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Development of a Scale to Evaluate Virtual Learning Environment Satisfaction

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Abstract: Recent advances in information and communication technologies (ICT) have resulted in improvements in the delivery of education. It is a well-known fact that learning technologies currently have a pivotal role in education. Amongst them, Virtual Learning Environments (VLEs) are widely used in education. The role of VLEs in improving quality and interaction in education as well as enabling better achievement through the use of a wealth of activities in teaching and learning is widely reported in the literature. However, there is a gap regarding the development of measurement instruments, especially in the Turkish context. Therefore, this study reports the development of a scale to evaluate students' satisfaction with respect to the use of VLEs in educational settings to address this gap. The dimensions of the scale are contribution (CONT), satisfaction (SAT), and communication (COM), and the scale is formed of 13 items. The sample consists of students enrolled in the Department of Computer Education and Instructional Technologies, studying on blended and face-to-face learning programs. First, the reliability of the instrument was calculated by Cronbach Alpha coefficient and test-retest reliability correlation coefficient. The Cronbach Alpha coefficients were found to be 0.87, 0.83, and 0.81 for CONT, SAT, and COM sub-dimensions respectively. The overall reliability of the scale was 0.92. EFA and CFA were conducted on the data collected from two different sample groups (206 and 186 students for EFA and CFA respectively) for the validity analyses of the scale. Results confirm that the scale is valid and reliable. While the t-test analysis shows no significant difference between gender groups, ANOVA revealed significant differences when year of study is considered.

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1. INTRODUCTION

The advances in ICT and the diffusion of the Internet have resulted in the transformation of both the construct and the functioning of educational environments virtually over the last two or three decades. Instructional technologies have witnessed a great change throughout the years, and borders of time and space are crossed by means of electronic learning systems (Raaij & Schepers, 2008), also known as virtual learning environments.

A VLE can be described as “a web-based communications platform, that allows students, without limitation of time and place, to access different learning tools, such as program information, course content, teacher assistance, discussion boards, document sharing systems,

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and learning resources” (Raaij & Schepers, 2008, p. 839). The emergence of VLEs gave new impetus to delivering subject content to learners and they are remarkably becoming part and parcel of teaching and learning process (Pituch & Lee, 2006; Raaij & Schepers, 2008).

Incorporation of VLEs into education has changed the way teaching and learning activities are implemented. Especially the interest of Higher Education Institutions (HEIs) in the deployment of VLEs has reached to new heights. Throughout the world, some HEIs currently offer certain forms of VLEs or Learning Management Systems (LMSs) such as Blackboard, Desire2-Learn, or open-source VLEs like Moodle (Rienties, Giesbers, Lygo-Baker, Ma, & Rees, 2016). The management of educational content, monitoring teaching and learning activities, empowering individuals’ learning can now all be performed in an integrated environment, and the aim of VLEs is to facilitate e-learning and provide a systematic and well planned approach to teaching and learning activities (McGill & Hobbs, 2008). With VLEs, some of the twenty-first century problems of learning and teaching can also be addressed and solved.

1.1. Review of Literature

A review of the relevant literature shows that both empirical and theoretical research on VLEs focus on several issues such as perceived usefulness of VLEs (Sun et al., 2008; Lang, Dolmans, Muijtjens, & van der Vieuten, 2006; Yilmaz, Karaman, Karakus, & Goktas, 2014), students’ attitudes (Liaw, 2008; Ogba, Saul, and Coates, 2012; Sumak, Hericko, Pusnik, & Polancic, 2011; Usta, Uysal, & Okur, 2016), perceptions of VLEs (Love & Fry, 2006), and success and motivation in blended learning environments (Unsal, 2012). The literature provides comprehensive information regarding VLEs’ use in teaching and learning processes, and presents the reasons for incorporating them into education. There is abundant research reporting the role of VLEs in improving the quality and interaction in education (Hettiarachchi & Wickramasinghe, 2016). Moreover, a considerable number of studies demonstrate that learning performance is affected positively by VLEs (McGill & Hobbs, 2008; Stricker, Weibel, Wissmath, 2011) when compared to traditional instruction (Chou & Liu, 2005; Zhang, Zhao, Zhou, & Nunamaker, 2004). Empirical evidence from the literature also suggests that VLEs have numerous benefits such as their effect on independent learning (Barker & Gossman, 2013), motivation to learn (Barker & Gossman, 2013; Forteza, Oltra, & Coy, 2015), interaction and communication among learners (Hettiarachchi & Wickramasinghe, 2016; Vuopala, Hyvönen, & Järvelä, 2016), and on student satisfaction (Forteza, Oltra, & Coy, 2015).

Besides these studies, a growing body of literature on VLEs presents data with respect to potential gender differences regarding electronic learning, distance education and VLEs (e.g. Ching & Hsu, 2015; Cutmore, Hine, Maberly, Langford, & Hawgood, 2000; Goulão, 2013; Gunn, McSporran, Macleod, & French, 2003; Horvat, Dobrota, Krsmanovic, & Cudanov, 2015; Lowes, Lin, & Kinghorn, 2016; Perkowski, 2013; Yukselturk & Bulut, 2009). Gender based differences might have an effect on the way the learners perceive VLEs, or their achievement or motivation might be affected.

In addition to potential differences among different sexes, year of study is another factor that might affect use of VLEs. It is expected that students at higher grades are more mature and experienced. Moreover, awareness of information on the Internet and age are also considered as important factors affecting learners’ performance in VLEs (Lee, Hong, & Ling, 2001). Therefore, when the fact that “the success of any virtual learning environment depends on the adequate skills and attitudes of learners” (Lee, Hong, & Ling, 2001, p. 231) is taken into consideration, it might be necessary to investigate the role of year of study. Moreover, as stated by Martins and Kellermanns (2004), “awareness of the capabilities of the system, . . ., and prior experience with computer and Web use are positively related to perceived ease of use of the system, which in turn is positively related to student acceptance of the system.” (p. 7).

As it can be seen, the incorporation of VLEs has received considerable attention from the researchers, teachers, and practitioners in the field, due to the benefits attributed to them. Nevertheless, since it is not quite possible to handle all the dimensions of VLEs, in this paper, we chose three dimensions of VLEs, which are considered amongst the critical factors in the implementation of VLEs. Therefore, in this paper, the following dimensions will be embraced: content, student satisfaction, and communication.

1.1.1. Satisfaction

Successful online teaching-learning processes, that are successful implementation of VLEs, hinge on satisfaction or dissatisfaction of users to a large extent. In a VLE, the critical factors affecting users' satisfaction can be categorized into six dimensions, which are learner, instructor, course, technology, design, and environment (Sun, Tsai, Finger, Chen, & Yeh, 2008, p. 1184). From a different point of view, Chua and Montalbo (2014) put forward four factors for users' satisfaction such as learner interface, learning community, content, and usefulness. Additionally, Wang (2003) developed a model for measuring e-learner satisfaction on asynchronous electronic learner systems including a fifth factor: *personalization*. Asoodar, Vaezi, and Izanloo (2016) developed six dimensions such as learner, instructor, course, technology, design, and the environment to improve the satisfaction of learners.

Links have been reported in the literature between VLE use and satisfaction (De Lange, Suwardy, & Mavondo, 2003; McGill & Hobbs, 2008). There are also studies demonstrating that the use of VLEs contributes to students' satisfaction when compared to students receiving traditional instruction (Chou & Liu, 2005; Koskela, Kiltti, Vilpola, & Tervonen, 2005). Hew and Kadir (2016) state that the use of VLEs would enhance student approaches to learning and may promote students' achievement by feedback, extra support, cooperative revision, and so forth. However, it should be noted that successful deployment of VLEs in HEIs depends considerably on user acceptance (Raaij & Schepers, 2008) and their satisfaction. While satisfaction is considered to have a significant relationship with online events continuance (Cheng, Wang, Huang, & Zarifis, 2016), individuals' level of satisfaction of the use of VLEs impacts the future use of those technologies (Al-Khalifa, 2009; Bell & Farrier 2008; Cheng, 2011; Lin, 2012; Sumak et al. 2011; Zafra et al. 2011). It should also be noted that when VLEs are selected appropriately for content, they support learners by providing content, and independent learning, hence increasing learners' satisfaction.

Earlier studies focused on a range of issues regarding satisfaction. To exemplify, Naveh, Tubin and Pliskin (2010) investigate the relationship between students' satisfaction and achievements when LMSs are used in teaching and learning. Lee, Srinivasan, Trail, Lewis, and Lopez (2011) examine the relationship between satisfaction, outcome, and student perception of support, and Zhu (2012) similarly investigates differences of satisfaction in different cultures. Ku, Tseng, and Akarasriworn (2013) state the importance of interaction on satisfaction. Shubina (2016) compares users' satisfaction on three different Massive Open Online Course (MOOC) platforms. There are also some other studies using instruments based on satisfaction with process and satisfaction with outcome variables (Briggs, Reinig, & de Vreede, 2008, 2014; Cheng et al., 2016; Reinig, Briggs, & de Vreede, 2009). Furthermore, the self-evaluation of students' satisfaction regarding the use of VLEs (e.g. Cassidy, 2016) is investigated in some studies.

All in all, students' satisfaction is considered as a critical element in learning environments in terms of effectiveness of the learning processes, especially of virtual learning environments.

1.1.2. Communication

In addition to their contribution to learner/user satisfaction, VLEs also promote effective communication among students (Barker & Gossman, 2013) as well as between students and

teachers (Martins & Kellermanns, 2004; Raaij & Schepers, 2008). Since borders of time and space are crossed by means of VLEs (Raaij & Schepers, 2008), the opportunities for communication are enhanced. That is, it can be stated that with VLEs, “the potential to improve communication and mutual support between students” (Leese, 2009, p. 70) is enhanced.

Numerous studies in the literature demonstrate that virtual learning environments enrich interaction and therefore communication that students have with one another in addition to the interaction between students and their instructors (Hettiarachchi & Wickramasinghe, 2016). That is, VLEs are considered to facilitate communication (Barker & Gossman, 2013).

1.1.3. Contribution

The contribution of VLEs is manifold. Several previous studies have presented results pertaining to the contribution of VLEs to the quality in education (Hettiarachchi & Wickramasinghe, 2016), students’ motivation (Beluce & Oliveria, 2015; Forteza, Oltra, & Coy, 2015) and satisfaction (Forteza, Oltra, & Coy, 2015), learning performance (McGill & Hobbs, 2008; Stricker, Weibel, Wissmath, 2011), interaction and/or communication among students, and between students and teachers (Barker & Gossman, 2013; Hettiarachchi & Wickramasinghe, 2016; Leese, 2009; Martins & Kellermanns, 2004; Raaij & Schepers, 2008), and so forth.

1.2. The Aim of the Study

In order to establish the impact of VLEs on student satisfaction of teaching and learning in higher education, this study aims to develop a valid and reliable instrument to measure the impact of VLEs on learning, focusing on satisfaction. An effective way of understanding the effectiveness of VLEs on students’ learning is through the evaluation of feedback collected from students. The collection of student feedback can best be made through a scale developed in their mother tongue and subjected to reliability and validity tests prior to its use. Furthermore, Vaz, de Bittencourt, Vaz, and Júnior (2015) contend the importance of student feedback in further improving VLEs through enhancing and developing new solutions and strategies. It is believed that measuring satisfaction of the use of VLEs would enable administrators and developers to identify the strengths and weaknesses of the systems concerned, and use these findings to further improve these systems to meet students’ needs and expectations. This is further emphasized in other studies in the literature (e.g. Eom, Wen, & Ashill, 2006; Kember & Ginns, 2012; Zerihun, Beishuizen, & Os, 2012). Finally, the report of Universities and Colleges Information System Association (2016) indicates the importance of technology enhanced learning and highlights the challenges faced by participating HEIs.

All in all, for successful deployment of VLEs, it is essential that effective instruments are developed to evaluate user satisfaction. This paper presents such a valid and reliable instrument that was developed.

1.3. The Significance of the Study

An in depth review of the literature points at several scales such as satisfaction scale toward online courses (Kolburan-Gecer & Deveci-Topal, 2015), preparedness and expectancy scale for e-learning process (Gulbahar, 2012), satisfaction scale for learning management systems (Naveh, Tubin, & Pliskin, 2010), and perception of satisfaction toward learning management systems (Horvat, Dobrota, Krsmanovic, & Cudanov, 2015).

When studies conducted in Turkish context are carefully researched, and to the best of our knowledge, there is no measurement tool to determine the satisfaction level of students in the use of VLEs. Moreover, “to measure how students and teachers are going to accept and use a specific e-learning technology or service, an appropriate instrument is needed” (Sumak, Polancic, & Hericko, 2010). This study was thereby motivated by the gap in the literature and

is considered significant for determining the satisfaction of students towards VLEs in the Turkish culture of education. Thus, learners' views towards existing systems can support the learning-teaching processes by helping institutions to improve themselves, as well as to see their strengths and weaknesses.

2. METHOD

The purpose of this study is to develop a scale on VLEs to evaluate the satisfaction of the users through gathering the opinions of Sakarya University students regarding the learning platform that they use.

2.1. Sample

The sample of this study is formed of university students ($N= 433$) studying at Sakarya University, Faculty of Education, Department of Computer and Instructional Technology Education (CITE) and Science Teaching Departments, during the 2013-2014 academic year. The participants are drawn from four different groups: The first group used for analyzing EFA consists of 206 students ($f=158, 76.7\%$; $m= 48, 23.3\%$) studying at CITE face-to-face learning program. The second group, from which confirmatory factor analysis results are obtained, consists of 186 students ($f=77, 41.4\%$; $m= 109, 58.6\%$) studying at CITE on a blended learning program. The third group consists of 10 students ($f=5, 50\%$; $m=5, 50\%$) studying at CITE, both on face-to-face and blended learning programs, used for pilot study. Finally, the fourth group consists of 31 students, of whom 11 (34%) are female and 20 (66%) were male, studying at the Department of Science Teaching, used for test-retest analysis in terms of internal consistency. The demographics of the participants are shown in Table 1:

Table 1. Demographics of participants

Participants	Variable	N	M	SD	Skewness	Kurtosis	
	Gender	F	77	49.75	7.23		
		M	109	49.69	7.09		
Participants employed for CFA		2	72	48.06	6.28	.025	-.049
	Year	3	66	48.92	7.11		
		4	48	53.27	7.23		
	Gender	F	158	55.09	9.54		
		M	48	56.23	10.28		
Participants employed for EFA		2	88	55.41	10.03	-.426	.750
	Year	3	53	54.55	10.49		
		4	65	55.94	8.64		

F: Female, M: Male

The reason behind employing students enrolled in Sakarya University was the fact that there are two types of programs in CITE Department, which involves face-to-face and blended learning environments. In both programs, Sakarya Universitesi Bilgi Sistemi (SABIS), an institution wide VLE - a course management system - from which students access lecture notes, follow course procedures, etc. is used. While students enrolled in blended learning programs use the system more actively, students studying on face-to-face programs use the system mostly for checking their grades. In blended learning programs, since only 30 percent of courses are delivered face-to-face, 70 percent of instruction is delivered via a virtual learning system. That

is, a face-to-face environment complements the virtual learning environment. Learning-teaching materials are sent to the students asynchronously (e.g. as a document, a video, a PowerPoint presentation, etc.) via the system. Besides, students in blended learning programs can also take an exam on the system.

2.2. Procedure

The study was conducted in two phases: the development of the scale, and administering and analyzing the results obtained from the scale.

2.2.1. The development of the scale

First of all, in the process of the development of a scale for evaluating the satisfaction of the students on VLEs, a theoretical basis was created by reviewing the literature. Following this step, a pool consisting of 20 items was created based on this theoretical basis. Expert opinions involving 3 field experts - one assessment and evaluation expert, one language expert and one Psychological Counselling and Guidance expert- were then elicited regarding the item pool. Following the expert opinions, some revisions were made and 2 items were omitted from the scale in light of the expert opinions, and the scale was administered for the pilot study.

The instrument was constructed and validated with the participation of pre-service teachers from Sakarya University. For the pilot study, a group of 10 people was employed in order to analyze the comprehensibility of the items. The participants were invited for a focus-group interview and the items which were not clear or comprehensible for the participants were revised. Following this step, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to establish the construct validity of the scale. A total of 3 and 2 items were omitted as a result of EFA and CFA respectively. As a result, a total of 7 items were excluded from the scale, leaving 13 items after conducting the pilot study and establishing the validity. The reliability level of the scale was examined by Cronbach alpha internal consistency and test-retest methods.

2.3. Data Collection Instrument

2.3.1. The VLE Scale

Developed within the scope of the research purpose, the VLE scale has a three-factor structure consisting of three dimensions – satisfaction (SAT), contribution (CONT), and communication (COM) - and comprises 13 items which were finalized following the validation study undertaken with the participation of pre-service teachers (see Appendix A). The scale is a 5-point Likert scale in which the options range from 1 to 5 (1 = Strongly disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, and 5 = Strongly agree). The scores taken from the scale vary from 13 to 65 at this interval. There are no reverse-scored items in the scale and students' satisfaction increases with higher scores received.

2.4. Data Analysis

Statistical analyses were conducted with SPSS 20 (Statistical Package for Social Sciences) and LISREL 8.7 (Linear Structural Relations) software programs.

3. FINDINGS

3.1. Validity of the Scale

To establish the validity of the scale, face, content, construct, convergent, and discriminant validity were explored.

3.1.1. Face and Content Validity

First of all, face and content validity were explored through expert opinions. Three field specialists from the field of Computer and Instructional Technology Education, one specialist

from the field of Measurement and Evaluation, and one Turkish language expert were consulted for appearance and coverage.

3.1.2. Construct Validity

To investigate the construct validity of the scale, EFA and CFA were conducted. Furthermore, convergent and divergent validity were established.

3.1.2.1. Exploratory Factor Analysis

The construct validity of the scale was evaluated via EFA. Before performing an exploratory factor analysis, it is necessary to determine whether the data set is suitable for factor analysis. The process for this is to perform Kaiser-Meyer-Okin (KMO) (Kaiser, 1974) and Bartlett Sphericity (Bartlett, 1954) tests. Therefore, before conducting EFA, KMO measure of sampling adequacy and Bartlett Sphericity tests were conducted. The KMO ranges from 0 to 1, and the KMO values above 0.5 are acceptable (Field, 2009). However, it is accepted that the KMO “values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are superior” (Field, 2009, p. 679, as cited in Loewen & Gonulal, 2015). The results exhibited a KMO measure of sampling adequacy of 0.92 (KMO= 0.92), a value greater than 0.70, indicating that the sample size was adequate for factor analysis (Bryman & Cramer, 1999). Bartlett test of sphericity was 1805.933 ($p < .001$, $SD=105$), indicating that a factor analysis was appropriate (Bryman & Cramer, 1999). According to these results, it can be stated that the data were fit for the factor analysis. As the scree plot of [Figure 1](#) depicts, eigenvalue-greater-than-one showed itself as a good choice in determining the optimal number of factors to retain EFA, which in case of this study is 15, and with the basic components analysis prioritized, the varimax (25) rotation was performed. The results of validity analysis demonstrated that the VLE scale had a 3 factor structure.

When the items to be included in the instrument were determined as a result of the EFA for the construct validity of the scale, it was noted that the eigenvalues of the factors constituting the scale items were 1 and above, and the factor loadings were 0.30 and above. In addition, it was also noted that the materials are included in a single factor or that there is at least a 0.10 difference between the factor loadings of the items (Buyukozturk, 2012).

Then, 3 items that were not suitable for these criteria were omitted from the scale. In addition, a rotation was performed on the factors. The results obtained from EFA indicate that there is a three-dimensional structure of the scale. These dimensions are called "Satisfaction" (SAT), "Contribution" (CONT), and "Communication" (COM). The self-scattering diagram regarding the three-dimensional structure larger than the eigenvalue of 1 is presented in [Figure 1](#) below whereas factor loadings and variance rates explained by the scale are presented in [Table 2](#).

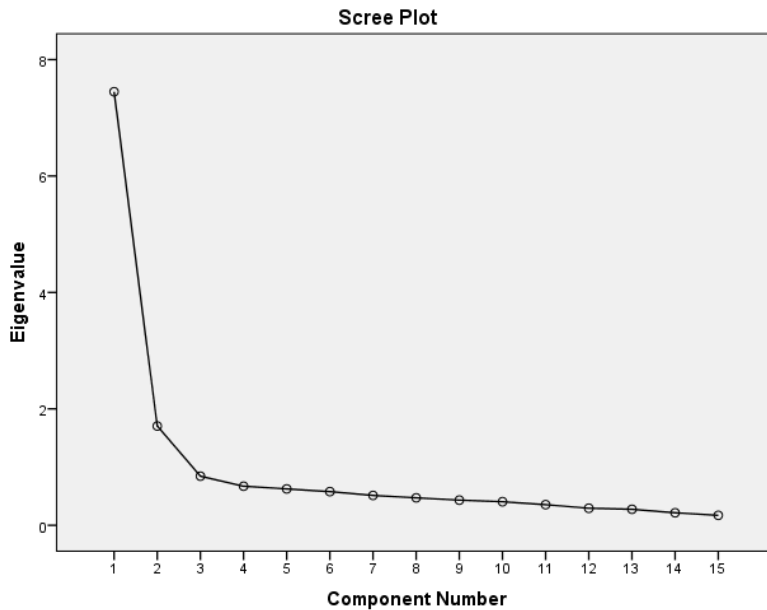


Figure 1. The graph of the eigenvalue-component number of the scale

There are a total of six items in the first factor- contribution. One of these items “I would like to use VLEs in my other courses as well” is the sample item of this factor. The factor loadings of these items on this factor vary between 0.56-0.74. This factor which explains 21.98% of the total variance of the scale is categorized as “CONT”. The second factor - satisfaction - in the scale consists of a total of five items. One of these items “I am content with the VLE used in the course” is the sample item of this factor. The factor loadings of these items on the second factor vary between 0.37 - 0.75. This factor which explains 23.59% of the total variance of the scale is named as “SAT”. The third factor – communication – in the scale consists of a total of four items. One of these items “I would recommend the use of forums for other courses as well” is a sample item of this factor. The factor loadings of these items on the third factor vary between 0.61 - 0.84. This factor which explains 21.06% of the total variance of the scale is named as “COM”.

Overall, the scale indicates a three-factor structure. The factor loadings of the 15 items in the scale on the factors vary between 0.37-0.84. Three factors in the scale explain 66.64% of the total variance. After EFA, the scale overall consists of 15 items and three factors. These values indicate that the scale explains participants’ opinion of the learning platform well. According to EFA results, the CONT sub-scale consists of 6 items and explains 21.98% of the total variance. The factor loadings of the items in the CONT sub-scale range from 0.560 to 0.704. The SAT subscale consists of 5 items and accounts for 23.59% of the total variance. The factor loadings of the items in the SAT subscale range from 0.367 to 0.747. The COM sub-scale consists of 4 items and accounts for 21.06% of the total variance. The factor loadings of the two items in the COM sub-scale are 0.605 and 0.840. The findings show that not only the scale can be used as it is but also the three-factor structure of the scale can be evaluated as three separate scales.

Table 2. The factor structure and factor loads of the scale

Factor	Item No	Items	Common Factor Variance	Factor load
CONT	2	Diğer derslerde de VLE kullanmak isterim. <i>[I would like to use VLEs in my other courses as well.]</i>	.609	.677
	3	Öğretim materyallerinin diğer derslerde VLE üzerinden sunulmasını isterim. <i>[I would like the materials of the other courses to be presented via VLE]</i>	.675	.614
	4	Öğrenme & öğretmen materyallerinin VLE üzerinden sunulması ders sürecine katkı sağlar. <i>[Presenting the learning and instruction materials via VLE contributes to the course process]</i>	.704	.628
	5	Diğer derslerde duyuruların VLE üzerinden yapılmasını öneririm. <i>[I would recommend the announcements in other courses to be made via VLE]</i>	.635	.700
	7	VLE üzerinden gönderilen mesaj yayınları öğrenme & öğretme sürecine katkı sağlar. <i>[Messages that are sent via VLE contribute to the learning and teaching process.]</i>	.638	.405
	12	Bana göre bütün derslerin VLE üzerinden sunulması gerekir. <i>[To me, all the courses should be offered via VLE]</i>	.560	.654
	Explained variance %			
SAT	6	Derste kullanılan VLE'den memnunum. <i>[I am content with the VLE used in the course]</i>	.701	.747
	8	VLE üzerinden ders kapsamında sunulan öğrenme & öğretmen materyallerinden memnunum. <i>[I am content with the learning & teaching materials presented within the course via VLE]</i>	.683	.743
	9	VLE üzerinden yayınlanan mesaj ve duyurulardan memnunum. <i>[I am content with the messages and announcements that are broadcasted via VLE]</i>	.636	.709
	10	Dersin VLE üzerinden sunumundan memnunum. <i>[I am content with the presentation of the course via VLE]</i>	.614	.581
	18	Derste VLE üzerinde kullanılan anketlerden memnunum. <i>[I am content with the questionnaires employed on VLE in the course]</i>	.767	.367
Explained variance %				23.59
COM	11	Diğer dersler için de VLE üzerinden forum kullanılmasını öneririm. <i>[I would recommend the use of forums via VLE for other courses as well]</i>	.605	.382
	14	Diğer dersler için de VLE üzerinden anket kullanılmasını öneririm. <i>[I would recommend the use of questionnaires via VLE for other courses as well]</i>	.653	.750
	16	VLE üzerinden daha fazla forum kullanılmasını isterdim. <i>[I would like to use more forums via VLE]</i>	.677	.732
	17	VLE üzerinden daha fazla anket kullanılmasını isterdim. <i>[I would like to use more questionnaires via VLE]</i>	.840	.898
Explained variance %				21.06
Total explained variance %				66.64

3.1.2.2. Confirmatory Factor Analysis (CFA)

Followed by the EFA, a confirmatory factor analysis (CFA) was conducted to verify and determine the factor structure of the scale, and the following fit indices were selected: 1) Chi-Square goodness of fit test, 2) Goodness of Fit Index (GFI), 3) Adjusted Goodness of Fit Index (AGFI) 4) Comparative Fit Index (CFI), 5) Normed Fit Index (NFI), 6) the Root Mean Square Error of Approximation (RMSEA) and 7) Standardized Root Mean Square Residual (SRMR).

In general, for indices GFI, CFI, and NFI 0.90 and 0.95 onwards represent acceptable and superior fit respectively (Bentler, 1980; Bentler & Bonett, 1980; Marsh, Hau, Artelt, Baumert & Peschar, 2006). For AGFI, a value of 0.85 indicates acceptable and a value of 0.90 indicates superior fit (Schermelleh-Engel & Moosbrugger, 2003). For RMSEA, 0.08 indicates acceptable fit and 0.05 indicates superior fit (Brown & Cudeck, 1993; Byrne & Campbell, 1999). For SRMR, the 0.05 value is considered as superior fit and the 0.10 value as acceptable fit (Schermelleh-Engel & Moosbrugger, 2003).

The structure reduced to 15 items following EFA and formed of three factors was then tested by CFA. CFA analysis was performed as first and second-level CFA (BD-CFA and ID-CFA). Factor loads for the three-dimensional model obtained from the first-order CFA are shown in Figure 2.

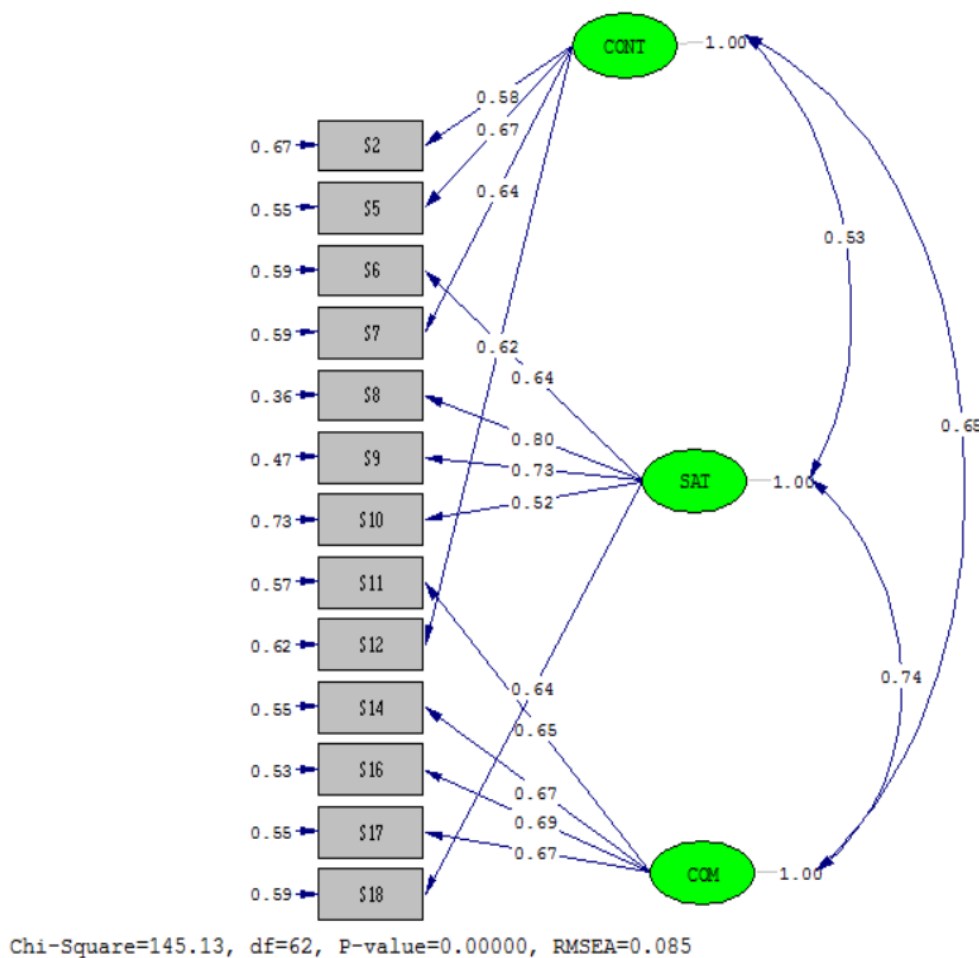


Figure 2. Path diagram and factor loadings obtained from first level CFA regarding the scale

As seen in Figure 2, the factor loadings for the CONT sub-dimension range from 0.58 to 0.67, from 0.52 to 0.80 for the SAT sub-dimension, and from 0.64 to 0.69 for the COM sub-dimension. The fit indices of the three-factor model consisting of 15 items and three sub-dimensions were examined at the first level. The standard solutions and t-values of 2 items serving for the CONT dimension were excluded on the grounds that they were not meaningful for the factor. In the first-level CFA, the items of the CONT factor were 0.58, 0.67, 0.64, and 0.62; The SAT factor was 0.64, 0.80, 0.73, 0.52, and 0.64; and the COM factor had a standard solution of 0.65, 0.67, 0.69 and 0.67, respectively. Since all the factors have a value higher than 0.45, thirteen items were important factors in terms of three factors. In addition, t values of thirteen items and three-factor structure are examined.

The t values of the items of CONT factor were 7.45, 8.84, 8.33 and 8.00; SAT factor were 9.05, 12.09, 10.69 and 7.05, and COM factor were 9.05, 9.39, 9.66 and 9.37, respectively. The calculated t values are greater than 1.96 and at 0.05 level (Jöreskog & Sörbom, 1993; Kline, 2011; Cokluk, Sekercioglu & Buyukozturk, 2012, p. 304) which are significant at the .01 level, and the number of people in the research group is at a sufficient level for factor analysis. When the correction proposal for 13 items was examined as a result of the CFA, items 3, 4, 8, and 9 were corrected. The reason for this correction can be explained as follows: If a change suggested by the correction indices corresponds to a significant decrease in the value of χ^2 of the model, and if this is the declining trend, it can be evaluated that the proposed correction is a critical change in terms of the model (Cokluk, Sekercioglu and Buyukozturk, 2012, p. 312). In addition, if more than one correction is required, these corrections must be made one at a time. The fit index of the model obtained in CFA was examined and it was found that the minimum chi-square value ($\chi^2 = 145.13$, $N = 62$, $p = 0.00$) was significant. The fit index values were RMSEA = 0.085, GFI = 0.89, AGFI = 0.84, CFI = 0.94, NFI = 0.91, and SRMR = 0.06. The superior and acceptable fit measures for the fit indices examined show that the three-factor model from the CFA is consistent and that the factor structure identified in the EFA is validated.

In addition to the first-level CFA, second-level CFA was applied to determine the extent to which the CONT, SAT, and COM subscales fit into the scale's implicit variable, which is defined as a superstructure. The analysis produced the same results as the first-level CFA, hence, it can be concluded that in terms of the model-data fit, the two models are identical, and the scale can be measured by a three-factor structure called CONT, SAT, and COM. The factor loadings for the three-dimensional model obtained from the second-level CFA are shown in Figure 3.

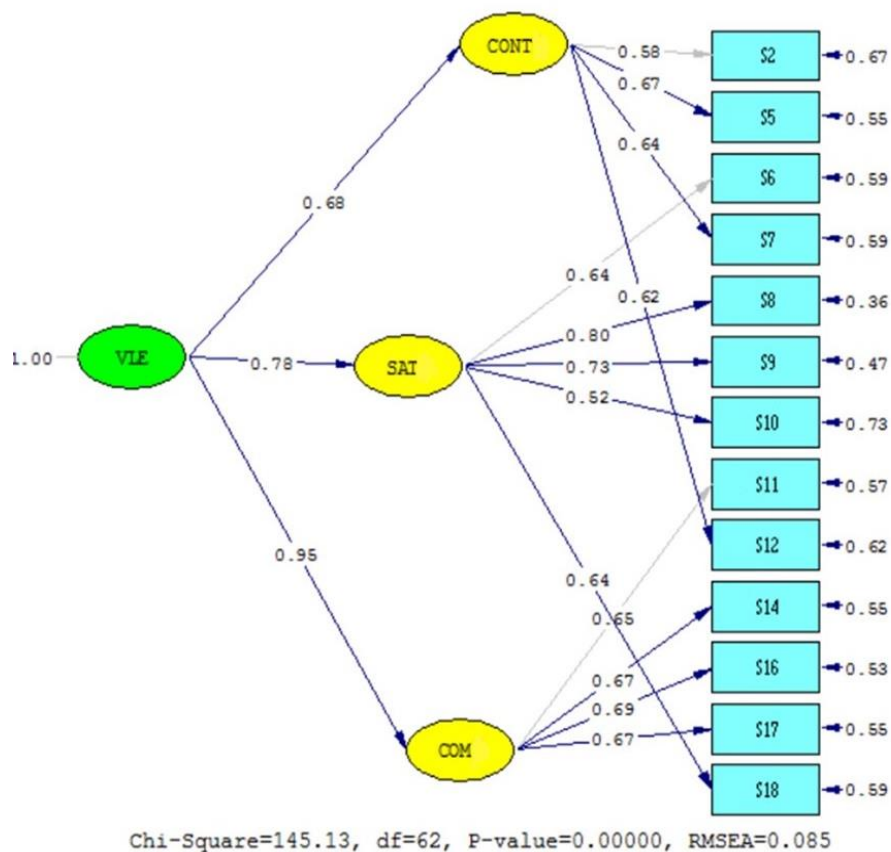


Figure 3. Path diagram and factor loads obtained from second-level CFA regarding VLES

As it can be seen in Figure 4, the factor loads for CONT, SAT and COM, defined as sub-dimensions of the scale's implicit variable, are 0.68, 0.78, and 0.95, respectively. Having a value higher than 0.45 for each and every factor of the scale, it is fair to state that these are important factors for the scale. In addition, the results of t values obtained as a result of examining the three-factor structure of the second-level CFA and the scale demonstrated that all t values were greater than 2.58, so it was statistically significant ($p < .01$). Therefore, it can be said that the CONT, SAT, and COM subscales are significant predictors of the scale's implicit variable.

In the final step, the R^2 findings were examined. Given the variances in R^2 explained above, the values for the items of the CONT factor were 0.33, 0.45, 0.41, and 0.38; the values for the items of the SAT factor were 0.41, 0.64, 0.53, 0.27, and 0.41; and the values for the items of the COM factors were 0.43, 0.44, 0.47, and 0.45 respectively. When the R^2 values of the factors in the latent variable are considered, they are 0.46, 0.61, and 0.91 respectively. The values of R^2 for the variance are above 20%, indicating that the fit indices are acceptable. The superior and acceptable fit measures for the fit indices examined in the study and the fit indices obtained from the first and second level CFA are presented in Table 3.

Table 3. Obtained fit index values

Fit Indices	Superior fit	Acceptable fit	Fit indices from first level CFA
χ^2/sd	$0 \leq \chi^2/sd \leq 2$	$0.2 \leq \chi^2/sd \leq 3$	2.34
GFI	$.95 \leq GFI \leq 1.00$	$.90 \leq GFI \leq .95$.89
AGFI	$.90 \leq AGFI \leq 1.00$	$.85 \leq AGFI \leq .90$.84
CFI	$.95 \leq CFI \leq 1.00$	$.90 \leq CFI \leq .95$.94
NFI	$.95 \leq NFI \leq 1.00$	$.90 \leq NFI \leq .95$.91
RMSEA	$.00 \leq RMSEA \leq .05$	$.05 \leq RMSEA \leq .08$.085
SRMR	$.00 \leq SRMR \leq .05$	$.05 \leq SRMR \leq .10$.067

As it can be seen from the findings given in Table 3, the fit indices obtained from the first and second level CFA are very close to each other. Accordingly, it can be said that the compatibility of both models is identical. The fit indices obtained from the first and second level CFA; the construct validity is established. It was then thought that an RMSEA of between 0.08 and 0.10 provides a mediocre fit and below 0.08 shows a good fit (MacCallum et al., 1996). In addition to all these, the total score of the scale and the individual correlation coefficients of the three factors were examined (see Table 4).

Table 4. The factor correlation values of the scale

	CONT	SAT	COM	Total
CONT	-	.42**	.48**	.75**
SAT		-	.60**	.85**
COM			-	.85**
Total				-

** $p < .01$

The correlation scores between CONT, SAT, and COM factors were 0.75, 0.85, and 0.85, respectively, with a total score from the developed scale, and a significant correlation was found between these scores ($p < 0.01$). Correlation coefficients of CONT, SAT, and COM factors were 0.42, 0.48 and 0.60, and it was also found that there was a significant correlation between these values ($p < 0.01$). The findings related to the correlation coefficient indicate that the factors comprising the scale are compatible and related. When the item total correlations are examined, it is seen that the correlation values for all the items in the scale change between

0.49 and 0.68. These values are higher than 0.30, indicating that all items can distinguish individuals at a high level (Buyukozturk, 2012).

The fit indices are observed to be at acceptable levels when the fit indices of the scale are examined. The internal consistency factors (alpha) were calculated for the reliability studies of the scale.

3.1.2.3. Convergent and Discriminant Validity

Convergent and discriminant validity were investigated for the construct validity that measures the 3 factorial structure of the VLE satisfaction scale. With respect to convergent validity, AVE values were examined for each factor [CONT(F1), SAT(F2), COM(F3)], and they were 0.72; 0.73 and 0.76 respectively. Being higher than 0.50, all these values demonstrate convergent validity (Bagozzi & Youjae, 1988), showing evidence of the VLE scale's convergent validity. On the other hand, discriminant validity of the scale was measured by calculating whether the AVE square root of the scale were greater than both the correlation among the structures and the value 0.50 (Fornell & Larcker, 1981), and the results indicated that VLE scale has discriminant validity (see Table 5).

Table 5. The coefficients of discriminant validity

	F1	F2	F3
F1	0.850		
F2	0.336	0.856	
F3	0.664	0.637	0.875

3.2. Reliability of the Scale

The reliability of the scale was calculated by internal consistency (Cronbach α) and test retest methods, for both the first and second group of the study. The results are illustrated in Table 6, and these values for the sub-dimensions and the total score of the scale can be stated as high values for the internal consistency values and the reliability factors of the scale are quite good.

Table 6. Reliability coefficients of the scale calculated by internal consistency method

Sub-scales	EFA		CFA
	Cronbach Alpha	Test-retest	Cronbach Alpha
CONT	.87	.94	.71
SAT	.83	.87	.78
COM	.81	.95	.76
The scale overall	.92	.94	.86

In the study, the internal consistency coefficient obtained from the first group of 206 students was 0.92 for the scale. Internal consistency coefficients for subscales were 0.87 for the subscale of CONT, 0.83 for the subscale of SAT, and 0.81 for the subscale of COM. The internal consistency coefficient obtained from 186 students in the second group was 0.86 for the scale. In addition, internal consistency coefficients for subscales were calculated as 0.71 for the subscale of CONT, 0.78 for the subscale of SAT, and 0.76 for the subscale of COM. In order to calculate the test retest reliability of the scale, it was administered to 31 students who

were enrolled in the Department of Computer and Instructional Technology Education twice with three weeks intervals and the correlations between the two applications were calculated. The reliability coefficients calculated by the test re-test method are 0.94 for the scale, 0.94 for the CONT subscale, 0.87 for the SAT subscale, and 0.95 for the COM subscale. Reliability coefficients of 0.70 and over are considered to be reliable (Buyukozturk, 2012; Pallant, 2005). According to this, it can be stated that the reliability coefficients of the scale and CONT, SAT, and COM subscales are appropriate.

3.3. Analysis of Scores from the Scale

The scale consists of 13 items. A 5-point Likert scale was used with responses ranging from Strongly agree (5), to Strongly disagree (1). There are no reverse-scored items in the scale. As there are 4 items in the CONT sub-dimension, the lowest score that can be taken from this dimension is 4 and the highest score is 20. There are 5 items in the SAT dimension. Therefore, the lowest score that can be taken from this dimension is 5 and the highest score is 25. Similarly, there are 4 items in the COM sub-dimension. For this reason, the lowest score that can be received from this dimension is 4 and the highest score is 20. The scale provides adequate fit indices in both first-level and second-level CFA; the scale can be used as a whole or just for the subscale. The higher the scores in subscales or overall scale indicate higher satisfaction from VLEs. Moreover, obtaining acceptable fit indices for both the first-level and second-level CFA means that it is possible to compute the scores obtained from the subscales of the scale as well as a total score on the scale.

4. CONCLUSION

As shown in Table 7, there are no significant differences between the participants' opinions on the CONT sub-dimension [$F(2,183)=2,165, p>.05$] in terms of participants' year of study. However, there are significant differences between the participants' opinions on SAT sub-dimension [$F(2,183)=8,024, p<.05$], COM sub-dimension [$F(2,183)=8,457, p<.05$] and overall Virtual Learning Environment Satisfaction [$F(2,183)=9,008, p<.05$] with respect to year of study. To investigate which groups differ from each other, a Scheffe test was performed for each of these dimensions. In the analysis, Scheffe test results revealed that there are significant differences in favor of 4th year students compared to 3rd and 2nd year students. In this case, it can be stated that 4th year students' levels of satisfaction, communication, and overall Virtual Learning Environment Satisfaction are higher than that of 3rd and 2nd year students'.

Table 7. ANOVA results based on year of study

		Sum of squares	Df	Means of squares	F	p	Significant Variation
CONT	Among groups	29.030	2	14.515	2.165	.118	no significance
	Within groups	1226.884	183	6.704			
	Total	1255.914	185				
SAT	Among groups	156.847	2	78.424	8.024	.000	4-3 and 4-2
	Within groups	1788.551	183	9.774			
	Total	1945.398	185				
COM	Among groups	126.612	2	63.306	8.457	.000	4-3 and 4-2
	Within groups	1369.952	183	7.486			
	Total	1496.565	185				
VLE overall	Among groups	843.145	2	421.572	9.008	.000	4-3 and 4-2
	Within groups	8564.753	183	46.802			
	Total	9407.898	185				

As Table 8 shows, there are no significant differences between the participants' opinions on overall Virtual Learning Environment Satisfaction [$t(.061)=184$, $p>.05$] and its sub-dimensions contribution [$t(-.362)=184$, $p>.05$], satisfaction [$t(.667)=184$, $p>.05$] and communication [$t(-.275)=184$, $p>.05$] in terms of gender variable. In this case, it can be expressed that the female and male participants' opinions on Virtual Learning Environment Satisfaction are similar to each other.

Table 8. The results of t-test based on gender differences

	Gender	N	\bar{X}	SS	df	t	p
CONT	Female	77	15.8961	2.57306	-362	184	.718
	Male	109	16.0367	2.63849			
SAT	Female	77	18.9740	3.04343	.667	184	.505
	Male	109	18.6514	3.38399			
COM	Female	77	14.8831	2.94231	-.275	184	.783
	Male	109	15.0000	2.78554			
VLE overall	Female	77	49.7532	7.23325	.061	184	.951
	Male	109	49.6881	7.09159			

5. DISCUSSION AND CONCLUSION

The results of ANOVA analysis indicate that there are no significant differences between the participants' opinions on the contribution sub-dimension while there are significant differences on satisfaction and communication sub-dimensions, and overall on Virtual Learning Environment satisfaction in terms of year of study. In this case, based on the Scheffe test, it can be stated that 4th year students' scores in satisfaction, communication, and overall Virtual Learning Environment satisfaction are higher than the 3rd and 2nd year students' opinions. The results of t-test analysis reveal that there are no significant differences between the participants' opinions on overall Virtual Learning Environment satisfaction and its sub-dimensions in terms of gender variable. In this case, it can be expressed that the female and male participants' opinions on Virtual Learning Environment Satisfaction are similar to each other. Similarly, Chua and Montalbo (2014) revealed in their study that there was no significant difference between the scores of male and female respondents in all dimensions.

The construct validity of the developed scale was examined with EFA and CFA. The KMO sample consistency coefficient (0.92) and the Barlett Sphericity test value of 1805,933 ($p < .001$, $SD = 105$) were superior fit for the data obtained from 206 students to EFA for factor analysis. In EFA, a 3-factor structure is described which accounts for 66.64% of the total variance in the principal components and varimax return results. The CONT subscale is 6, the SAT subscale is 5, and the COM subscale is 4. The CONT subscale describes 21.98% of the total variance, 23.59% of the SAT subscale total variance, and 21.06% of the COM subscale total variance. Factor loads are between 0.560 and 0.704 for the CONT subscale, 0.747 and 0.747 for the SAT subscale, and 0.605 and 0.840 for the COM subscale, respectively.

The data from 186 students were analyzed to confirm the factor structure of the scale developed with CFA. In order to demonstrate the adequacy of the model tested with CFA, the fit indices of the three factor model consisting of 15 items were examined. The standard solutions and t-values of 2 items serving for the CONT dimension were excluded on the grounds that these items were not meaningful for the factor. Moreover, when the correction proposal for thirteen items was examined with CFA, it was concluded that there was a significant decrease in chi-square value between the third and fourth items as well as the ninth and eighth items and that this might be of critical importance for the developed model (Cokluk,

Sekercioglu & Buyukozturk, 2012, p. 312). The fit indices ($\chi^2 = 145.13$, $N = 62$, $p = 0.00$), RMSEA = 0.085, GFI = 0.89, AGFI = 0.84, CFI = 0.94, NFI = 0.91, and SRMR = 0.06. Factor loads for the three-dimensional model obtained from the first-level CFA range from 0.58 to 0.67 for the CONT sub-dimension, from 0.52 to 0.80 for the SAT sub-dimension, and from 0.64 to 0.69 for the COM sub-dimension. Since all the factors have a value higher than 0.45, thirteen items were important items for the three dimensions considered. In addition, the t values of the items of CONT factor were 7.45, 8.84, 8.33, and 8.00, respectively. The same for SAT factor were 9.05, 12.09, 10.69 and 7.05, respectively; and 9.05, 9.39, 9.66 and 9.37, respectively for the COM factor. The calculated t values are greater than 1.96 and at 0.05 level (Jöreskog & Sörbom, 1993; Kline, 2011; Cokluk, Sekercioglu, & Buyukozturk, 2012, p. 304) is significant at the 0.01 level, and the number of people in the research group is at a sufficient level for factor analysis. With the first-level CFA, the number of people in the research group was at a sufficient level for factor analysis. Furthermore, the superior and acceptable fit measures for the fit indices examined show that the three-factor model from the CFA is acceptable and that the factor structure identified in the EFA is validated.

The second level CFA was used to determine the extent to which the subscales fit into the scale's implicit variable, which is defined as a superstructure. RMSEA = 0.085, GFI = 0.89, AGFI = 0.84, CFI = 0.94, NFI = 0.91, and SRMR = 0.067, respectively, as the result of the analysis ($\chi^2 = 145.13$, $N = 62$, $p = 0.00$) and these values were sufficient. The factor loads for CONT, SAT, and COM, defined as sub-dimensions of the scale implicit variable, appear to be 0.68, 0.78, and 0.95, respectively. Accordingly, it can be said that it can be measured by a three factor structure called CONT, SAT, and COM. The fit indices obtained from the first and second level CFA confirm the validity of the developed scale. In addition, all t-values were significant at 0.01 level; it was established that the CONT, SAT, and COM subscales were significant predictors of the scale implicit variable.

Jöreskog and Sörbom (1996) state that examining the R^2 values is a strong indicator of the significance of the items and factors of the scale. It turns out that the R^2 values of the items of the adapted scale are above 30% in terms of the explained variance. The 3 factors of the scale showed more than 30% variance of explanatory state fit indices on the scale.

The reliability of the scale was examined by the internal consistency coefficient (Cronbach Alpha) and test-retest methods. The internal consistency coefficient obtained from the data was 0.92 for the scale, 0.87 for the CONT subscale, 0.83 for the SAT subscale, and 0.81 for the COM subscale. 31 students from the Department of Computer and Instructional Technologies participated in the test-retest reliability analysis and the correlation value was obtained as 0.94 for the scale itself, while for the subscales CONT, SAT, and COM the same was 0.94, 0.87, and 0.95 respectively. The findings show that there is a sufficient level of reliability coefficients for all of the scale and its subscales.

Findings from the study provide evidence of the validity and reliability of the scale developed by the researchers. The increasing importance of virtual learning in educational environments today, and the lack of adequate means of measuring VLE satisfaction mean that the developed scale can be an instrument to be used in future research.

In addition to the development of an instrument, this study presents the findings of exploring students' expectations from a VLE system. Such findings will be useful for stakeholders such as instructors, managers and parents to reach key factors that will provide satisfaction in teaching.

Clearly, work presented here may have certain limitations. The first one concerns the sample of the study; the participants used for the development of the scale were drawn from a

single sample - a particular university. The reason behind employing these participants was the fact that the participants had to be experienced in using VLEs. However, it worth noting that two different groups of participants were employed during the process of scale development, and scale administration. Secondly, invariance design analysis was not conducted since the developed scale was administered to the participants drawn from the same sample, yet it is highly recommend that test of measurement invariance is conducted if the scale is going to be administered to participants from different contexts. Last but not least, the scale was originally developed in Turkish language and if this scale is going to be administered in a foreign culture, scale adaptation studies should be conducted. We hope that further studies undertake the task of creating a richer item pool, which can be followed by meetings –qualitative in nature- with students. Moreover, it should be noted that science advances cumulatively. Since technology changes constantly, so do the needs. The individuals feel satisfied when their needs are met. Therefore, further research can address the needs of the students on the basis of technological developments and the dimensions of satisfaction may further be developed.

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