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A scale for monitoring students' tendencies to ubiquitous learning environments

Öğrencilerin ulaşılabilir öğrenme ortamlarına eğilimlerini gözlemlemek için bir ölçek

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ABSTRACT

In this study, the gender-based tendencies of university students towards ubiquitous learning environments were analyzed. Within that scope, first, a tendency scale was developed. In the development process of the scale, the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted. To that end, a two-stage application process was enacted. Throughout the process, all participant data was employed in the tendency analyses which were conducted comparatively to gender. Students from different universities, 276 in the first stage and 211 students in the second stage formed a participant group consisting of a total of 487 students. At the end of the analyses, a final scale form with 20 items was developed. After the scale development process, university students' tendencies towards u-learning environments were analyzed with factor-based and item-based comparisons. it was found that, on the basis of scale total scores and sub-factor scores, the female participants displayed a significantly higher tendency towards using ubiquitous learning environments than the male participants. The comparative analysis for each of the scale item was presented in the paper.

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ÖZ

Bu çalışmada, üniversite öğrencilerinin her yerde öğrenme ortamına yönelik eğilimleri cinsiyet farklıları dikkate alınarak analiz edilmiştir. Bu kapsamda, öncelikle bir eğilim ölçeği geliştirilmiştir. Ölçeğin geliştirme sürecinde Açımlayıcı Faktör Analizi (AFA) ve Doğrulayıcı Faktör Analizi (DFA) yapılmıştır. Bu amaçla, iki aşamalı bir uygulama süreci gerçekleştirilmiştir. Süreç boyunca, cinsiyete göre karşılaştırmalı olarak yapılan eğilim analizlerinde tüm katılımcı verileri kullanılmıştır. Farklı üniversitelerden öğrenciler, birinci aşamada 276 ve ikinci aşamada 211 öğrenci olmak üzere toplam 487 öğrenciden oluşan bir katılımcı grubunu oluşturmuştur. Analizler sonunda, 20 maddelik nihai bir ölçek formu geliştirilmiştir. Ölçek geliştirme sürecinden sonra, üniversite öğrencilerinin u-öğrenme ortamlarına yönelik eğilimleri faktör bazlı ve madde bazlı karşılaştırmalar ile analiz edilmiştir. Ölçek toplam puanları ve

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alt faktör puanları bazında, kadın katılımcıların her yerde öğrenme ortamlarını kullanmaya yönelik erkek katılımcılara göre anlamlı düzeyde daha yüksek bir eğilim sergiledikleri bulunmuştur. Her bir ölçek maddesinin karşılaştırmalı analizi makalede sunulmuştur.

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INTRODUCTION

In line with the rapid consumption rate of knowledge, there has been a corresponding rise in information production rate, creating a myriad of demands for technology (Garda & Temizel, 2016). Developmental phases in information technologies have decidedly moved in constant interaction with the developments recorded in communication technologies. One of the most vital components of information technologies, which relates to the concurrent usage of knowledge and communication via the internet, has added a novel dimension to the domain of communication from the beginning. From physical letters delivered by post to the telegram and then the rotary phone, instant information was difficult to obtain. Now, however, it is feasible to use modern systems that make it possible to access places thousands of kilometers away in less than a second. The low cost of the technological tools that enable easy access to information has become a big factor in popularizing their worldwide usage (Şeker, 2005). It is now possible to easily access databases in any location on earth and to scan library archives and all kinds of information resources anytime and anywhere. Because of the removal of geographical barriers and time limits, education institutions are now able to develop flexible learning environments and practice innovative pedagogical applications (Wong, 2018).

Speed, one of the most obvious indicators of our modern age, has become more valuable in both professional life and education settings. The twenty-first-century student profile reflects a generation very different from past ones that became familiar with technology in early childhood. New habits introduced by the everyday use of smart devices are most likely to change expectations in the field of education. Through the development of new software, students are now able to acquire a customized platform to improve skills that need to be honed and improved, and, via this platform, they can perform self-directed learning and receive instant feedback. Thanks to simulations and relevant interactive software, different illustrations can now be drawn in the field of science and mathematics; thus, it becomes easier for students to grasp higher-order knowledge. By exploiting advanced simulations and account tool technology, students can find answers to various questions without being bound to pen and paper. Internet supplies the students with a vast source of information. In this setting, students can access a rich data source that offers various types of information and analyses which normally would be impossible to easily access from their physical location. Some autonomous students can master self-learning skills via utilizing types of several educational software or distance education materials. Currently, modern web-based learning environments provide the students avenues such as hypermedia and web sites that offer remote access to reach a wider network and to enjoy non-spatial usage. Such learning environments may be utilized in a range of formats including mobile learning, electronic learning, and ubiquitous learning.

Ubiquitous Learning Environment

Today almost anyone with internet access can reach information in a given place in a given period. Distance education environments have been developed to exploit this access and offer the learner an efficient setting for learning. In our modern age when certain technological changes have been observed, it is reasonable to claim that learning environments have also been affected by such changes. In studies in the literature it has been observed that we have experienced an information revolution, similar in scope to the industrial revolution., entailing video games, the internet, tablets, computers, smartphones, smartwatches, augmented reality, and other new media technologies (Collins & Halversont, 2010). These technologies allow interaction via the internet. Thus, a new concept has emerged, the transferring of information to humans following their needs and without losing contact with daily life. Known as ubiquitous learning, this concept can be defined as an everyday learning environment that provides learners with information anytime and anywhere via a smart device (Ogata, Matsuka, El-Bishouty, &Yano, 2009). Ubiquitous learning environments are also considered multidisciplinary settings that connect varied disciplines including education, pedagogy, psychology, computer sciences, cognitive sciences, and information and communication technologies (Adriana Cárdenas-Robledo & Peña-Ayala, 2018). Researchers have isolated six main characteristics of this concept: permanency, accessibility, immediacy, interactivity, situating of instructional activities, adaptability (Yahya, Ahmad, & Jalil, 2010). Information is permanently saved unless it is purposefully deleted, information requested from a device can be obtained anytime it is wanted, accessing the information requested by using any device that is nearby is useful for saving time for any user, students can engage in active communication with their peers, instructors, and field experts by a variety of media channels.

According to the principles of ubiquitous learning environments, students should be able to attain required digital materials without facing any barriers. Moreover, they should be able to receive real-time feedback from their mobile devices. The common goal of all these components is to provide the learners with a worthy learning environment in which they can hone knowledge and skills and be motivated. The concept of ubiquitous learning was initially introduced along with the ubiquitous computing concept that was heralded by Mark Weiser toward the end of the 1980s (Zhang, 2008). Ubiquitous computing refers to using computers anytime and anywhere. Weiser argued that nowadays computers and relevant technologies have become deeply embedded into daily life and inseparable from it and thus invisible (Zhang, 2008). Based on Weiser's concept, ubiquitous computing that relates to computer usage anytime and anywhere refers to the process of making the presence of computers less visible and smoothly integrating them into the physical world where they have already been embedded into everyday life. In the literature, ubiquitous computing is also described as "accessible computer technologies" and "programming anytime and anywhere." Advancements in computer and wireless communication technologies have popularized the use of computer technologies anytime and anywhere. In addition, a long list of data processing and communication technologies such as sensors and actuators, RFID (Radio Frequency Identification) tags and cards, wireless communication equipment, mobile phones, PDAs(Personal Digital Assistant), and wearable computers have been developed (Yahya, Ahmad & Jalil, 2010). Ubiquitous computing is the origin point of the ubiquitous learning environment concept; its meaning encompasses the kind of technologies that enable learning anytime and anywhere. In this way, by using phones and other mobile devices and computers and similar smart devices. students can engage in the learning process in a smooth and interactive manner. To ensure the adaptability of the ubiquitous learning environment, which is one of its foundational characteristics, sensors and smart devices must be programmed, and a suitable digital environment must be created. This is possible through accessible computer technologies (ubiquitous computing) (Sakamura & Koshizuka, 2005).

For students, online learning environments should not only mean sitting in front of the computer screen and reciting the instructions on the screen to find out course contexts, keystroking and memorizing the context shared on screen. To make learning activities meaningful and effective students are obliged to grasp and internalize on-screen information (Olpak& Kılıç, 2009). One of the most significant goals of accessible computer technologies (ubiquitous computing) is the situating of instructional activities into real life, which is also one of the characteristics of a ubiquitous learning environment (Resnick et al., 1995). Thanks to accessible computer technologies, aside from mobile learning environments, ubiquitous learning environments have emerged where different situations can be used concomitantly and content can be adapted and designed as an interactive setting (Adriana Cárdenas-Robledo & Peña-Ayala, 2018).

Ubiquitous Learning and Mobile Learning

There may be conceptual confusion triggered by the similar characteristics of ubiquitous learning environments and mobile learning/distance education. Certain decisive characteristics of these interconnected learning environments have been comparatively analyzed by researchers, and different tables have thus been created. The table below draws a comparative analysis of the characteristics of mobile learning and ubiquitous learning environments by combining the common perspective of some researchers.

Table 1 shows that there are many commonalities between mobile learning and ubiquitous learning environ-

Table 1. Comparison of the characteristics of a ubiquitous learning environment and a mobile learning environment (Hwang, 2006; Yahya, Ahmad, & Jalil, 2010)

Mobile Learning	Ubiquitous learning
Records online actions of the learner.	Records learner's online actions and his/her real-life actions and environmental data.
Learning at the right place and right time	Learning at the right place and right time in the right way
Data loss is probable. Changes made in learning devices or changes made in mobile learning may disrupt learning activities.	Data loss is never an issue.
Installation of a software program customized to the mobile device is required.	The topic content is actively adapted to ensure that several mobile devices fulfill their functions.
Access to information is possible only on a compatible mobile device model where a related software program is installed.	Immediate access to information is always possible.
Access to the system is viable only through the internet.	Access to the system is possible through accessible computer technologies (ubiquitous computing).
A learners' position can only be detected by the information in the database.	A learners' position can be detected not only by the information in the database but also by sensors and geolocation information
Learners can initiate communication with their peers, instructors, or experts only via exclusively designated environments.	Learners can actively initiate communication with their peers, instructors, or experts via several interfaces of ubiquitous learning environments.

ments, but it is also apparent that ubiquitous learning environments have a more flexible and wider medium. By turning this new trend into an opportunity, ubiquitous learning environments allow the further expansion of learning opportunities and endow them with a multi-dimensional character (Resnick et al.,1995). In this study it was aimed to investigate the tendencies of the individuals towards ubiquitous learning environments at the university level. Research questions were listed below:

RQ1: What can be the factors of a scale measuring ubiquitous learning tendencies of university students?

RQ2: Are there any gender-based differences among the university students' tendencies towards u-learning environments in respect to:

a) Total scores of ubiquitous learning tendency scale?
b) Each factor scores for each factor of the scale ?
c) Item-based scores ?

METHOD

The cross-sectional survey model including factor analyses was the selected research design. In the cross-sectional survey process, information is collected from a sample of a predetermined population. The time required to collect all data can take from one day to several days (Fraenkel, Wallen & Hyun, 2012). Factor analysis is a multivariate analysis technique that allows the interpretation of a large number of variables that are thought to be related with a smaller number of variables or variables that cannot be directly observed (Çolakoglu & Büyükekşi, 2014). In accordance with that, a question pool was formed after a literature review. To check the scope and face validity of designed question pool, four educational technology specialists were consulted. One linguist was asked to check linguistic validity, and one specialist in educational psychology was asked to verify the accuracy of the tendency statements. Following views collected from the experts, items were regulated, and application steps could thus begin. To test the construct validity of the items in the first stage, exploratory factor analysis was conducted to identify factor names, and, by deleting the items with a lower eigenvalue load, a second version of the scale form was drawn. Next, a second application was performed, and, to check the coordination of these data and the structure of scale factors with the items, confirmatory factor analyses were executed. created the final form of the scale. Explanatory factor analysis is used to investigate the number of factors that explain the covariation between variables in situations where there is insufficient prior evidence about the number of factors underlying the data. Confirmatory factor analysis is used to test the theory (Stapleton, 1997). After the scale development process, university students' tendencies towards u-learning environments were analyzed with factor-based and item-based comparisons.

Study Group

In the scale development process performed in this study, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were applied in a two-stage application process. In this process, all participant data were included into the tendency analyses conducted comparatively on the basis of gender. The total number of participants and distribution as per different universities may be seen in Table 2.

Data Collection and Analysis Process

Collecting data for the scale in a systematic manner in order to allow accurate computing is of utmost value in the process of scale formation. In this study determined that a five-point Likert form was the optimal choice to obtain healthy data for scale items. To design proper items, first, the characteristics of ubiquitous learning environments including permanency, accessibility, immediacy, interaction, situating of instructional activities, and adaptability were determined. Moreover, since ubiquitous learning environments and mobile learning environments share common features, scale research directed at mobile learning environments were also referred to for our research. From the literature review, the details of every characteristics (feature) were explored, features identified for complex situations were divided into pieces, and multiple items were generated. Since a ubiquitous learning environment incorporates the

Table 2. Total number of university students taking part in scale applications

University Name	Stage One Number of Participants	Stage Two Number of Participants
Yildiz Technical University	180	0
Trakya University	15	0
Karadeniz Technical University	8	0
Marmara University	8	192
İzmir Katip Çelebi University	7	0
Medipol University	7	0
Celal Bayar University	0	19
Other Universities	51	0
TOTAL	276	211

related skills of mobile learning and other internet-based learning environments, it can be argued that a critical issue is the students' views about utilizing an internet environment to learn lessons and this factor that plays a huge role in detecting their tendency towards these environments. Accordingly, this was first item added to the scale. "I enjoy studying my lesson in the internet environment.". To ensure that the varied features found in the literature review could be measured in a healthier way, every characteristic was given a different item coding.The study was carried out in two stages. In both, exploratory factor analyzes were performed in order to ensure content validity and to determine the factors. Afterwards, confirmatory factor analyzes were applied to be able to check the factor-item relationships. All data analyzes were performed in the SPSS 26.0 and AMOS statistical analysis software.

FINDINGS

Exploratory Factor Analysis

First, to determine whether data gathered from the scale were fit for factor analysis, a principal components analysis was performed using exploratory factor analysis and the varimax vertical rotation technique. KMO and Bartlett test results showed that the Kaiser-Meyer-Olkin (KMO) coefficient has a significance level of .887 and the Barlett test has a significance level of <.05. Erkuş (2012) reported that to deem data from a scale fit for applying factor analysis, the KMO value must exceed .50 and the Bartlett Sphericity Test value must be significant. Later, item correlation matrix values were examined. As the item correlation matrix values were computed, significant values over .30 were obtained. In that case, the accuracy of the hypotheses regarding factor analysis was verified. Later, factor analyses were initiated to determine factors and item distributions. The Eigen values of the factors obtained at the end of these analyses. According to the analysis result limiting the scale to six factors showed that the distribution of Eigen values is significant, and the explanatory levels of these values are sufficient. The first of these factors explains 12.3% of the total variance of the scale, the second factor explains 10.045% of the total variance of the scale, the third factor explains 7.7% of the total variance of the scale, the fourth factor explains 6.7% of the total variance of the scale, the fifth factor explains 6.5% of total variance of the scale, and the sixth factor explains 4.9% of the total variance of the scale.

The Eigen value distribution graphic of the scale in Figure 1 demonstrates that for the first seven factors, the Eigen values of the scale factors were in a vertical distribution but then moved in the direction of a horizontal distribution.

After the rotation, it was determined that first factor of the scale contained 11 items, the second factor contained eight, the third factor contained eight, the fourth factor contained five, the fifth factor contained three, and the sixth factor contained four items. Having an Eigen value of .45 and above was accepted as the base point for items. Load values of items in the first factor varied between .495-.778; in the second factor, they varied between .530-.645; in the third factor, they varied between .448-.648; in the fourth factor, they varied between .769-.832; in the fifth factor, they varied between .425-.815; in the sixth factor, they varied between .417-.648. Factors were named based on the contents of items. In that sense, renamed factors and ranked list of the items may be seen in Table 3.

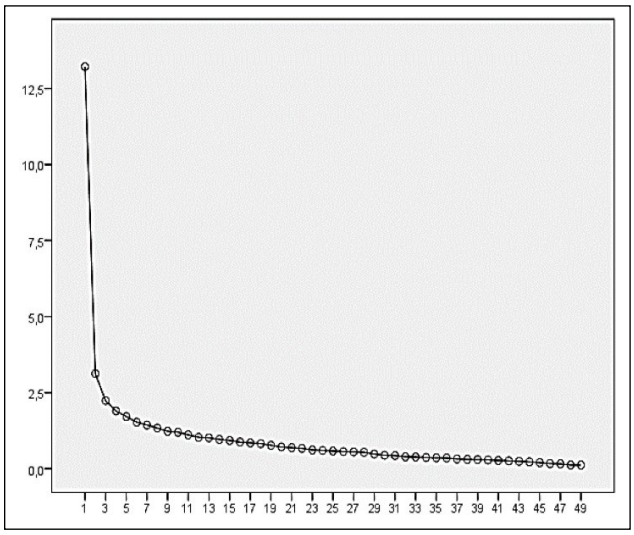

Figure 1. Eigen value distribution graphic of the scale factors.

Items were divided into factors by examining the factor values listed in the scale form in Table 3. In each factor, the context of the items it covered and its interactions were taken into account to designate factor names.

Confirmatory Factor Analysis

A scale form was designed at the end of explanatory factor analyses that aimed to test the construct validity of the scale items. The scale form was then used in the second-stage application and the obtained data were used to conduct confirmatory factor analyses. Confirmatory factor analyses aimed to unveil whether a significant relationship existed between items and factors. Data garnered from the first analysis stage revealed the items of which the standardized regression value were low (ubiquitous learning environments mediated as a support tool: 2, 8, 9, 10, 11; ubiquitous learning environments mediated as a learning facilitator: 2, 4, 8; ubiquitous learning environments mediated as a motivation tool: 1, 2, 3, 5, 6; ubiquitous learning environments mediated as entertainment and sharing platforms: 4; learner-centered teaching environments: 1), and these were excluded from the scale. With the remaining 23 items, the analysis was repeated, and it was seen that standardized regression values shifted between .486 and .914. A list ranked by item numbers may be seen in Table 3. After creating the final version of the scale form, the data of the analysis were examined. A chi-square value of 309. 279 and

Table 3. Form scheme of rotated component matrix (RCM)

List No	Item No	Factor Loads					
		1	2	3	4	5	6
Factor 1: Ubiquitous learning environments mediated as support tool							
1	37	**.778**	-.049	.199	-.017	.114	.231
2	38	**.762**	.011	.188	-.048	.022	.305
3	36	**.721**	.179	.059	.258	.145	.045
4	34	**.691**	.258	.094	.221	.182	.009
5	39	**.686**	.267	.046	-.019	.131	.051
6	40	**.609**	.359	-.009	.057	.303	-.020
7	35	**.562**	.249	.186	.264	.201	.098
8	41	**.555**	.521	-.003	.196	.072	-.140
9	32	**.522**	.411	-.018	.360	.086	-.043
10	33	**.509**	.428	.040	.292	.012	-.125
11	31	**.495**	.430	.006	.404	.076	-.056
Factor 2: Ubiquitous learning environments mediated as a learning facilitator							
12	29	.170	**.645**	.203	.056	.204	.139
13	23	.123	**.636**	.436	-.068	-.035	.207
14	27	.178	**.635**	.012	.175	.166	.088
15	28	.118	**.633**	.104	-.017	.308	.078
16	25	.157	**.592**	.200	.181	.191	.163
17	22	.262	**.571**	.376	.074	.030	.139
18	30	.163	**.551**	.232	.031	.195	.031
19	42	.354	**.530**	-.084	.120	.168	-.092
Factor 3: Ubiquitous learning environments mediated as a motivation tool							
20	15	.011	-.035	**.648**	-.088	.061	.007
21	20	.118	.105	**.647**	-.037	.126	.105
22	1	.055	.232	**.609**	.098	.098	-.199
23	6	.200	.210	**.584**	.003	.159	-.213
24	21	.040	.058	**.548**	-.053	.083	.042
25	19	.318	.196	**.545**	.135	.192	.112
26	13	-.098	-.013	**.520**	.251	-.021	.069
27	24	.094	.416	**.448**	.140	-.024	.345
Factor 4: Learning environment at the right time and right place							
28	10	.173	.193	-.014	**.832**	.109	.153
29	12	.139	.146	.032	**.826**	.111	.203
30	11	.198	.003	.068	**.769**	.156	.182
Factor 5: Ubiquitous learning environments mediated as entertainment and sharing platforms							
31	47	.226	.187	.097	.068	**.815**	.064
32	46	.127	.333	.134	.040	**.736**	.089
33	49	.080	.034	.196	.304	**.554**	.033
34	48	.281	.245	.160	.136	**.483**	.095
35	45	.321	.343	.243	.008	**.425**	.233
Factor 6: Learner-centered teaching environment							
36	14	.114	.117	.069	.195	.071	**.648**
37	8	.009	.035	.039	.119	.189	**.573**
38	3	.115	.413	-.223	.083	-.033	**.435**
39	18	.345	.334	-.033	.267	-.068	**.417**

a chi-square/degree of freedom value below 3 (1.466) indicated that there was a high degree of item fitness. In conducting the confirmatory factor analysis, factor load names are abbreviated as shown in Table 4.

The diagram in Figure 2 shows that there are connections between every factor in the scale and items within every factor. The details of the diagram reveal that the first and third items of the factor, the learner-centered teaching environment, maintain a significant relationship. Accordingly, it can be argued that there is a vital link between accessing course materials in a required period of time and analysis of course materials in required amounts. This association is in parallel with the characteristics of accessing educational materials anytime and anywhere as one of the features provided by ubiquitous learning environments. Similarly, between the third and fourth items of the ubiquitous learning environments mediated as the learning facilitator factor, there is a significant relationship. It can be argued that, in addition to presenting fit choices for students' learning rates, enriching course materials with simulations and other advanced contexts provided a positive effect on the factor. When the relationship between the first and second items of the factor, the "ubiquitous learning environments mediated as entertainment and sharing platforms" was examined, it was clear that there is a strong connection with educational games that are among online environments customized in line with an education context.

Table 4. The fit values of the suggested model

Form scheme of rotated component matrix (RCM)Index	Value Found
RMSEA (root mean square error of approximation:	0.047
AGFI (adjusted goodness-of-fit index):	0.85
CFI (comparative fit index):	0.95
GFI (goodness-of-fit index):	0.89
NFI (normed fit index):	0.86
IFI (incremental fit index):	0.95

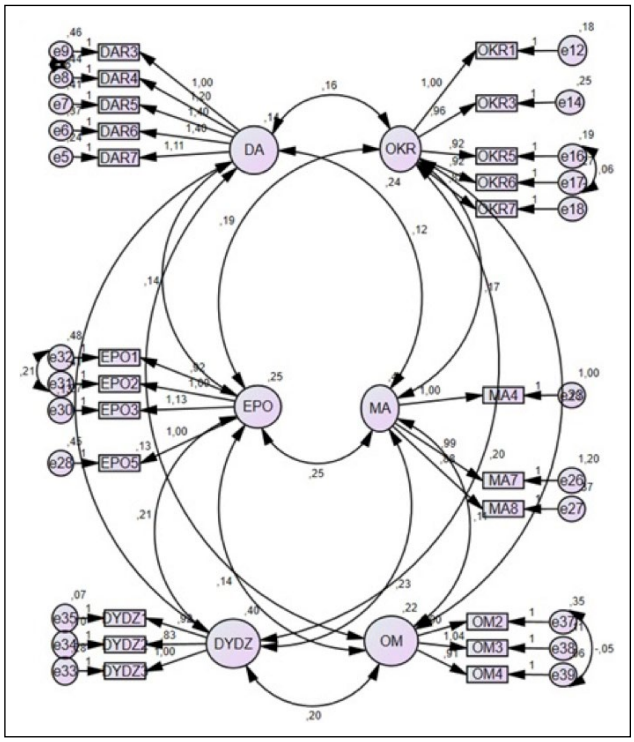

Figure 2. Confirmatory factor analysis (CFA) diagram.[1]

Scale Reliability and Item Analyses

Each factor in the scale was expected to obtain a valid degree of reliability. For the measurements, the internal consistency coefficient that is detected after Cronbach's alpha analysis should be examined. By conducting reliability analyses of the factors, every factor's Cronbach's alpha internal consistency coefficient was measured independently. The third factor, "ubiquitous learning environments mediated as motivation tools" had a lower internal consistency coefficient and was not at a sufficient level (<.70); for this reason , it was removed from the scale, and the confirmatory factor analyses were reapplied.

Second Confirmatory Factor Analyses

In the scale form, the factor with three items labeled "ubiquitous learning environments mediated as motivation tools" with a low internal consistency coefficient (Cronbach's alpha value) was deleted from three items. To test whether a significant relationship existed between the remaining factor items, confirmatory factor analyses were reiterated. According to the last analyses, the chi-square value was 253.753, and the chi-square/degree of freedom value was below 3 (1.616). These values indicate that fitness of items is at a significant level. According to the last analysis result, other important statistical data are listed in Table 5.

From these values, it can be argued that, according to the study by Erkorkmaz, Etikan, & Sanisoğlu (2011), the RMSEA, AGFI, CFI, GFI, NFI, and IFI values should be above .9 in general, and if values between the .8 and .9 range are taken as a reference, they are assumed to at a good fit level. Compared to results taken before deleting the "ubiquitous learning environments mediated as motivation tools" factor, we could claim that the last values are in a better range of (Figure 3).

[1] DAR ubiquitous learning environments mediated as a support tool
EPO ubiquitous learning environments mediated as entertainment and sharing platforms
OKR ubiquitous learning environments mediated as a learning facilitator
MA ubiquitous learning environments mediated as a motivation tool
DYDZ learning environment at the right time and the right place
OM learner-centered teaching environment

Table 5. The fit values of the suggested model

Index	Value Found
RMSEA (root mean square error of approximation)	0.054
AGFI (adjusted goodness-of-fit index)	0.865
CFI (Comparative fit index)	0 .951
GFI (Goodness-of-fit index)	0.899
NFI (Normed fit index)	0.883
IFI (Incremental fit index)	0.952

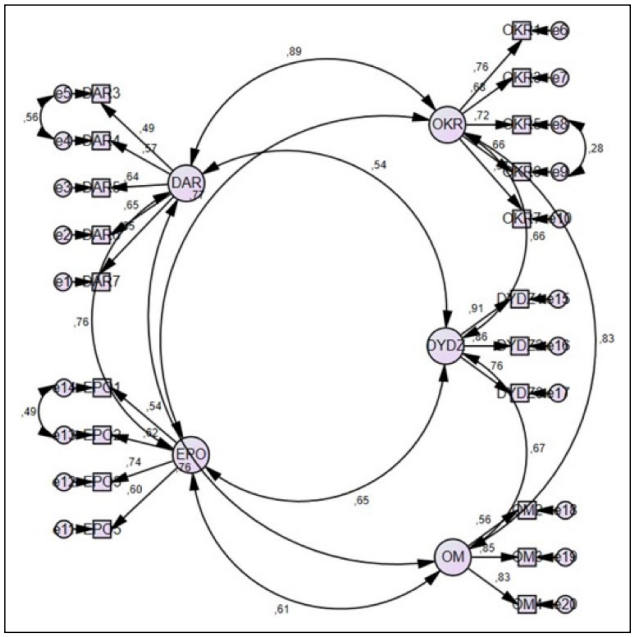

Figure 3. Second confirmatory factor analysis (CFA) diagram.[2]

The connection diagram of the last confirmatory factor analysis shows that, of all the connections in previous analysis, only in the learner-centered teaching environment factor did the connection between the first and third items deviate. In addition to presence of a multi-connection between each factor, it can be argued that scale factors are consistent and maintain a significant relationship.

Findings on Scale Reliability and Item Analyses Subsequent to Second Confirmatory Factor Analysis

After the second confirmatory factor analyses, reliability analyses of the remaining five factors were repeated, and each factor's Cronbach's alpha internal consistency coefficient was computed. The internal consistency coefficient of all factors was at a sufficient level (<.70). Thus, it can be claimed that factors obtained via second confirmatory factor analyses can perform measurements at a sufficient level. After the last analysis, the contexts of the remaining scale items were revised. Some of the factor titles were changed due to standardization in item topics and names.

Tendencies of University Students Towards using Ubiquitous Learning Environments

Tendency of university students towards using ubiquitous learning environments was analyzed comparatively on the basis of the total scale score, factor scores, and item scores with respect to the gender variable. Before comparative analyses, mean item scores with respect to data from a total of 487 participants were examined, and item mean scores were detected to fluctuate between a score range of four to five. It can reasonably be claimed that factors with a maximum score range are "learning resource role" and "learner-centered teaching environment." Whether university students' tendency towards ubiquitous learning environments displayed a significant distribution was analyzed with respect to the gender variable. To that end, first, a normalcy test was conducted to detect whether item distributions exhibited normal distribution. In line with the structural equation model, a normal distribution test was administered in AMOS software. George & Mallery (2012) reported that, in general, a kurtosis value within the range of ± 1.0 was accepted as perfect, but, under specific circumstances, a value within ± 2.0 range could also be accepted depending on a special application. The results of the normal distribution test revealed that, within each other and also within the total distribution value, items failed to exhibit a normal distribution. In line with this finding, it was deemed appropriate to apply non-parametric statistics to compare the obtained data. It was resolved to administer a scale-compatible non-parametric test, namely the Mann-Whitney U test which is conducted to detect if there is a significant difference among the scores of independent groups (Nachar, 2008). Among university students, the Mann-Whitney U Test results on gender-based tendencies towards ubiquitous learning environments are exhibited in Table 6.

The data in Table 6 shows that no significant differentiation exists between female, university students' tendencies towards ubiquitous learning environments and male stu-

Table 6. Comparison of university students' tendency towards ubiquitous learning environment based on the gender variable

Gender	N	Mean rank	Sum rank	U	Z	P
Men	104	96.21	10006.00	4546.000	-2.093	.036
Women	105	113.70	11939.00			

[2] DAR ubiquitous learning environments mediated as a support tool
EPO ubiquitous learning environments mediated as entertainment and sharing platforms
OKR ubiquitous learning environments mediated as a learning facilitator
MA ubiquitous learning environments mediated as a motivation tool
DYDZ learning environment at the right time and the right place
OM learner-centered teaching environment

dents' tendencies (p<0,05). Accordingly, it can also be argued that female students are, compared to male students, more interested in ubiquitous learning environments. Subsequent to the general data, gender-based differences among sub-factor scores were examined, and the obtained results are as displayed in Table 7.

When the gender-based distributions of factor scores in Table 7 are analyzed, it is seen that there is no significant difference observed between "learning resource role" and "learner-centered teaching environment" factors. From a general perspective, it is clear that female students have, compared to males, a more positive tendency towards ubiquitous learning environments, and this distribution tends to differ in only factor of "flexible learning environment role".

In Table 8, it is seen that in terms of tendencies towards 35, 25, 27, 22, 8, 18, and 3, there's is significant variation with respect to gender group (p<.05). In other words, it can be argued that tendencies of students asking a question about the course content to classmates, watching videos in an internet environment, having educational materials that offer choices for a personal learning rate, having visual materials in an internet environment, receiving notifications on location and weather forecast data, being able to review course materials anytime, reaching materials anytime all display a significant distribution based on gender groups. As we take a look at items much closer to zero (0), it can be claimed that, in a classroom environment, female students are more willing to receive rapid feedback for any questions. Moreover, it is safe to argue that female students are more enthusiastic about the variety of material types and personalization of data. Details of the item show that females are more inclined to utilize visual and multimedia course materials in an internet environment. One of the most distinctive characteristics of ubiquitous learning environments is the feature of customizing course materials in line with the knowledge level of individuals, and females are, compared to males, inclined to think more positively about this option. Some of the other characteristics of such environments are reaching course materials anytime, limitless access, free viewing and use of course materials are some other features that female students have a more positive tendency towards.

An overall analysis of the data shows that students exhibit a high tendency towards studying in an online learning environment enriched with several multimedia tools. Several studies on ubiquitous learning environments also claim that students think positively about reaching education materials anytime and anywhere, and students think highly of the adaptability of attained information to suit their unique knowledge level and unique needs. This situation is also believed to elevate students' academic achievement, motivation, and interest in the course (Erdoğdu & Şahin, 2016).

Table 7. According to Mann-Whitney U test results, distribution of factors based on gender group

Gender	N	Mean rank	Sum rank	U	Z	P
Performance support role						
Men	104	98.10	10202.50	4742.500	-1.683	0.092
Women	105	111.83	11742.50			
Total	209					
Learning resource role						
Men	104	93.12	9684.00	4224.000	-2.941	0.003
Women	105	116.77	12261.00			
Total	209					
Ubiquitous learning environments mediated as entertainment and sharing platforms						
Men	104	99.35	10332.00	4872.000	-1.357	0.175
Women	105	110.60	11613.00			
Total	209					
Flexible learning environment role						
Men	104	107.11	11139.50	5240.500	-0.514	0.607
Women	105	102.91	10805.50			
Total	209					
Learner-centered teaching environment						
Men	104	91.88	9555.00	4095.000	-3.363	0.001
Women	105	118.00	12390.00			
Total	209					

Table 8. Distributions of item scoresshowing significant differences based on gender variable

Item No	Question statement	Gender	N	Mean rank	Sum rank	p
35	I like asking a question that bothers me about the course contents to my classmates in internet environment.	Men	104	93.71	9745.5	
		Women	**105**	**116.19**	**12199.5**	**.002**
		Total	209			
25	I think videos in an internet environment would be helpful to study lessons.	Men	104	94.86	9865	
		Women	**105**	**115.05**	**12080**	**.004**
		Total	209			
27	I believe that once education materials offer choices that adapt to my learning rate, they would positively affect my studies.	Men	104	94.74	9853	
		Women	**105**	**115.16**	**12092**	**.004**
		Total	209			
22	I believe that visual materials in the internet environment would be useful for me to study lessons.	Men	104	96.15	9999.5	
		Women	**105**	**113.77**	**11945.5**	**.010**
		Total	209			
8	I like receiving notifications on location and weather forecast data.	Men	104	94.34	9811	
		Women	**105**	**115.56**	**12134**	**.004**
		Total	209			
18	It is important for me to be able to review course materials as much as I want.	Men	104	96.44	10029.5	
		Women	**105**	**113.48**	**11915.5**	**.010**
		Total	209			
3	I feel happy to be able to reach materials anytime I want.	Men	104	97.73	10164	
		Women	**105**	**112.2**	**11781**	**.013**
		Total	209			

CONCLUSION AND DISCUSSION

In education technologies, distance education systems are becoming more widespread each day, mostly because of positive feedback collected from users. To raise the quality of education and, where necessary, to make learning stages more efficient, utilizing technology provides a great advantage for the future. Organizing education materials according to personal learning rates and levels of users and enriching educational materials via audio and visual multimedia tools could be instrumental in creating a noticeable difference in the learning process of students. An accessible learning environment called a ubiquitous learning environment in the literature, is an innovative model in which most of the advanced technologies of our age can be applied collectively or individually. Also known as learning from anywhere, this model is treated as a novel learning method that makes use of computer infrastructure in all places.

Ubiquitous learning environments offer students a more efficient, effective, and comfortable educational environment. In the customization of education, shaping the content in line with students' conditions of physical space and knowledge level and their need to utilize real-time data is a critical effort (Bozkurt, 2015). Moreover, studies have shown that such an environment creates a positive effect on the motivation and success level of learners (Erdoğdu & Şahin, 2016). Among the scale factors, it is seen that the factor item labeled "performance support role entails concepts that reinforce this notion. The generic results of the scale analysis reveal that, in a broader framework, tendencies are mostly geared in a positive direction. In the same vein, in a descriptive study that examined students' and instructors' views of this learning system as an extension of the logic of any time and anywhere education, it was clear that participants' views were mostly positive (Pan & Akay, 2016). As the number of classes that have network systems increases, a U-learning system could shine as the best applicable choice (Sung, 2009). Ubiquitous learning environments are suitable for multiple multimedia learning environments because they can offer audio and video functions. In the study by Sung, it was seen that these environments maintain various types of communication, questions and answers, multiple learning sessions, a high-efficiency level, a high level of cooperation, lower periodic cost, and fewer time restrictions. It is well known, for every student regardless of age, interaction with their peers is quite important.

Data collected in this scale study that aimed to designate university students' tendencies towards ubiquitous learning environments can be used as supportive reference data in the process of forming ubiquitous learning environments. Pre-designation of students' tendencies towards such environments would offer a positive contribution to the process of educational design. Particularly in creating customized education, which is one of the characteristics of these environments and in forming a student-centered teaching environment, it would be of great help in employing data

obtained from the scale. Scale items would be reorganized in line with received feedback and expert opinions about future versions that could provide more effective results. Furthermore, additions, omissions, and changes could be made in light of the data obtained from the scale for the characteristics of ubiquitous learning environments to be designed in the future.

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KAYNAKLAR

Bektaş Şeker, T. (2005). Bilgi Teknolojilerindeki Gelişmeler Çerçevesinde Bilgiye Erişimin Yeni Boyutları. *Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 377–391.

Bozkurt, A. (2015). Mobil öğrenme: her zaman, her yerde kesintisiz öğrenme deneyimi. *Açıköğretim Uygulamaları ve Araştırmaları Dergisi, 1*(2), 65–81.

Cárdenas-Robledo, L. A., & Peña-Ayala, A. (2018). Ubiquitous learning: A systematic review. *Telematics and Informatics, 35*(5), 1097–1132. [CrossRef]

Collins, A., & Halversont, R. (2010). The second educational revolution: rethinkingeducation in the age of technology. *Journal of Computer Assisted Learning, 26*(1), 18–27.

Çolakoğlu, Ö. M., & Büyükekşi, C. (2014). Evaluation of factors effecting exploratory factor analysis process. *Karaelmas Journal of Educational Sciences, 2*(1), 58–64.

Erdoğdu, F., & Şahin, S. (2016). The effect of ubiquitous learning on academic achievement and motivation in higher education: the case of human-computer interaction course. *Bilişim Teknolojileri Dergisi, 9*(3), 285–290.

Erkorkmaz, Ü., Etikan, İ., & Sanisoğlu, Y. (2013). Confirmatory factor analysis and fit indices: Review. *Turkiye Klinikleri J Med Sci* 2013 Vol. *33*(1), 210–223. [CrossRef]

Erkuş, A. (2012). Varolan ölçek geliştirme yöntemleri ve ölçme kuramları psikolojik ölçek geliştirmede ne kadar işlevsel: Yeni bir öneri. *Eğitimde ve Psikolojide Ölçme ve Değerlendirme Dergisi, 3*(2), 279–290. [Turkish]

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). How to design and evaluate research in education. McGraw-Hill Education.

Garda, B., & Temizel, M. (2016). Education in the information age. *Selcuk University Journal of Social and Technical Researches*, 12, 23–43.

George, D. & Mallery, P. (2001). *SPSS for Windows step by step: A simple Guide and reference*.

Hwang, G. J. (2006, August 21). *Criteria and strategies of ubiquitous learning* [Conference presentation]. IEEE International Conference on Sensor Networks Ubiquitous, and Trustworthy Computing (SUTC'06), Taichung, Taiwan

Nachar, N. (2008). The Mann-Whitney U: A Test for Assessing Whether Two Independent Samples Come from the Same Distribution. *Tutorials in Quantitative Methods for Psychology, 4*(1), 13–20. [CrossRef]

Ogata, H., Matsuka, Y., El-Bishouty, M. M., & Yano, Y. (2009). LORAMS: Linking physical objects and videos for capturing and sharing learning experiences towards ubiquitous learning. *International Journal of Mobile Learning and Organisation, 3*(4), 337–350. [CrossRef]

Olpak, Y. Z., & Kılıç Ç,E. (2009). Assessing social presence in e-learning environments: validity and reliability analysis. *Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 6*(1), 142–160.

Pan, V. L., & Akay, C. (2016). Öğretmen adaylarının ve öğretim elemanlarının "her yerde her zaman" eğitim için mobil iletişim teknolojilerinin kullanımına dair görüşleri. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 219–237. [Turkish]

Resnick, M., Martin, F., Sargent, R., & Silverman, B. (1995). Programmable bricks: Toys to think with. *IBM Systems Journal, 35*(3.4), 443–452. [CrossRef]

Sakamura, K., & Koshizuka, N. (2005, November 28–30). *Ubiquitous Computing Technologies for Ubiquitous Learning* [Conference presentation]. IEEE International Workshop on Wireless and Mobile Technologies in Education, Tokushima, Japan.

Stapleton, C. D. (1997, January 23-25). *Basic concepts and procedures of confirmatory factor analysis* [Meeting papers]. Annual Meeting of the Southwest Educational Research Association, Texas, United States.

Sung, J. S. (2009). U-learning model design based on ubiquitous environment. *International Journal of Advanced Science and Technology*, 13, 77–88.

Wong, B. (2018). Success in mobile and ubiquitous learning: Indicators of effectiveness. *Broad Research in Artificial Intelligence and Neuroscience*, 9, 56–64.

Yahya, S., Ahmad, E., & Jalil, K. (2010). The definition and characteristics of ubiquitous learning: A discussion. *International Journal of Education and Development using Information and Communication Technology, 6*(1), 117–127.

Zhang, J. P. (2008). Hybrid Learning and Ubiquitous Learning. In: Fong, J., Kwan, R., Wang, F.L. (Eds). *Hybrid Learning and Education*. ICHL 2008. Lecture Notes in Computer Science, Springer, 5169, 250–258. [CrossRef]