school students with their teachers. To find out how students at various learning levels of the scale interact with their teachers, validity and reliability studies can also be carried out. In addition, validity and reliability studies can be carried out by adapting it to different languages and cultures, and teacher-student interactions in different cultures can be compared with interactions in Turkish culture.

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