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DEVELOPING A SCALE TO INVESTIGATE LEARNERS' ATTITUDES TOWARDS EDUCATIONAL VIRTUAL REALITY APPLICATIONS (EdVR- AS)*

Research Paper

Melike Akçelik[1], Bahar Baran[2]

Abstract

This study describes the process of developing an attitude scale to determine middle school students' attitudes towards educational virtual reality applications. The process started with writing the test items of the scale by conducting a literature review, and then continued with a semi-structured interview with six students. Then quantitative scale development studies included two main steps. The sample of the first step of the study consisted of 850 middle school students who were let them watch videos about educational virtual reality applications or had previous experience of using virtual reality applications. As a result of Exploratory Factor Analysis (EFA), a single factor structure consisting of 18 items emerged and this structure explained 54.96% of the variance. The Cronbach Alpha coefficient was 0.95. After Confirmatory Factor Analysis (CFA), the Cronbach Alpha coefficient was 0.94. The sample of the second step of the study consisted of 26 6th grade students who have experienced educational virtual reality applications individually. Descriptive statistical methods were used in the analysis of the data obtained from this group and the Cronbach Alpha reliability coefficient was calculated to measure the reliability. The Cronbach Alpha coefficient was 0.90. The analysis results showed that the compliance statistics of the eighteen-item attitude scale was at a good level; it showed that the scale was a reliable and valid measurement tool that could be used to determine students' attitudes towards educational virtual reality applications.

Keywords: virtual reality; attitude; middle school student; scale development.

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ÖĞRENCİLERİN EĞİTSEL SANAL GERÇEKLİK UYGULAMALARINA KARŞI TUTUMLARINI ARAŞTIRMAYA YÖNELİK ÖLÇEK GELİŞTİRİLMESİ (ESG-TÖ)

Araştırma Makalesi

Öz

Bu çalışma, ortaokul öğrencilerinin eğitsel sanal gerçeklik uygulamalarına yönelik tutumlarını belirlemeye yönelik bir tutum ölçeği geliştirme sürecini anlatmaktadır. Süreç, bir literatür taraması yapılarak ölçeğin test maddelerinin yazılmasıyla başlamış, ardından altı öğrenciyle yarı yapılandırılmış görüşme ile devam etmiştir. Ölçek geliştirme çalışması iki adımdan oluşmuştur. Araştırmanın ilk adımındaki örneklem, eğitsel sanal gerçeklik uygulamaları ile ilgili videolar izletilen veya daha önce sanal gerçeklik uygulamalarını kullanma deneyimi olan 850 ortaokul öğrencisinden oluşmuştur. Açımlayıcı Faktör Analizi (AFA) sonucunda 18 maddeden oluşan tek faktörlü bir yapı ortaya çıkmıştır ve bu yapı varyansın % 54.96'sını açıklamıştır. Cronbach Alpha katsayısı 0,95'tir. Doğrulayıcı Faktör Analizi (DFA)' dan sonra Cronbach Alpha katsayısı 0,94 olarak bulunmuştur. Araştırmanın ikinci aşamasının örneklemini eğitsel sanal gerçeklik uygulamalarını bireysel olarak deneyimlemiş 6. sınıfa giden 26 öğrenci oluşturmuştur. Bu gruptan elde edilen verilerin analizinde tanımlayıcı istatistiksel yöntemler kullanılmış ve güvenilirliği ölçmek için Cronbach alfa güvenirlik katsayısı hesaplanmıştır. Cronbach Alpha katsayısı 0,90'dır. Analiz sonuçları, on sekiz maddelik tutum ölçeğinin uyum istatistiklerinin iyi düzeyde olduğunu; ölçeğin, öğrencilerin eğitsel sanal gerçeklik uygulamalarına yönelik tutumlarını belirlemede kullanılabilir güvenilir ve geçerli bir ölçme aracı olduğunu göstermiştir.

Anahtar Kelimeler: sanal gerçeklik; tutum; ortaokul öğrencisi; ölçek geliştirme.

Geniş Özet

Son yıllarda sanal gerçeklik teknolojisi ile ilgili çalışmaların artmasıyla, bu teknolojiyi bilimsel çalışmalarında konu edinen bilim insanları yöntemsel olarak geçerli ve güvenilir araç ve gereçlere ihtiyaç duymuşlardır. Literatürde sanal gerçeklik uygulamalarının farklı değişkenler üzerindeki etkisi incelenmiştir. Araştırmalarda, sanal gerçeklik kullanımının öğrencilerin akademik performans, derse olan ilgi, motivasyon ve öğrenme kalıcılığına etkisi (Aktamış & Arıcı, 2013; Gedik, 2020; Villena Taranilla, Cózar-Gutiérrez, González-Calero & López Cirugeda, 2019); öğrenme ve görev performansı (Liou, Yang, Chen & Tarng, 2017); öğrenme çıktıları ve başarı puanları (Liou & Chang, 2018), problem çözme performansları (Araiza- Alba, Keane, Chen & Kaufman, 2021) incelenmiştir. Sanal gerçeklik teknolojisi kullanımındaki tutumları inceleyen çalışmalarda, araştırmacılar tarafından hazırlanan yarı yapılandırılmış görüşme formlarının ölçme aracı olarak kullanıldığı görülmektedir. Tutumlar, olaylara veya nesnelere olumlu ve olumsuz tepki verme eğilimidir (Burns & Dobson, 1981). Tutumların bilişsel, duyuşsal ve davranışsal olmak üzere üç ana bileşenden oluştuğu kabul edilmektedir. İnceoğlu'na (2004) göre kişide tutum oluşumu, kişinin bir olay veya nesne hakkında bilgi sahibi olmasıyla başlar. Kişinin konu hakkındaki bilgisi bakış açısını olumlu etkiliyorsa bu, kişinin o konuya yönelik tutumunun da olumlu olduğunu gösterir (aktaran Tavşancıl, 2018).

Bilimsel bir çalışmada, elde edilecek verilerin doğru ve güvenilir olması için veri toplamada kullanılacak ölçme aracının geçerli ve güvenilir olması gerekir. Bu doğrultuda ortaokul öğrencilerinin eğitsel sanal gerçeklik uygulamalarına yönelik tutumlarını belirlemede kullanılabilecek güvenilir ve geçerli bir ölçeğe ihtiyaç vardır. Bu çalışmada: "Ortaokul Öğrencilerinin Eğitsel Sanal Gerçeklik Uygulamalarına Yönelik Tutum Ölçeği, ortaokul öğrencilerinin sanal gerçeklik uygulamalarına yönelik tutumlarını değerlendirmek için kullanılabilecek geçerli ve güvenilir bir ölçme aracı mıdır?" sorunun cevabı aranmıştır.

Çalışmadaki katılımcılar belirlenirken öğrencilerin sanal gerçekliği kullanma deneyimleri dikkate alınmış ve çalışma faklı gruplarla iki farklı adımda yürütülmüştür. Çalışmanın birinci adımında daha geniş bir kitleye ulaşmak için eğitsel sanal gerçeklik uygulaması "video izleme" yöntemi ile öğrenciler tarafından deneyimlenmiştir. Bunun için çeşitli platformlardan (Facebook, WhatsApp ve sınıflardaki akıllı tahtalar) öğrencilerle eğitimde kullanılan sanal gerçeklik uygulamalarını gösteren örnek bir uygulama videosu paylaşılmıştır. Çalışmanın ikinci adımında ise, eğitsel sanal gerçeklik uygulamasını “bireysel” olarak deneyimleyen öğrenciler yer almaktadır. Bu grupta yer alan her öğrenci sınıf ortamında bir kulaklık ve joystick ile eğitsel sanal gerçeklik uygulamasını kullanmıştır.

Ölçeğin deneme maddelerinin yazılması için önce konu ile ilgili literatür gözden geçirilmiş ve daha sonra bazı ölçek maddeleri araştırmacılar tarafından geliştirilmiştir. Ayrıca daha önce sanal gerçeklik uygulamalarını kullanan altı ortaokul öğrencisine sanal gerçeklik uygulamalarının resimleri gösterilmiş ve bu uygulamaların derste kullanımına ilişkin düşünceleri ile ilgili görüşmeler yapılmıştır. Öğrencilerden alınan cevaplara göre geliştirilen maddelerde bazı değişiklikler yapılmış ve yeni tutum maddeleri eklenmiştir. Böylelikle 24 maddelik bir soru soru havuzu oluşturulmuştur. Asıl uygulamadan önce her sınıf düzeyinde (5-6-7-8) bir kız ve bir erkek olmak üzere toplam sekiz öğrenci ile ölçek sorularının anlaşılabilirliği ve ölçek için gereken süre ile ilgili pilot çalışma yapılmıştır. Ölçekte yer alan soruları anlamada herhangi bir sorun yaşanmamış ve öğrencilerin ölçeği tamamlama süreleri ortalama beş dakika olarak gerçekleşmiştir. *Adım 1*'deki veriler, pilot çalışmadan iki hafta sonra öğrencilerin ana uygulamada eğitim gördükleri sınıflarda araştırmacı gözetiminde toplanmıştır. Çalışmanın ikinci bölümünde veriler, öğrencilerin eğitsel sanal gerçeklik uygulamasını bireysel olarak deneyimledikten iki hafta sonra bir sınıfta araştırmacı tarafından toplanmıştır.

Çalışmanın birinci adımından elde edilen verilerin analizinde ölçeğin geçerlilik çalışmasının yürütülmesi için verilere AFA ve DFA uygulanmış ve uzman görüşü alınmıştır. İlk olarak eğitim teknolojileri, Türkçe ve ölçme alanlarından toplam 10 uzmanın görüşleri alınmıştır. Uzman görüşleri doğrultusunda iki maddenin değerlendirme puanlarının daha düşük düzeyde olduğu ve üç maddenin de benzer şeyleri ölçtüğü gerekçesiyle toplam beş madde ölçekten çıkarılmıştır. Geriye kalan 19 maddelik ölçeğin öğrencilerin eğitsel sanal gerçeklik uygulamalarına yönelik tutumlarını ölçüp ölçemeyeceğini değerlendirmek için madde analizi yapılmıştır. Bu kapsamda ölçeğin deneme formunda yer alan her bir madde için alt % 27’lik ve üst % 27'lik gruplar belirlenmiş ve aralarındaki fark *t*-testi ile değerlendirilmiştir. Bu test, araştırmacıların en düşük puana sahip grup ile en yüksek puana sahip grup arasında en yüksek farka sahip maddeleri bulmasını sağlamıştır. Ölçekte *t* değeri 10 ve üzerinde olan maddeler daha yüksek düzeyde ayırt ediciliğe sahip oldukları için ölçeğe alınmak üzere seçilmiştir. Ölçekteki her bir maddenin kendi başına bir faktör olup olmadığını ve hangi değişkenlerin birlikte faktör oluşturduğunu anlamak için Açımlayıcı Faktör Analizi (AFA) uygulanmıştır. AFA ve DFA katılımcıları İzmir ili Buca ilçesinde bir devlet okulunda öğrenim gören 5, 6, 7 ve 8. sınıf öğrencilerinden oluşan bir gruptan basit rastgele örnekleme yöntemi

ile belirlenmiştir. Okuldaki her sınıf seviyesinde 8 şube vardır (A'dan H'ye). AFA için her sınıf seviyesindeki dört şubeden 422 öğrenci; DFA için aynı sınıf seviyesindeki farklı dört şubeden 428 öğrenci seçilmiştir.

AFA sonrası iki faktör ortaya çıkmıştır. İlk faktör yükleri 0.32 ile 0.87 arasında değişmekte olup, açıkladığı toplam varyans %54,42'dir. İkinci faktör yükleri 0,32 ile 0,49 arasında değişmekte olup, açıkladığı toplam varyans %4,96'dır. Her iki faktörde de benzer faktör yüküne sahip olan bir madde ölçek dışında tutularak AFA tekrarlanmıştır. Bu madde çıkarıldıktan sonraki AFA sonucu, faktör yüklerinin 0.60 ile 0.85 arasında olduğunu ve tek faktör tarafından açıklanan toplam varyansın %54.96 olduğunu göstermiştir. Diğer gruptan elde edilen verilere yapılan Doğrulayıcı Faktör Analizi (DFA) sonuçları, bu ölçeğin tek faktörlü modelinin verilere iyi uyduğunu doğrulamıştır. Ölçeğin son hali 18 maddeden oluşan 5'li likert tipi bir tutum ölçeğidir.

Güvenirlik çalışması için madde toplam korelasyonları ve Cronbach Alpha katsayıları incelenmiştir. Bu çalışma için madde toplam korelasyon değerleri 0,56 ile 0,82 arasında değişmektedir. Bu değerler 0.30'un altında olduğunda yorumlanamaz (Büyüköztürk, 2002; Harrington, 2009). Ancak değerler 0.30 ve üzeri ise ölçekteki maddeler ölçülmek istenen özelliği ölçebilmektedir (Green & Salkind, 2008). Cronbach Alpha katsayısı AFA' dan sonra 0,95 ve DFA' dan sonra 0,94 olarak bulunmuştur.

Çalışmanın ikinci adımında katılımcılardan elde edilen verilerin analizinde tanımlayıcı istatistiksel yöntemler kullanılmış ve güvenilirliği ölçmek için Cronbach alfa güvenirlik katsayısı hesaplanmıştır. Cronbach Alpha katsayısı 0,90'dır. Analiz sonuçları, on sekiz maddelik tutum ölçeğinin uyum istatistiklerinin iyi düzeyde olduğunu; ölçeğin öğrencilerin eğitsel sanal gerçeklik uygulamalarına yönelik tutumlarını belirlemede kullanılabilecek güvenilir ve geçerli bir ölçme aracı olduğunu göstermiştir.

Introduction

Technology which is used in education may increase interaction, provide equal opportunities among students, and motivate students (Youngblut, 1998). Thanks to technology, we may have information about places we have never seen or envisioned, or have a chance for learning by doing and experiencing events that we cannot experience daily (İnceelli, 2005). Nowadays simulation (Akdeniz, Öztürk & Bakırcı, 2017; Kim, Park, Lee, Yuk & Lee, 2001), augmented reality (Erbaş & Demirer, 2014; Koçoğlu, Akkuş & Özhan, 2018) and virtual reality (Tepe, Kaleci & Tüzün, 2016) have been very popular technologies that offer an opportunity to learn and vitalization technologies with experience. The common point of the three technologies is that they offer opportunities for living in virtual or semi-virtual environments (Akdeniz, Öztürk & Bakırcı, 2017; Emre, Selçuk, Budak, Bütün, & Şimşek, 2019).

There are different definitions of virtual reality, which is the subject of this study, in national and international literature. According to Kayabaşı (2005), virtual reality enables three-dimensional pictures and animations designed in a computer environment to give human mind a feeling of being in a real environment by using technological tools (headgear, glasses, joystick, etc.) and it is a technology that enables it to interact with objects in the environment. Somyürek (2014) defines virtual reality as the creation of a new three-dimensional and interactive virtual environment by modeling the real world in a computer environment. In this way, objects are transferred to three-dimensional environments instead

of being static and provides users an opportunity to interact. According to Azuma (1997), virtual reality completely immerses a user in an artificial environment and this user cannot see the real world items around him. According to another definition, virtual reality is a simulation in which computer graphics are used to create a virtual world that looks realistic (Burdea & Coiffet, 2003). Virtual reality is a computer-generated artificial set of images and sounds to create a simulated environment that includes auditory, visual, tactile, and other types of sensory feedback (Smutny, Babiuch & Foltynek, 2019). For Pantelidis (1993), virtual reality is a highly interactive computer-based multimedia in which a user becomes a participant in a "near real" world with a computer. Virtual reality is a computer interface that provides a high degree of immersion, reliability, and interaction to convince a user that they are in a computer-generated environment as much as possible, rather than being an outside observer (Bell & Fogler, 1995).

Virtual reality technology, which has become very popular today and is encountered in many fields, is also used in the fields of engineering, medicine, art, entertainment, military airline industry (Carruth, 2017; Huang, Rauch & Liaw, 2010; Lau & Lee, 2015; Özdemir, 2017; Radianti, Majchrzak, Fromm & Wohlgenannt, 2020; Shufelt, 2006; Tepe, Kaleci & Tüzün, 2016). Similar to these areas, the use of virtual reality technology in education has also increased. Virtual reality (VR) studies associated with experimental design, which greatly improves learning with interactive experiences and software embedded teaching methods, have revealed some important results for the use of virtual reality in education. Some of the reasons why virtual reality is preferred in educational environments are that it can provide learners with highly interactive experiences (Gökoğlu & Çakıroğlu, 2019). The use of virtual reality in the lesson has benefits such as encouraging students to creativity and participating in the lesson, increasing their motivation, moving from passive to active and helping to transfer knowledge (Araiza- Alba, Keane, Chen & Kaufman, 2021; Hu, Wu & Shieh, 2016; Liou & Chang, 2018). Virtual reality applications are very suitable for conveying difficult abstract concepts because they allow visualization (Burdea & Coiffet, 2003). While providing ideal environments to embody abstract knowledge and facilitate learning this information; Virtual reality applications can be used in areas such as geography and history. (Lei, Zhang, Wang & Rau 2018; Özdemir, 2017; Tepe, Kaleci & Tüzün, 2016). Teaching the course with a virtual reality learning environment provides students with three-dimensional visuals and rich interaction opportunities (Beas, 2016). Therefore, virtual reality technologies seem promising in that they give students the opportunity to experience real life in the classroom. Virtual reality technology adds vitality by transforming various lesson elements such as classroom, lecture, subject, concept and painting into three-dimensional by removing them from being two-dimensional static objects. Students can be a researcher experimenting with virtual reality applications in the lab, embark on a historical journey, or live on an island surrounded by three-dimensional geographic shapes. Considering these features and advantages related to virtual reality, it is important to learn the attitudes of students towards virtual reality technology that they will use individually in lessons or at home in the education system that changes according to the conditions of the period.

The increase in studies on virtual reality technology in recent years has revealed the need for scales to be used in studies using these technologies. In studies, the effect of virtual reality use on students' academic performance, interest in the course, motivation and learning persistence (Aktamış & Arıcı, 2013; Gedik, 2020; Villena Taranilla, Cózar-Gutiérrez, González-Calero, & López Cirugeda, 2019); learning and task performance (Liou, Yang, Chen, & Tarng,

2017); learning outcomes and achievement scores (Liou & Chang, 2018), problem solving performances (Araiza-Alba, Keane, Chen & Kaufman, 2021) were examined. In studies examining attitudes in using virtual reality technology, it is seen that semi-structured interview forms prepared by researchers are used as a measurement tool. Attitudes are the tendency to react positively and negatively to events or objects (Burns & Dobson, 1981). It is accepted that attitudes consist of three main components: cognitive, affective and behavioral. According to İnceoğlu (2004), the formation of an attitude in a person starts when the person has knowledge about an event or an object. If the knowledge of the person on the subject positively affects his / her point of view, this indicates that the individual's attitude towards that subject is positive (as cited Tavşancıl, 2018).

In a scientific study, the measurement tool to be used in data collection must be valid and reliable for the data to be obtained to be accurate and reliable. There is a need for a reliable and valid scale that can be used to determine middle school students' attitudes towards educational virtual reality applications in this direction. When the virtual reality attitude scale (Yeşiltaş, 2019) used in education was examined, it was determined that this scale was a rearranged version of the augmented reality attitude scale developed by another group of researchers and used in foreign language teaching. This revised attitude scale is also limited to use in the science lesson only. The related scale has some limitations in terms of reliability and validity. Children's positive attitudes towards any subject can positively affect them behaviorally and cognitively. Similarly, a virtual reality application to be used to support the lesson may affect their course success. For this reason, it was aimed to contribute to existing experimental designs by developing a valid and reliable attitude scale to measure children's attitudes towards educational virtual reality applications. In this study: "Is the Attitude Scale of Middle School Students towards Educational Virtual Reality Applications a valid and reliable measurement tool that can be used to evaluate middle school students' attitudes towards virtual reality applications?" the answer to the question has been sought.

Method

Two consecutive studies were carried out to develop a scale measuring middle school students' attitudes towards educational virtual reality. The study started with the researchers writing trial items based on literature review. After, 10 experts evaluated the items, the trial scale was developed. Attitude may be towards an existing known situation or towards a newly emerging event/ phenomenon/ technology with different factors. During the process of this research, virtual reality technology is a new technology that is not very known and experienced among secondary school students. This situation was seen as a validity threat by the researchers that the students could think about the attitudinal expressions in the scale. When other studies on the subject (Peker 2014; Aktaş, 2017; Altınbay, 2019) are examined, it is seen that the researchers carried out the study without any manipulation to the target group. In this study, educational video was used to inform students in order to prevent this disadvantageous situation. With educational video technology supported by visually rich content, it was ensured that a high number of students quickly learned SG technology, which is not possible to try individually.

At the application time of first step of this study, secondary school students' prior knowledge and experience with virtual reality were at a very low level. With the thought that they would not be able to develop an attitude to virtual reality they had not heard before, the

students who would be included as the sample of the study were shown a video about a student using educational virtual reality and also shared this video with them by social media. In this way, many students have gained prior knowledge about educational VR applications in a short time. Then trial scale was applied to them. EFA (Exploratory Factor Analysis) and CFA (Confirmatory Factor Analysis) were data analysis technics of this step. The aim of the second study, unlike the first study, was to test whether the same scale items would work with SG experienced students (Figure 1). Therefore, students who individually experienced educational VR applications related to human body and planet subjects participated to the second step of this study.

	Trial Items and Developing the Scale	Literature review Interview with 6 students 10 experts
Educational VR Attitude Scale	Step 1. Informing Participants by Presenting an Educational VR Video	→ Applying EFA & DFA n= 850 students
	Step 2. Informing Participants by Letting Them Experience Educational VR	→ Cronbach Alfa n= 26 students

Figure 1. The Process for EdVR-AS

Turkey Statistics Institute [TUIK] (2020) reported by sharing the "Proportion of Availability of Devices in Households" that people in Turkey has mostly cell phones and portable computers. The report did not indicate any data on virtual reality technology. The lack of such data indicates that virtual reality, which is a popular technology in the world, is an expensive technology due to system requirements and so there are limited people experiencing it although it is known by individuals in technology. For this reason, while determining the participants in the scale development study, students' experiences of using virtual reality were also taken into account. In *Step 1*, to reach a wider audience, it was enough to introduce educational virtual reality applications to students owing to "watching video" method. But, in *Step 2*, the researchers studied with students who individually had experienced an educational virtual reality application.

The process steps in Figure 1 are as follows:

Writing Trial Items and Developing the Scale

The literature review about scale development in similar topics helped researchers to compose a base how to proceed during test construction and writing trial items. In addition, researchers studied with six middle school students who used virtual reality applications before. The students examined some pictures of virtual reality applications to remember it and then the researchers conducted a semi-structured interviews to reveal their ideas about the use of educational virtual reality. So, after new attitude items were added and some changes has been made, the scale included 24 trial items. Ten educational technology and Measurement experts evaluated items owing to a form which aimed to evaluate whether or not the items had an understandable language they were suitable for the student level.

Step 1: Informing Participants by Presenting an Educational VR Video

Before examining students' attitudes towards educational virtual reality applications, a sample application video showing how virtual reality technology was used in education was shared with them from various platforms. First of all, a Facebook page which many students in the school followed was used to announce the video link (Figure 2). This video consisted of the movements and experiences of a student while he was using a virtual reality application about the Solar System subject. Then, another post about the video was sent to the students and their parents in WhatsApp groups to reach more participants. Finally, the researchers showed sample videos in a class environment. Students who did not come to school on the days when the sample application video was watched may not have watched the video. In addition, students who are not in their groups on WhatsApp and Facebook or who cannot access these posts may not have watched the video. It constitutes a limitation of this research.

Figure 2. Facebook Announcement About the EdVR App Video[3]

Step 2: Informing Participants by Letting Them Experience Educational VR

This step included middle school students who individually experienced educational virtual reality application by using a headset and joysticks. The researcher informed the students about the educational virtual reality applications and said that two sample applications will be used. Students used each of the educational virtual reality applications on human body and planet subjects for five minutes. Figure 3, shows one of the students using the application.

[3] The link to the video about the educational virtual reality application (https://www.youtube.com/watch?v=SYvax5EVnR4

Figure 3. A Student Using the EdVR App Individually

Study Group

Ethical report regarding the study was taken from Dokuz Eylul University. The study was conducted in two different schools in Buca, Izmir in the 2019-2020 academic year. Step 1 included students with and without VR experience (Mixed) while Step 2 included students with VR experience.

Step 1- Students with and without SG Experience (Mixed)

In the first step of the research, 5th, 6th, 7th and 8th grade students studying in a public school in Buca, Izmir are involved. There are 8 branches at each grade level in the school (A to H). The researchers used a simple random sampling method to determine participants for EFA and CFA. Four hundred and twenty-two students from four branches at each grade level (5B, 5E, 5F, 5G; 6B, 6E, 6F, 6G; 7B, 7E, 7F, 7G; 8B, 8E, 8F, 8G) for EFA; For CFA, 428 students from four different branches at the same grade level (5A, 5C, 5D, 5H; 6A, 6C, 6D, 6H; 7A, 7C, 7D, 7H; 8A, 8C, 8D, 8H) were selected (Table 1). This research tried to give the possibility of being selected equally to both study groups and compose a valid sample that represents the whole group (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2018). EFA- Study Group included 217 (51.4%) female and 205 (48.6%) male while CFA- Study Group included 218 (50.9%) female and 210 (49.1%) male. In the EFA group, there were 92 (21.8%) students from 5th level, 101 (23.9%) from the 6th level, 112 (26.6%) from 7th level and 117 (27.7%) from 8th level. In the CFA group, there were 99 (23.1%) students from 5th level, 102 (23.8%) from 6th level, 108 (25.1%) from 7th level and 119 (27.8%) from 8th level (Table 1).

Table 1. Demographics for EFA-Study Group and CFA- Study Group

	EFA-Study Group I (EFA)					**CFA-Study Group II (CFA)**				
	5th level	**6th level**	**7th level**	**8th level**	**Total**	**5th level**	**6th level**	**7th level**	**8th level**	**Total**
Female	47	48	57	65	217	55	48	58	77	218
Male	45	53	55	52	205	44	54	50	52	210
Total	92 (%21,8)	101 (%23,9)	112 (%26,6)	117 (%27,7)	**422**	99 (%23,1)	102 (%23,8)	108 (%25,1)	119 (27,8)	**428**

Step 2- Students with VR Experience

The second step of the study was carried out with 26 6th grade students in a private school in Buca, Izmir (A different school than the school in step one). VR Study Group included students 8 (30.7%) female and 18 (69.3%) male.

Collection of Data

Content validity: Expert opinions were collected to evaluate the content validity of EdVR-AS. For this, the trial scale was sent to five faculty members. They evaluated test items according to criteria "a) Suitable, b) need to be developed and c) Not suitable". The experts' study area was educational technology, Turkish language expert and Measurement. Experts evaluated the scale items according to criteria such as "a) Suitable, b) The item should be slightly revised, c) The item should be seriously revised and d) The item not suitable".

Before collecting the students' data, a pilot study was conducted with eight students, one female and one male from each grade level (5-6-7-8), and the understandability of the scale questions and the time required for the scale were determined. There was no problem in understanding the items in the scale and they completed the scale an average of five minutes.

The first step: one of the researcher went to school and collected data from students. the date collection was realized two weeks later after the pilot study.

The second step: The same researcher went to school to collect two weeks later after the students experienced the educational virtual reality application individually.

Data Analysis

Literature review: Scale development studies indicated that different analysis methods were used to ensure reliability and validity of the scale such as factor Analysis (discovery and confirmatory), expert comments, Cronbach alpha coefficient, Pearson product moment correlation coefficient, Kuder-Richardson reliability coefficients, and consistency between measurements. Similar methods were used in this study for validity and reliability studies.

The content validity: expert opinions were evaluated with the Lawshe (1975) technique and the Davis (1992) technique. The Excel program was used and the points for per item were calculated.

The first step: Item analysis, exploratory factory analysis and the Lower and Upper 27% groups have been examined by SPSS 24 software. Then, confirmatory factor analysis was conducted to test whether the theoretical structure determined in the Exploratory Factor Analysis exists in the series. In the Confirmatory Factor Analysis, maximum likelihood estimation was used and in hypothetical models, χ^2 / df, GFI (goodness of fit index), AGFI (adjusted goodness of fit index), CFI (comparative fit index), RMSEA (root mean squared error of approximation), RMR (root mean square residual) values such as residue and SRMR (standard root mean square residual) were examined. Lisrel 8.5 software was used for CFA.

The second step: While analyzing the scale scores of the second research group, descriptive statistical methods were used and the Cronbach Alpha reliability coefficient was calculated to measure the reliability.

Findings

Content Validity of EdVR-Attitude Scale

Content validity converts qualitative expert opinions into quantitative statistical data (Yurdugül, 2005). A valid scale is expected to measure intended property if the content validity had an acceptable level (Schriesheim, Cogliser, Scandura, Lankau, & Powers, 1999).

In this study, first of all, qualitative opinions were obtained from five experts working in the field of educational technologies in order to understand whether the test items in the scale properly measure the desired behaviors to be measured. The researchers evaluated the data and changed the structure of some items but none of the items were eliminated.

Then, different five expert opinions (Three educational technologies field experts, one measurement field specialist and one Turkish field specialist) were evaluated by Davis (1992) technique. Based on this technique, the experts rated the items as a) Suitable, b) The item should be slightly revised, c) The item should be seriously revised and d) The item not suitable. The content reliability index is the division of the number of experts who marked the options (a) Suitable and (b) The item should be revised slightly to the total number of experts (Yurdugül, 2005). 0.80 and over is acceptable. Two items in this study were excluded from the scale since they were at lower levels. Three items were also excluded since they measured the same things. The final version of the scale consists of 19 items with high content validity index.

Item Analysis

Item analysis was conducted to evaluate whether the 19-item "EdVR Attitude Scale" would measure secondary school students' attitudes towards educational virtual reality applications. In this context, for each item included in the trial form of the scale, the groups of 27% and upper 27% were determined and the difference between them was evaluated by t-test. This test let researchers to find items with the highest difference between the group with the lowest score and the group with the highest score. The lower and upper group means, standard deviations, values and probability values of the items included in the scale are presented in Table 2.

The item was used in the scale because the items with a t-value of 10 and above had a high level of discrimination. Among EdVR AS items, the lowest t value was 12.21 and the highest t value was 22.60.

Table 2. The Results of the Independent Samples T-test Between the Lower 27% and Upper 27% Groups of the Scale

No	Items	Group	n	$\underline{x}$	SS	t	sd	p
1	I am interested in the lessons in which Educational Virtual Reality (EdVR) apps are used.	Lower Upper	114 114	2,75 4,72	1,36 0,64	13,93	226	<0,05
2	I like using EdVR apps.	Lower Upper	114 114	2,90 4,90	1,23 0,35	16,65	226	<0,05
3	I don't like using EdVR apps in lessons.*	Lower Upper	114 114	2,78 4,91	1,35 0,34	16,28	226	<0,05

4	I participate more wilingly in lessons where EdVR apps are used.	Lower Upper	114 114	2,42 4,90	1,12 0,32	22,60	223	<0,05
5	I enjoy using EdVR apps in a lesson.	Lower Upper	114 114	2,63 4,89	1,22 0,37	18,86	226	<0,05
6	I dont' know how the time passes in a lesson where EdVR apps are used.	Lower Upper	114 114	2,84 4,61	1,31 0,80	12,21	226	<0,05
7	Using EdVR apps make me exciting.	Lower Upper	114 114	2,53 4,58	1,31 0,85	13,96	226	<0,05
8	EdVR apps makes the lesson fun.	Lower Upper	114 114	2,83 4,83	1,33 0,60	14,60	226	<0,05
9	It is unnecessary to use EdVR apps.*	Lower Upper	114 114	3,03 4,96	1,39 0,20	14,64	226	<0,05
10	EdVR apps allows me to learn more easily.	Lower Upper	114 114	2,42 4,75	1,11 0,52	19,92	226	<0,05
11	Thanks to EdVR apps, I understand complex topics better.	Lower Upper	114 114	2,49 4,65	1,15 0,62	17,56	226	<0,05
12	I would also like to use EdVR apps in learning outside class.	Lower Upper	114 114	2,71 4,66	1,26 0,85	13,67	226	<0,05
13	EdVR apps offer an opprtunity to experiences the places that we cannot go sightseeing.	Lower Upper	114 114	3,00 4,76	1,33 0,68	12,59	226	<0,05
14	I like to share my experiences in EdVR apps with my friends.	Lower Upper	114 114	2,68 4,55	1,25 0,81	13,39	226	<0,05
15	I remember more the topics covered using EdVR apps.	Lower Upper	114 114	2,55 4,78	1,19 0,49	18,45	226	<0,05
16	I would like EdVR apps to become widespread.	Lower Upper	114 114	2,62 4,89	1,22 0,36	19,09	225	<0,05
17	EdVR apps reduces my anxiety in the lesson.	Lower Upper	114 114	2,38 4,41	1,13 1,11	13,69	226	<0,05
18	EdVR apps in confusing for me .*	Lower Upper	114 114	2,91 4,75	1,34 0,60	13,32	226	<0,05

Construct Validity

EdVR-AS was evaluated by exploratory factor analysis (EFA) to understand whether each item was a factor on its own and which variables form factors together. Kaiser-Mayer-Olkin measure of sampling adequacy and Bartlett's Test of Sphericity ($\chi^2(153) = 4358,17$; $p=0.000$) were used to evaluate the status of data for factor analysis. KMO criterion of .96 showed a suitable rate for factor analysis when it was compared with the rate of 0.60 (Tabachnick & Fidell, 2001).

EFA results indicated two factors. The first factor loadings were ranged between 0.32 to 0.87 and the total variance explained by it was 54.42%. Second factor loadings were ranged between 0.32 to 0.49 and the total variance explained by it was 4.96%. However, M2 had a similar factor load on both factors. Therefore, M2 was excluded from the scale and the analysis was carried out again.

The last EFA indicated the factor loads were between 0.60 to 0.85 and the total variance explained by the single factor was 54.96%. The final version of the scale is a 5-point Likert-type attitude scale consisting of 18 items. The Scree Plot showing that the scale has a single factor is presented in Figure 4.

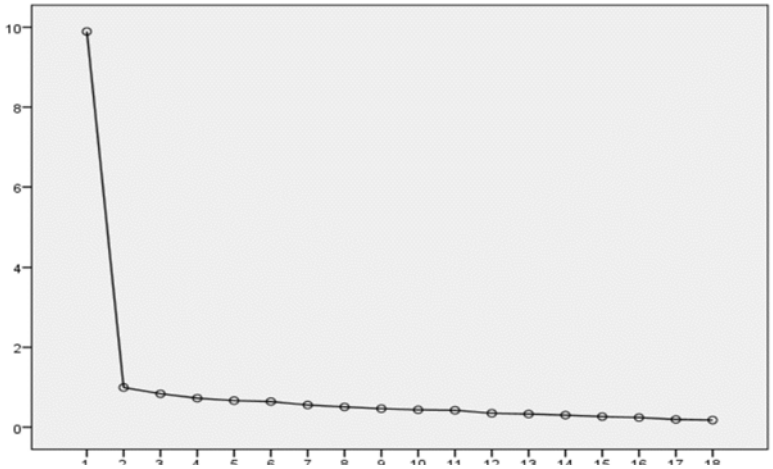

Figure 4*. The Scree Plot Indicating Single Factor*

Reliability Studies for the Data from EFA Study Group

In order to find the reliability coefficient of EdVR-AS, total statistics (item-total correlations) of items and Cronbach Alpha coefficient were examined. The item total correlation values for this study ranged from 0.56 to 0.82. These values cannot be interpreted when they are below 0.30 (Büyüköztürk, 2002; Harrington, 2009). However, if the values are 0.30 and above, the items in the scale can measure the feature desired to be measured (Green & Salkind, 2008). In addition, there are opinions in the literature that the correlation value should not be below 0.40 (Ladhari, 2010; Loiacono, Watson & Goodhue, 2002). The Cronbach Alpha coefficient was found to be 0.95.

Confirmatory Factor Analysis and Reliability Score for the Data from CFA Study Group

Confirmatory Factor Analysis was used to test the existence of the theoretical structure after determining the factor structure with the help of EFA (Lomax & Schumacker, 2004). The CFA results for this study confirmed that the single factor model was a good fit of the data. The model fit indices for one factor scale consisting of 18 items; $\chi 2 = 371.40$, $df = 132$, $\chi 2 / df = 2.81$, GFI = 0.91, AGFI = 0.89, CFI = 0.95, RMSEA = 0.06, RMR = 0.05, SRMR = 0.03 was found (Figure 3). According to Byrne (2011), in cases where the sample size for fit indices is greater than 250 and the number of observable variables is between 12 and 30; $\chi 2/df$ ratio is less than 5, GFI> 0.90 and CFI> 0.92 RMSEA <0.07; RMR and SRMR values are less than 0.08 (Hu & Bentler, 1999) points to a good fit.

The Cronbach Alpha reliability coefficient of EdVR-AS after CFA was found as 0.94.

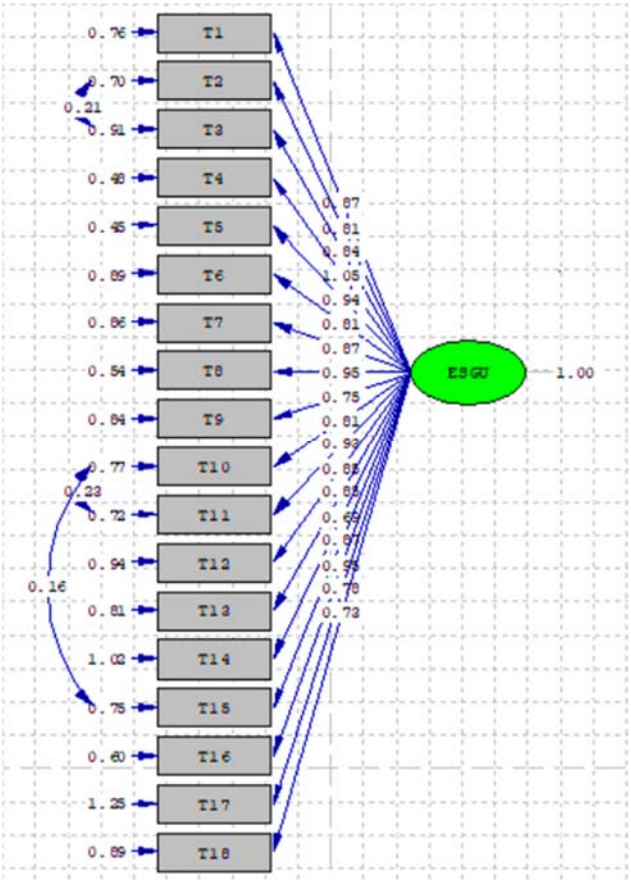

Figure 5. Path Diagram for EdVR- AS

Descriptive Analysis for EdVR-AS

Descriptive statistics such as mean, median, mode, standard deviation, variance, minimum and maximum were calculated for 26 students experiencing educational VR applications before.

Table 3. Descriptive Statistics on Item Total Scores

Mean	75.90
Median	75.50
Mode	61
Std. Deviation	10.28
Variance	105
Minimum	59
Maximum	90

The Cronbach Alpha reliability coefficient was found to be 0.90 for this group.

Conclusion

This study aimed to develop a scale to investigate middle school students' attitudes towards educational virtual reality applications (EdVR-AS). A literature review was conducted to create an item pool, and interviews were conducted with six secondary school students on the use of virtual reality applications in education. After 10 expert opinions, two items and

then three items that were thought to be similar in meaning were removed from the scale. A total of 850 students from two different groups were included in the first study group. Firstly, item analysis, EFA, and reliability analysis studies were conducted with 428 middle school students studying at a public school. After EFA, one item was removed from the scale and an attitude scale consisting of 18 items, was prepared. The scale had a single factor and this factor explained 54.96% of the variance. The Cronbach Alpha coefficient was found to be 0.95. After the CFA was conducted with another group of 422 students from the same school, the Cronbach Alpha coefficient was found to be 0.94. Later CFA results confirmed that the single factor model of this scale fits the data well.

According to the results of the descriptive statistics of the second study group in which 26 students participated, more than half of the students got a score above the average. The analyzes showed that the compliance statistics of the eighteen-item attitude scale were at a good level and the scale could be used to measure students' attitudes towards educational virtual reality applications. EdVR-AS could be used for different disciplines (mathematics, science, history, etc.) to examine students' attitudes towards educational virtual reality applications. In addition, students' educational virtual reality attitudes can be evaluated by conducting a survey study including different independent and dependent variables.

References

Akdeniz, A. R., Öztürk, M., & Bakırcı, H. (2017). Bilgisayar destekli öğretim uygulamalarının sekizinci sınıf öğrencilerinin fen dersi akademik başarılarına ve bilginin kalıcılığına etkisi. *HAYEF: Journal of Education*, *14*(2), 59-77. http://dx.doi.org/10.26650/hayef.2017.14.2.0007

Aktamış, H., & ARICI, V. (2013). Sanal gerçeklik programlarının astronomi konularının öğretiminde kullanılmasının akademik başarı ve kalıcılığa etkisi. *Mersin Üniversitesi Eğitim Fakültesi Dergisi*, *9*(2), 58-70. Retrieved from https://dergipark.org.tr/en/pub/mersinefd/issue/17383/181566?publisher=mersin-university

Aktaş, V. (2017). *Sosyal bilgiler öğretmenlerinin sanal müze kullanımına yönelik tutumları* (Yayımlanmamış yüksek lisans tezi). Marmara Üniversitesi Eğitim Bilimleri Enstitüsü: İstanbul.

Altınbay, R. (2019). *Sosyal bilgiler dersinde sanal tur kullanımının sosyal bilgiler öğretmenlerinin görüşlerine göre değerlendirilmesi* (Yayımlanmamış yüksek lisans tezi). Dokuz Eylül Üniversitesi Eğitim Bilimleri Enstitüsü: İzmir.

Araiza-Alba, P., Keane, T., Chen, W. S., & Kaufman, J. (2021). Immersive virtual reality as a tool to learn problem-solving skills. *Computers & Education*, *164*, 104121.

Azuma, R. T. (1997). A survey of augmented reality. *Presence: teleoperators & virtual environments*, *6*(4), 355-385.

Beas, D. R. (2016). Do we really need virtual reality (VR) in education? Express Computer, Retrieved from https://search.proquest.com/docview/1819231791?accountid=10527 adresinden 7 Mayıs 2019 tarihinde alınmıştır.

Bell, J. T., & Fogler, H. S. (1995). The investigation and application of virtual reality as an educational tool. In *Proceedings of the American Society for Engineering Education Annual Conference* (pp. 1718-1728).

Burdea, G. C., & Coiffet, P. (2003). *Virtual reality technology*. John Wiley & Sons.

Burns, R. B., & Dobson, C. B. (1981). Attitude measurement. In *Experimental psychology* (pp. 369-384). Springer, Dordrecht.

Büyüköztürk, Ş. (2002). Faktör analizi: Temel kavramlar ve ölçek geliştirmede kullanımı. *Kuram ve Uygulamada Eğitim Yönetimi*, *32*(32), 470-483.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2018). Bilimsel araştırma yöntemleri (24. bas.). Ankara: Pegem Yayıncılık, 82-103.

Byrne, B.M. (2011). Structural Equation Modeling with Mplus: Basic Concepts, Applications, and Programming (1st ed.). Routledge. https://doi.org/10.4324/9780203807644

Carruth, D. W. (2017), October. "Virtual reality for education and workforce training", In 2017 15th International Conference on Emerging eLearning Technologies and Applications (ICETA) (pp. 1-6). IEEE.

Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied nursing research*, *5*(4), 194-197.

Emre, İ. E., Selçuk, M., Budak, V. Ö., Bütün, M., & Şimşek, İ. (2019). Eğitim amaçlı sanal gerçeklik uygulamalarında kullanılan cihazların daldırma açısından incelenmesi. *Bilişim Teknolojileri Dergisi, 12(2),* 119-129.

Erbaş, Ç., & Demirer, V. (2014). Eğitimde artırılmış gerçeklik uygulamaları: Google Glass örneği. *Öğretim Teknolojileri ve Öğretmen Eğitimi Dergisi*, *3*(2), 8-16.

Gedik, R. (2020). Sanal gerçeklik teknolojisinin ortaokul sosyal bilgiler dersi iklimler konusunda kullanılması üzerine öğrenci görüşleri. *Sosyal Bilgilerde Yenilikçi Araştırmalar Dergisi*. *3*(1), 33-53.

Gökoğlu, S., & Çakıroğlu, Ü. (2019). Sanal gerçeklik temelli öğrenme ortamlarında bulunuşluk hissinin ölçülmesi: bulunuşluk ölçeğinin Türkçe'ye uyarlanması. *Eğitim Teknolojisi Kuram ve Uygulama*, *9*(1), 169-188.

Green, S. B. & Salkind, N. J. (2008) *Using SPSS for Windows and Macintosh* (5th ed.). Prentice Hall.

Harrington, D. (2009). *Confirmatory factor analysis*. Oxford university press.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: a Multidisciplinary Journal, 6*(1), 1-55.

Hu, R., Wu, Y. Y., & Shieh, C. J. (2016). Effects of virtual reality integrated creative thinking instruction on students' creative thinking abilities. *Eurasia Journal of Mathematics, Science and Technology Education*, *12*(3), 477-486.

Huang, H. M., Rauch, U., & Liaw, S. S. (2010). Investigating learners' attitudes toward virtual reality learning environments: Based on a constructivist approach. *Computers & Education, 55*(3), 1171-1182.

İnceelli, A. (2005). Dijital hikâye anlatımının bileşenleri. *The Turkish Online Journal of Educational Technology, 4*(3), 132- 142.

Kayabaşı, Y. (2005). Sanal gerçeklik ve eğitim amaçlı kullanılması. *The Turkish Online Journal of Educational Technology, 4(3)*, 151-158.

Kim, J. H., Park, S. T., Lee, H., Yuk, K. C., & Lee, H. (2001). Virtual reality simulations in physics education. *Interactive Multimedia Electronic Journal of Computer-Enhanced Learning*, *3*(2), 1-7.

Koçoğlu, E., Akkuş, İ., & Özhan, U. (2018). Yeni bir öğrenme ortamı olarak artırılmış gerçeklik uygulamalarıyla sosyal bilgiler öğretimi. *Alternatif Yaklaşımlarla Sosyal Bilgiler Eğitimi,* (Vol 2, 313-336): PEGEM.

Lau, K. W., & Lee, P. Y. (2015). The use of virtual reality for creating unusual environmental stimulation to motivate students to explore creative ideas. *Interactive Learning Environments*, *23*(1), 3-18.

Ladhari, R. (2010). Developing e-service quality scales: A literature review. *Journal of Retailing and Consumer Services*, *17*(6), 464-477.

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personnel Psychology, 28*(4), 563-575.

Lei, X., Zhang, A., Wang, B., & Rau, P. L. P. (2018). Can virtual reality help children learn mathematics better? The application of vr headset in children's discipline education. In *International Conference on Cross-Cultural Design* (pp. 60-69). Springer, Cham.

Liou, W. K., & Chang, C. Y. (2018). "Virtual reality classroom applied to science education", In 2018 23rd International Scientific-Professional Conference on Information Technology (IT) (pp. 1-4). IEEE.

Liou, H. H., Yang, S. J., Chen, S. Y., & Tarng, W. (2017). The influences of the 2D image-based augmented reality and virtual reality on student learning. *Journal of Educational Technology & Society*, *20*(3), 110-121.

Loiacono, E. T., Watson, R. T., & Goodhue, D. L. (2002). WebQual: A measure of website quality. *Marketing Theory and Applications, 13*(3), 432-438.

Lomax, R. G., & Schumacker, R. E. (2004). *A beginner's guide to structural equation modeling*. Psychology Press.

Özdemir, M. (2017). Sarmalayan sanal gerçeklik teknolojisi ile öğrenme deneyimleri: sistematik bir inceleme. *11. Uluslararası Bilgisayar ve Öğretim Teknolojileri Sempozyumuna Sunulmuş Bildiri.*

Pantelidis, V. S. (1993). Virtual reality in the classroom. *Educational Technology*, *33*(4), 23-27.

Peker, N. (2014). *Sosyal bilgiler dersinde sanal müze kullanımı ve sosyal bilgiler öğretmen adaylarının sanal müze kullanımına yönelik tutumları* (Yayımlanmamış yüksek lisans tezi). Aksaray Üniversitesi Sosyal Bilimler Enstitüsü: Aksaray.

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, *147*, 103778.

Shufelt Jr, J. W. (2006). *A vision for future virtual training*. Army Combined Arms Training Activity Fort Leavenworth Ks Training Simulations Devices Management Dıv.

Schriesheim, C. A., Cogliser, C. C., Scandura, T. A., Lankau, M. J., & Powers, K. J. (1999). An empirical comparison of approaches for quantitatively assessing the content adequacy of paper-and-pencil measurement instruments. *Organizational Research Methods 2*(2), 140-156.

Smutny, P., Babiuch, M., & Foltynek, P. (2019). A review of the virtual reality applications in education and training. In *2019 20th International Carpathian Control Conference (ICCC)* (pp. 1-4). IEEE.

Somyürek, S. (2014). Öğretim sürecinde z kuşağının dikkatini çekme: Artırılmış gerçeklik. *Eğitim Teknolojisi Kuram ve Uygulama*, *4*(1), 63-80.

Tabachnick, B. G., & Fidell, L. S. (2001). Principal components and factor analysis. *Using multivariate statistics*, *4*(1), 582-633.

Tavşancıl, E. (2018). Tutumların ölçülmesi ve SPSS ile veri analizi (6. basım). *Nobel Yayıncılık, Ankara*.

Tepe, T., Kaleci, D., & Tüzün, H. (2016). Eğitim teknolojilerinde yeni eğilimler: sanal gerçeklik uygulamaları. 10. Uluslararası Bilgisayar ve Öğretim Teknolojileri Sempozyumuna Sunulmuş Bildiri.

Turan, I., Şimşek, Ü., & Aslan, H. (2015). Eğitim araştırmalarında likert ölçeği ve likert-tipi soruların kullanımı ve analizi. *Sakarya Üniversitesi Eğitim Fakültesi Dergisi 30*(1), 186-203.

TUİK, (2020). "Hanelerde Bilişim Teknolojileri Bulunma Oranı" https://data.tuik.gov.tr/Kategori/GetKategori?p=bilgi-teknolojileri-ve-bilgi-toplumu-102&dil=1 adresinden 20 Nisan 2021 tarihinde alınmıştır.

Villena Taranilla, R., Cózar-Gutiérrez, R., González-Calero, J. A., & López Cirugeda, I. (2019). Strolling through a city of the Roman Empire: an analysis of the potential of virtual reality to teach history in Primary Education. *Interactive Learning Environments*, 1-11.

Yeşiltaş, H. M. (2019). *Animasyon ve sanal gerçekliğe dayalı rehber materyallerin bazı öğrenme ürünlerine etkisi: Dolaşım sistemi örneği* (Yayımlanmamış yüksek lisans tezi). Ordu Üniversitesi Fen Bilimleri Enstitüsü: Ordu.

Youngblut, C. (1998). *Educational uses of virtual reality technology* (Technical Report IDA, Document D-2128). Alexandria, VA: Institute for Defense Analyses.

Yurdugül, H. (2005). Ölçek geliştirme çalışmalarında kapsam geçerliği için kapsam geçerlik indekslerinin kullanılması. *XIV. Ulusal Eğitim Bilimleri Kongresine Sunulmuş Bildiri.*

Additional Resources

Appendix 1. Eğitsel Sanal Gerçeklik Uygulamaları Tutum Ölçeği (ESG- TÖ)

(1: Kesinlikle Katılmıyorum; 2: Katılmıyorum; 3: İki Aradayım; 4: Katılıyorum; 5: Kesinlikle Katılıyorum)

		Kesinlikle Katılmıyorum	Katılmıyorum	İki Aradayım	Katılıyorum	Kesinlikle Katılıyorum
		1	2	3	4	5
1.	Eğitsel Sanal Gerçeklik (ESG) uygulamalarının kullanıldığı derslere ilgi duyarım.					
2.	ESG uygulamalarını severek kullanırım.					
3.	Derslerde ESG uygulamalarını kullanmak istemem.*					
4.	ESG uygulamalarının kullanıldığı derslere daha istekli katılırım.					
5.	Derste ESG uygulamalarını kullanmaktan zevk alırım.					
6.	ESG uygulamalarının kullanıldığı derste zamanın nasıl geçtiğini anlamam.					
7.	ESG uygulamalarını kullanmak beni heyecanlandırır.					
8.	ESG uygulamalarını kullanmak dersi eğlenceli hale getirir.					
9.	ESG uygulamalarını kullanmak gereksizdir.*					
10.	ESG uygulamalarını kullanmak daha kolay öğrenmemi sağlar.					
11.	ESG uygulamaları sayesinde karmaşık konuları daha iyi anlarım.					
12.	ESG uygulamalarını sınıf dışı öğrenmelerimde de kullanmak isterim.					
13.	ESG uygulamaları gidip göremediğimiz yerleri deneyimleme fırsatı sunar.					
14.	ESG uygulamalarında elde ettiğim deneyimleri arkadaşlarımla paylaşmaktan hoşlanırım.					
15.	ESG uygulamaları kullanılarak işlenen konuları daha fazla hatırlarım.					
16.	ESG uygulamalarının yaygınlaşmasını isterim.					
17.	ESG uygulamalarını kullanmak dersteki kaygılarımı azaltır.					
18.	ESG uygulamalarını kullanmak kafamın karışmasına sebep olur.*					

Bu ölçek tek faktörlüdür. *' lı maddelerin ters madde olarak kodlanması gerekmektedir.

Appendix 2. Educational Virtual Reality Applications Attitude Scale (EdVR- AS)[+]

[+]The original language of the scale is Turkish. Reliability and validity studies have also been carried out on Turkish version then its use in this language. The researcher translated the scale into English by taking three expert opinions.

(1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly Agree)

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
		1	2	3	4	5
1.	I am interested in the lessons in which Educational Virtual Reality (EdVR) apps are used.					
2.	I like using EdVR apps.					
3.	I don't like using EdVR apps in lessons.*					
4.	I participate more wilingly in lessons where EdVR apps are used.					
5.	I enjoy using EdVR apps in a lesson.					
6.	I dont' know how the time passes in a lesson where EdVR apps are used.					
7.	Using EdVR apps make me exciting.					
8.	EdVR apps makes the lesson fun.					
9.	It is unnecessary to use EdVR apps.*					
10.	EdVR apps allows me to learn more easily.					
11.	Thanks to EdVR apps, I understand complex topics better.					
12.	I would also like to use EdVR apps in learning outside class.					
13.	EdVR apps offer an opprtunity to experiences the places that we cannot go sightseeing.					
14.	I like to share my experiences in EdVR apps with my friends.					
15.	I remember more the topics covered using EdVR apps.					
16.	I would like EdVR apps to become widespread.					
17.	EdVR apps reduces my anxiety in the lesson.					
18.	EdVR apps in confusing for me .*					

This scale is single factor. Items with * should be coded as reverse items.