A Scale Development Study for Socio-Technical Pedagogical Usability of Mobile Applications

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To Cite: Yılmaz, E. O. (2023). A scale development study for socio-technical pedagogical usability of mobile applications. *Malaysian Online Journal of Educational Technology, 11*(1), 59-76.
http://dx.doi.org/10.52380/mojet.2023.11.1.469

ABSTRACT

This study aims to develop a measurement tool to determine the socio-technical pedagogical usability of mobile applications that can be used in an educational context. The study group consists of a total of 1012 students who are studying at a higher education institution in Turkey in the fall semester of the 2021-2022 academic year. A draft scale of 24 items was prepared by the researcher following a literature review. After taking expert opinions within the scope of content validity studies, it was reduced to 20 items. While performing the data analysis, firstly exploratory factor analysis was applied on the first data set (N=604). Confirmatory factor analysis was performed on the second data set (N=408). Within the scope of validity and reliability studies of the scale, content and construct validity were examined and internal consistency coefficient, item-total correlation analysis, composite reliability, and average variance extracted analyses were performed. As a result of the exploratory factor analysis, the final scale consisting of 17 items and three dimensions was obtained. The total variance explained was 74.75 % and the Cronbach's Alpha reliability coefficient for the whole scale was .946. The model fit indices obtained as a result of CFA were found as: $\chi^2/df=2.870<3$, NFI=.951, CFI=.968, TLI=.961, GFI=.915, AGFI=.885, RMSEA=.068, which verified the resulting structure. In line with the data obtained, it was concluded that the socio-technical pedagogical usability scale is a valid and reliable measurement tool with three factors and 17 items. Thanks to the developed scale, the socio-technical pedagogical usability of mobile applications and software that can be used in education processes can be revealed.

Keywords: *Scale development; socio-technical pedagogical usability; mobile application; usability; mobile learning*

Article History:
Received: 13 October 2022
Received in revised form: 20 Nov. 2022
Accepted: 8 January 2023
Article type: Research Article

INTRODUCTION

Developments in today's mobile technologies are progressing rapidly in terms of both hardware and software. With the popularization of mobile technologies, more applications are being developed today. According to the Statista (2021) report, the number of mobile applications in the world reached 6.3 million (Google Play, Apple App Store, Amazon Appstore, and Windows Store) as of the beginning of 2021. This number continues to increase day by day. Every day, new applications and new programs are uploaded to mobile application markets and made available for use. As of 2021, these applications have been downloaded and installed on mobile devices 218 billion times. The mobile application market has reached a revenue of 462 billion dollars and continues to rise. The fact that mobile technologies are wireless, portable, and have access from anywhere at any time makes the use of these technologies widespread and enables them to reach more and more users every day (El-Hussein & Cronje, 2010). In as much as today's smart device technologies have reached extraordinary power and levels in terms of both hardware and software, the interest in these technologies increased.

Access to social media platforms is enabled through mobile devices at a rate of 98.8%. Approximately 66.6% of the world's population are mobile device users. About 92% of mobile device owners are also mobile internet (3G, 4.5G, LTE, etc.) users. These users can access the internet via mobile devices. Thanks to these mobile devices, activities such as communication, interaction, sharing, and learning are carried out (Hootsuite, 2021). According to the Hootsuite (2021) report, 59.5% of the total world population of ~7.83 billion use the internet and 53.6% use social networks effectively. Social networks are web-based services where individuals can create public or private profiles and interact with other individuals or groups within a system (Boyd & Ellison, 2008). The number of social network users is increasing by about 10% every year. The tools used in the formation and development of social networks are called social media (Pierre, 2018). Conceptually, social media are web-based platforms built on Web 2.0 technologies, where users come together and create content (Kaplan & Haenlein, 2010). Web 1.0 was about connecting to a network and accessing read-only documents on the network. Web 2.0, on the other hand, specified a readable and writable web environment (Naik & Shivalingaiah, 2008). Individuals on the internet use social media platforms for purposes such as social interaction, entertainment, passing time, communication, and sharing. In addition, activities such as obtaining information, sharing information, receiving information, education, and training can be carried out in these environments (Whiting & Williams, 2013). Social networking platforms can also be used as pedagogical and educational tools. In this sense, they are environments that support students' learning processes, encourage their collaborative work, provide information, teach, enable them to discover, share and support content creation (Lee & McLoughlin, 2008). Social networks are platforms that activate teaching-learning processes, enable individuals in the environment to work in cooperation, enable individuals to reveal their creativity and facilitate the development of interactions between students and instructors (Manca, 2020). At the same time, they support students in research, development, questioning, and problem solving (Özmen, Aküzüm, Sünkür & Baysal, 2012).

In terms of technology, mobile learning emphasizes the teaching and learning activity performed through any mobile device. Quinn (2000) defines mobile learning as e-learning activities performed through mobile portable computers. According to Winters (2007), it is the learning process carried out through portable devices such as mobile phones, tablets, iPods, and PDAs. An effective teaching-learning process on a mobile device can be realized by creating an interactive environment, creating materials that can be accessed through different contexts, making the most of the hardware features of the mobile device (sound, image, processing power), and using the mobile device not only to provide teaching but also to facilitate the activities of learning (Naismith & Corlett, 2006). Due to the advantages of mobile technologies, their use in the educational context has become growingly widespread in recent years (Martínez, 2019). Thanks to mobile technologies, people can interact with each other and realize their learning processes (Sharples, Arnedillo-Sanchez, Milrad, & Vavoula, 2009). Mobile learning opportunities improve with the development of internet infrastructure and rise of access speeds both in the world and Turkey, the increase in the ownership of portable smart devices such as mobile phones and tablets, and the increase in the time individuals spend with these devices (Güler, Şahinkayası, & Şahinkayası, 2017). The use of mobile technologies in education increases the motivation of students and supports learners to achieve meaningful learning (Martínez, 2019).

Besides the advantages of mobile learning, there are undoubtedly some disadvantages as well. Mobile learning may not be suitable for individuals with various physical disabilities (Asabere, 2013). It can be cheated in measurement and evaluation activities, while it provides an advantage to students with technical knowledge, it can negatively affect students who do not have device usage knowledge, it can cause students to feel lonely and isolated, it may impose additional workload on educators, and it may not be suitable for applied courses (Corbeil & Valdes-Corbeil, 2007). Today, some measures can be taken to overcome such negative situations. For example, mobile systems with voice commands can be used for students with disabilities. Protected online exam modules (proctor) can be used to prevent cheating. For applied courses, various interactive modules can be used today.

As of 2020, 4.28 billion of the 4.66 billion active internet users worldwide are active mobile device users. 91% of internet users also access the internet via mobile devices (Statista, 2020). With the COVID-19 pandemic, it can be stated that the significant increase in distance education activities has increased the use of both the internet and mobile devices. When this increase is considered on a yearly basis, only from 2020 to 2021, the daily internet usage rate of people increased by 9% to 7 hours a day (Hootsuite, 2021). During the global pandemic that started in 2020, there has been a transition from face-to-face education to distance education at all levels, from preschool to higher education. In this process, most of the students continued their education via mobile devices.

In the field of mobile applications, there are 30 basic categories of mobile applications of various types, from social networking applications to video editing, from communication to weather, from health to finance. The most common types of mobile applications are social networking, productivity, music, photo editing, and video apps (McIlroy, Ali, & Hassan, 2016). Many of these mobile applications can be used in an educational context. For examples, Facebook (Mazman & Usluel, 2010), Instagram (Oliveira et al., 2021), Twitter (Ha & Kim, 2014), Clubhouse (Guardian, 2021), Telegram (Alizadeh, 2018), Skype (Sivakumar, 2015), and Google Docs (Walsh, 2010) are some mobile applications in different categories that can be used for educational purposes. Mobile applications, most of which are social network-based, can also be used in education processes. At this point, the necessity of questioning the usability of these applications arises.

Socio-Technical Pedagogical Usability

One of the first scholars to deal with the concept of usability Miller (1971) defined usability as ease of availability. According to Shackel (2009), usability is a computer software's capacity of being used by people easily and effectively. The success of web-based simultaneous learning environments depends on the interaction structure in the environment and the design of the virtual classroom (Bower, Dalgarno, Kennedy, Lee, & Kenney, 2015). Besides, the popularity and success of an application among users depend on the usability of that application. According to ISO-9241-11 standards, usability is concerned with an application being effective, efficient, and creating a sense of satisfaction in its users (Bevan, 2001; Bevan, Carter, & Harker, 2015). On the other hand, the ISO-9126 standards, which deal with the evaluation of software products consider usability in a more specific context and define it as the design and evaluation of the user interface quality of the software. Esgin and Bayram (2008) state that the quality of the programs is directly related to the functionality of the product. According to Nielsen (2012) there are five basic components of the concept of usability in terms of technology, and these are learnability, efficiency, memorability, errors, and satisfaction. According to these attributes, it is essential that the use of a program should be easy to learn, the users should be able to perform tasks or operations quickly and efficiently, the use of the program should be easily remembered in future uses, errors caused by users, or the system should be easily eliminated, and the users should be satisfied with the program.

The usability of systems or software for educational purposes should be handled differently than business purposes. Considering the usability of an environment in an educational context, the concept of pedagogical usability comes to the fore. Pedagogical usability focuses on the relationship between the technical usability of the environment and its pedagogical design (Kukulska-Hulme, 2007). While the concept of technical (traditional) usability generally focuses on whether the environments are user-friendly or not, pedagogical usability is related to the pedagogical design elements such as the fulfilment of teaching and learning tasks (Jahnke, Schmidt, Pham, & Singh, 2020). Considering the pedagogical usability of mobile environments, some basic evaluation dimensions emerge. These dimensions include learner activity, cooperative learning, applicability, effectiveness, and valuation of previous knowledge (Syvänen & Nokelainen, 2004). The dimensions of pedagogical usability are learner control, learner effectiveness, motivation, and feedback (Kukulska-Hulme, 2007).

Jahnke et al. (2020) created the socio-technical-pedagogical usability (STPU) model by re-blending the concept of technological usability with social and pedagogical dimensions. Researchers have prepared the STPU framework by synthesizing the models related to technological usability, pedagogical usability, and social usability in the literature. The schematic representation of this framework is given in Figure-1.

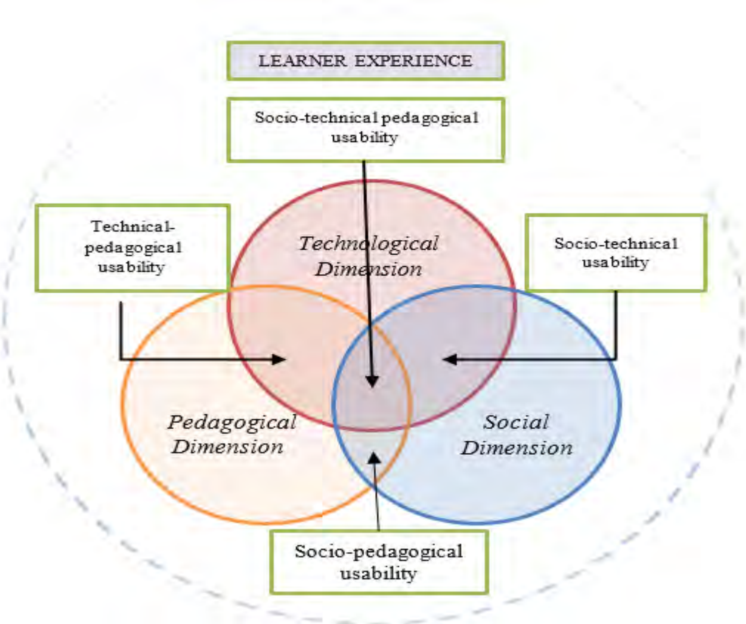

Figure 1. ***Socio Technical-Pedagogical Usability Model (Jahnke et al., 2020).***

The purpose of the STPU model is to support learner experiences and to provide a structure that puts students at the center and makes them active in the environment. In this context, the first of the three dimensions of the model is the socio-technical usability dimension. This dimension deals with technology and the social dimension together. The social dimension includes learner-teacher communication, cooperation, social presence, and social relationships in learning processes that cannot be achieved without a useful technological tool. It includes ensuring communication between learners with technology and ensuring active participation of students in the learning process. The second dimension, socio-pedagogical usability, focuses on the balance of social and pedagogical factors in learning design. The pedagogical dimension includes learning/instructional strategies, supports, tasks, and learning activities. The social dimension is also one of the necessary dimensions to support a positive learning experience. This dimension includes sociality and social presence in learning processes. The third and final dimension of the model is the technical-pedagogical dimension. This dimension deals with usable technology and usable pedagogy. It considers how to explain the aims and objectives of instruction from the perspective of the teacher, learner activities, and formative-summative assessment (Jahnke et al., 2020). Demonstrating the pedagogical usability of an environment provides important data for experts who develop that environment and contribute to the development processes of the environment (Alizadeh, 2018).

It can be said that revealing the STPU status regarding newly developed/developing mobile applications is an important step for the development of a more effective and efficient application. In addition, an evaluation of the STPU status of a mobile application can guide practitioners and researchers in determining and selecting efficient mobile applications, especially in the educational context. This study aims to develop a scale to determine the STPU status of mobile applications and software used for educational purposes depending on user experiences.

RESEARCH METHOD

Context of the Research

This research is a scale development study that attempts to determine the socio-technical pedagogical usability of mobile applications that can be used in an educational context.

Study Group

The sample of the study was determined using the convenience sampling method. Data were collected from two different student groups for EFA and CFA analyses. A total of 1012 (N_{EFA}=604, N_{CFA}=408) students from several disciplines and levels of education who continue their studies at Uşak University in the spring semester 2020-2021 and agreed to volunteer in the study, constitute the sample of this research. The distributions of two different samples are given in Table-1.

Table 1. ***Distributions of Study Groups EFA (N=604) and CFA (N=408)***

Gender	Study Group EFA		Study Group CFA	
	N	%	N	%
Female	372	61.59	213	52.20
Male	232	38.41	195	47.80
Total	604	100	408	100

According to Table 1, while 604 of the students were included in the data set in which exploratory factor analysis (EFA) was performed, 408 students were included in the data set in which a second-order confirmatory factor analysis (CFA) was performed. Tabachnick and Fidell (2001) stated that 300 people were sufficient as a sample size. In this context, it was decided that the total student data in both groups provided a sufficient sample size, and the scale development, validity, and reliability study was continued. During the data collection process, data were collected online from the students via the distance education system used by all students of the university.

Scale Development Process

In order to measure the socio-technical pedagogical usability of mobile applications depending on the user experience, similar studies evaluating the educational usability of mobile applications and measurement tools were examined as part of the study. Based on the social, technical, and pedagogical model developed by Jahnke et al. (2020) and in line with the opinions of experts in the field, the Socio-Technical Pedagogical Usability Scale item pool was prepared. The list of experts is given in Table-2.

Table 2. ***Expert List***

Experts	Title	Department	Institution
Expert 1	Assistant professor	Computer Education and Instructional Technologies	Usak University
Expert 2	Assistant professor	Computer Education and Instructional Technologies	Usak University
Expert 3	Asistant Dr.	Computer Education and Instructional Technologies	Usak University
Expert 4	Asistant Dr.	Computer Education and Instructional Technologies	Usak University
Expert 5	Assistant professor	Measurement and Evaluation	Usak University
Expert 6	Lecturer	Turkish Language	Usak University

In the creation of the item pool, the conceptual framework was determined by being inspired by similar scales in the literature and Janke's et al. (2020) model. Five field experts *(Except for the Turkish Language expert)* were asked open-ended questions and asked to write their written opinions about the social, technical and pedagogical usability dimensions of mobile applications. In line with the opinions received and by examining similar scale items in the literature, a draft question pool of 24 items was created. The draft scale, which is thought to reflect all of the sub-dimensions, was scored with a 10-point Likert scale ranging from 1 to 10, where (1) = I strongly disagree and (10) = I strongly agree. The presentation of the items in the pool to expert opinion and the data obtained are presented in the findings section.

Data Analysis

Validity and reliability studies of the scale were carried out within the scope of the STPU scale development study. In this context, the content validity of the draft scale was first examined in line with expert opinions, and a preliminary application was made. Then, to examine the construct validity, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) with a different sample were applied. Since there is an expectation of a structure consisting of interrelated factors in EFA, analysis was performed using the Direct Oblimin oblique rotation technique. In addition, principal component analysis method was preferred in EFA. Thus, it is aimed to reveal the maximum variance for each component (Karaman, Atar & Aktan, 2017). It was accepted that the Factor loadings should be at least .30 (Büyüköztürk, 2018). Within the scope of reliability studies of the draft scale, internal consistency Cronbach's Alpha, item-total correlations, combined/composite reliability (CR), and average variance extracted (AVE) calculations were performed. SPSS v21 statistical software was used in the analysis of the data. For the confirmatory factor analysis, the AMOS v22 software was used.

FINDINGS

Findings Concerning the Validity of the STPU Scale

The 24-item draft scale prepared was first presented to a total of six experts, including five field experts and a Turkish Language expert, within the scope of the content validity study. The field experts have expressed their opinions on whether the draft scale items are suitable for the purpose and whether they are comprehensible expressions (Table-3). Experts rated each draft item as appropriate, partially appropriate (should be corrected) and not appropriate (must be removed). In line with expert opinions, content validity was estimated by the content validity rate (CVR) specified by Veneziano and Hooper (1997) and calculated with the formula: CVR=Ne/(N/2)–1. For six field expert opinions, the minimum CVR is expected to be 0.99 (Yurdugül, 2005).

Table 3. ***Draft Scale Item Expert Evaluation Frequency Table***

Items	Appropriate (f)	Partially Appropriate (f)	Not Appropriate (f)	CVR	Status
M1	5	0	0	1	Appropriate
M2	5	0	0	1	Appropriate
M3	5	0	0	1	Appropriate
M4	5	0	0	1	Appropriate
M5	5	0	0	1	Appropriate
M6	5	0	0	1	Appropriate
M7	5	0	0	1	Appropriate
M8	5	0	0	1	Appropriate
M9	5	0	0	1	Appropriate
M10	5	0	0	1	Appropriate
M11	5	0	0	1	Appropriate
M12	5	0	0	1	Appropriate
M13	5	0	0	1	Appropriate
M14	2	3	0	-0.2	Not Appropriate
M15	5	0	0	1	Appropriate
M16	0	0	5	-1	Not Appropriate
M17	5	0	0	1	Appropriate
M18	2	3	0	-0.2	Not Appropriate
M19	1	4	0	-0,6	Not Appropriate
M20	5	0	0	1	Appropriate
M21	5	0	0	1	Appropriate
M22	5	0	0	1	Appropriate
M23	5	0	0	1	Appropriate
M24	5	0	0	1	Appropriate

In line with the opinions of the experts, corrections were made in some expressions, and some sentences were revised according to the suggestions of the Turkish Language expert. In line with the suggestions of the experts, four items (M14, M16, M18, M19) were removed from the draft scale. The content validity index (CVI) for the entire 20-item draft scale was calculated as 1.00. Since CVI > CVR, it has been accepted that the draft scale provides content validity. In order to evaluate the comprehensibility of the draft scale items examined by the experts, a preliminary application was carried out with a group of 25 students. In line with the evaluations obtained from the students, the draft scale was made suitable for examining the construct validity.

Within the scope of the construct validity study of the draft scale, EFA was carried out first. Necessary permissions were obtained from before the scale implementation process. Official permission was obtained from the Usak University administration before the application. The draft scale was administered to 604 students online. Since the online scale form was designed to be filled in completely, no missing value occurred. Before starting the factor analysis, Barlett Test of Sphericity and Kaiser-Meyer-Olkin (KMO) coefficient calculations were performed. Whether the data came from a normal distribution or not was examined with the Bartlett Test. Whether the sample size was sufficient for factor analysis was examined with the KMO test (Table-4).

Table 4. ***Kaiser-Meyer-Olkin (KMO) and Barlett Test Results***

Test	Value
Kaiser-Meyer-Olkin KMO	.941
Barlett test of Sphericity chi-square	9110.594
Df	136
Sig.	.000

Büyüköztürk (2018) stated that the KMO value should be higher than 0.60. Since the Barlett test results obtained according to Table-4 is significant and the KMO value is >.60, it was decided that the data set was suitable for factor analysis and the analyses were continued.

As a result of EFA, three factors with eigenvalues greater than 1 were found. It was found that the three factors accounted for 74.75% of the total variance. Also, three overlapping items with high values in two factors with a factor value difference of less than .10 were excluded from the draft scale (M12, M15, M21). It was observed that there were no items with factor loadings lower than .30. After removing the items, EFA was performed again. The factor loading distributions, arithmetic mean and standard deviation values of the obtained three-factor and 17-item scale are as seen in Table-5 below.

Table 5. ***STPU Scale EFA Factor Loadings and Item Distributions***

Factors and Draft Item No	Items	Factor Loadings			Item-Total Correlation
		Factor 1	Factor 2	Factor 3	
Social					
M7	I can engage in collaborative activities	.960			.655
M20	I can do group work	.913			.652
M3	I can work with my friends	.893			.673
M17	I engage in useful interactions	.689			.701
Technological					
M24	I don't feel lost while using the app		.817		.546
M5	I do not have difficulty using the application		.808		.454
M2	I learned to use the app easily		.761		.571
M6	I always feel in control when using the app		.742		.622
M10	I can use the application effectively		.694		.724
M11	I can easily find solutions to problems/errors I encounter.		.639		.677
Pedagogical					
M22	I achieve permanent learning			.941	.783
M1	It contributes to my learning process			.921	.803
M9	I get motivated to learn			.913	.809
M8	I become aware of learning objectives			.886	.785
M23	I go through an efficient learning process			.877	.791
M13	I will be able to use what I have learned in my professional life.			.865	.755
M4	Assessment and evaluation processes make me think			.763	.803
Cronbach's Alpha (For full scale: .946)		.909	.876	.962	

According to Table-5, it was found that factor loadings in the first factor consist of four items ranging between .689 and .960; factor loadings in the second factor consist of six items distributed between .639 and .817 and factor loadings in the third factor consist of seven items, ranging between .763 and .941.

Büyüköztürk (2002) found that factor loadings between 0.30-0.59 are considered middle while factor loadings of 0.60 and above are considered high. In this context, it can be said that the items have high factor loadings. Item-total correlations for items range between .454 and .809. The total variance explained by the three factors regarding the STPU scale was 74.75%. The first factor explains 11.01% of the total variance and consists of statements about the use of the environment for socialization. This factor is called "social" for short. The second factor explains 8.99% of the total variance and consists of statements that address the technical usability of the environment. This factor is named as "technological". The third and last factor explains 54.740% of the total variance and consists of expressions related to the usability of the environment in the educational context. This factor is called "pedagogical" for short.

Cronbach's Alpha reliability coefficient for the whole scale was found to be .946. It was calculated .909 for the first factor (social), .876 for the second factor (technological), and .962 for the third factor (pedagogical). In line with these findings, it can be stated that the reliability of the scale is high. Scree plot was also examined for the SPTU scale, which consists of 17 items and three factors (Figure-2).

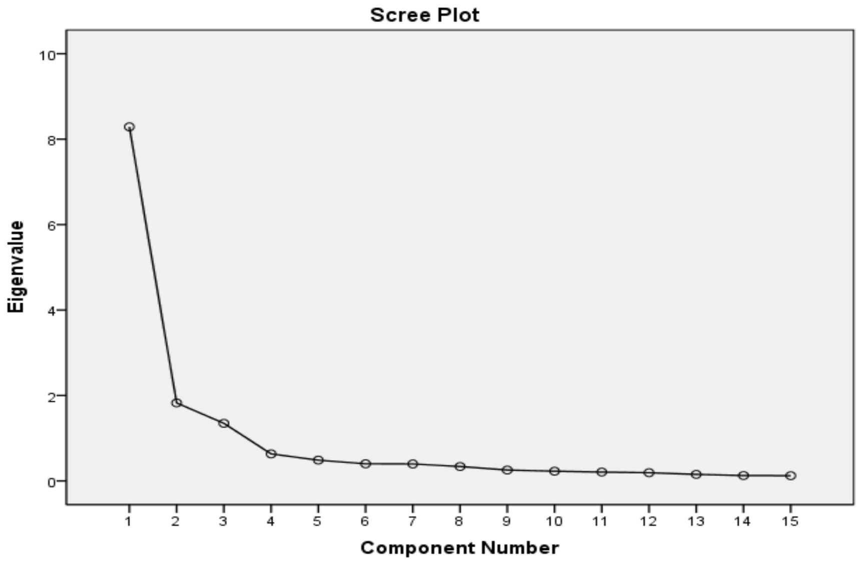

Figure 2. ***Scree Plot***

According to Figure-2, it can be stated that the scale has three factors, and it plateaus after the fourth point. It was observed that the eigenvalue of each factor was 1 and above.

The level of relationship between the factors in the scale was examined at the level of Pearson Product Moments Correlation Analysis. Correlation coefficients calculated between the factors are given in Table-6.

Table 6. ***Correlation Between Factors (n=604)***

Factor	Social	Technological	Pedagogical
Social	1	.488**	.564**
Technological		1	.512**
Pedagogical			1
*(**p< .001)*			

According to Table-6, it can be said that there is a positive relationship between all factors (p<.001). The correlations coefficients range between .488 and .564. According to these results, it can be stated that all factors and the scale measure a similar structure.

Confirmatory Factor Analysis (CFA)

CFA was performed to verify the 17-item three-factor scale structure being developed. In the CFA, a different sample group of 408 students were analysed from EFA. The maximum likelihood method was used as the estimation method in CFA. This estimation method is capable of making consistent and unbiased estimations on independent, continuous and multivariate datasets with large sample sizes and normally distributed datasets (Kline, 2005). The scale application was carried out with the students online. The CFA diagram generated with the data obtained from 408 students is shown in Figure-3.

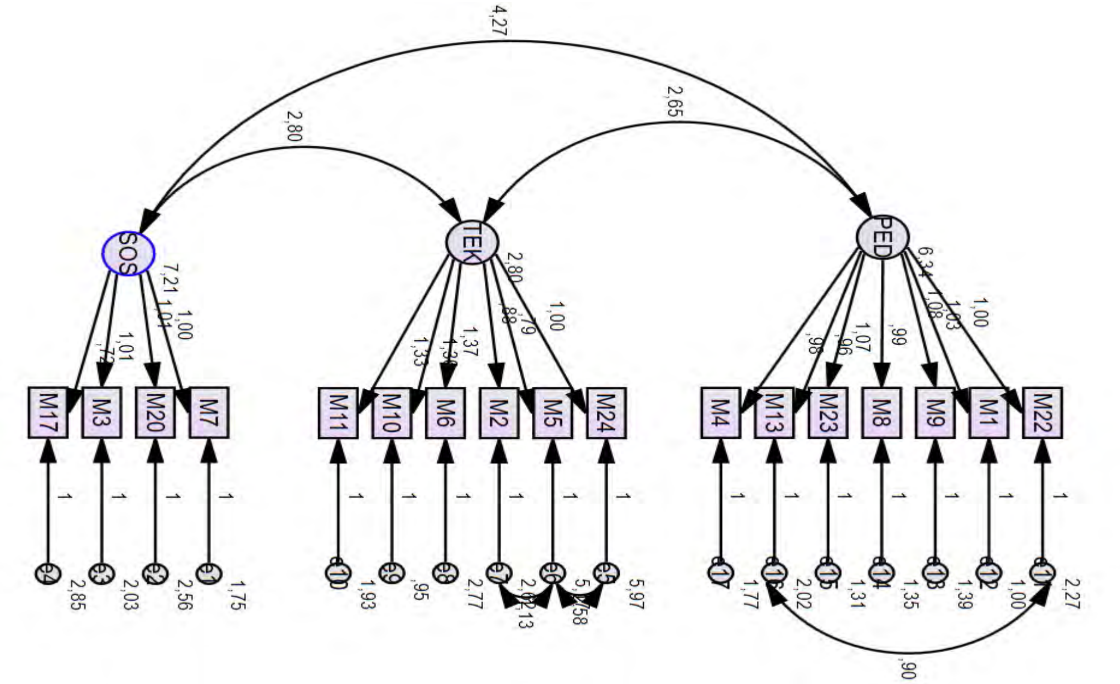

Figure 1. ***Path Diagram of the Confirmatory Factor Analysis***

In the CFA performed on the AMOS program, suggested covariance modifications were applied between some error variances (E5-E6, E6-E7, E11-E16). In order to improve the model fit, the proposed modifications were applied in accordance with the theoretical structure. When the related items are examined; *-I did not feel like I was lost while using the application, I did not have difficulty using the application and I used the mobile application easily.* It was thought that these items were close to each other and were modifications suitable for the theoretical structure. As a result of the CFA, the fit indices were obtained as: $\chi^2/df = 2.870<3$, IFI=.968, NFI=.951, CFI=.968, TLI=.961, GFI=.915, AGFI=.885, RMSEA=.068 (Table-7).

Table 7. ***Fit Indices Criterion Ranges and Scale CFA Data***

Fit Indices	Perfect Fit	Acceptable Fit	Scale Data	Status
χ^2/df	$0\leq\chi^2/sd\leq2$	$2<\chi^2/sd\leq 5$	2.870	Acceptable Fit
IFI	.95≤ IFI<1.00	.90≤IFI<.95	.968	Perfect Fit
TLI	.95≤TLI<1.00	.90≤TLI<.95	.961	Perfect Fit
CFI	.95≤CFI<1.00	.90≤CFI<.95	.968	Perfect Fit
GFI	.95≤GFI<1.00	.80≤GFI<.95	.915	Acceptable Fit
AGFI	.95≤AGFI<1.00	.80≤AGFI<.95	.885	Acceptable Fit
RMSEA	0≤RMSEA≤.05	.05<RMSEA≤.08	.068	Acceptable Fit

Source: Byrne (2010), Schermelleh-Engel, Moosbrugger, and Müller(2003), Şimşek (2007).

When the fit indices obtained in Table-7 are examined, it can be said that the fit index indicators obtained as a result of CFA indicate acceptable and perfect fit (Byrne, 2010; Schermelleh-Engel, Moosbrugger, & Müller, 2003; Şimşek, 2007). According to these findings, the findings obtained in CFA show that the model provides construct validity. In other words, the validity of the construct revealed in EFA was confirmed by CFA.

In the study, the item discrimination analysis based on lower and higher groups was also carried out. In this context, in order to determine the distinctiveness of 17 items in the scale, item score averages were calculated, and item analysis was carried out with the data in the highest 27% and the lowest 27% groups. Whether there is a difference between the mean scores of the higher and lower groups was examined with the independent samples t-test. The data obtained are presented in Table-8.

Table 8. ***Item Analysis According to the Lower and Higher 27% Groups.***

Item	Group	N	X̄	Std. Dev.	t	Sig. and Decision
M7	High group	110	9.7091	0.88147	20.681*	p<.001 There is a difference
	Low group	110	4.2727	2.61228		
M20	High group	110	9.7182	1.04163	21.069*	p<.001 There is a difference
	Low group	110	4.0909	2.60044		
M3	High group	110	9.7636	0.74103	21.821*	p<.001 There is a difference
	Low group	110	4.1545	2.59211		
M17	High group	110	9.7545	1.01535	15.543*	p<.001 There is a difference
	Low group	110	5.4545	2.71806		
M24	High group	110	9.5818	1.58769	11.568*	p<.001 There is a difference
	Low group	110	5.7727	3.06702		
M5	High group	110	9.8455	0.84795	10.653*	p<.001 There is a difference
	Low group	110	6.5909	3.08977		
M2	High group	110	9.8636	0.73544	10.852*	p<.001 There is a difference
	Low group	110	6.8273	2.84092		
M6	High group	110	9.6909	0.93598	16.111*	p<.001 There is a difference
	Low group	110	5.0091	2.90048		
M10	High group	110	9.7727	0.67265	17.560*	p<.001 There is a difference
	Low group	110	5.3455	2,55737		
M11	High group	110	9.8000	0.64680	18.801*	p<.001 There is a difference
	Low group	110	4.9545	2.62447		
M22	High group	110	9.8273	0.58825	24.546*	p<.001 There is a difference
	Low group	110	4.0909	2.37937		
M1	High group	110	9.9000	0.40524	24.541*	p<.001 There is a difference
	Low group	110	4.1909	2.40601		
M9	High group	110	9.7909	0.63673	26.750*	p<.001 There is a difference
	Low group	110	3.8273	2.24981		
M8	High group	110	9.9091	0.34655	24.950*	p<.001 There is a difference
	Low group	110	4.3545	2.30908		
M23	High group	110	9.8182	0.65219	29.080*	p<.001 There is a difference
	Low group	110	3.6364	2.13201		
M13	High group	110	9.9273	0.35086	23.313*	p<.001 There is a difference
	Low group	110	4.3636	2.47826		
M4	High group	110	9.8091	0.56658	26.443*	p<.001 There is a difference
	Low group	110	4.1000	2.19236		

*(*p< .001).*

According to the findings in Table-8, since the t-test significance values (*p*) of all 17 items in the scale are less than .001, there is a significant difference between the mean scores of the lower and higher groups. In other words, it can be said that all items of the scale under development are items that have distinctive features related to STPU, have high validity, and measure similar behaviour.

In the scale development study, Cronbach's Alpha internal consistency and composite reliability (CR) calculations were also performed. Composite reliability of the first factor, the social dimension was estimated to be .924, while the CR of the second factor, the technology dimension was estimated to be .882, and the CR of the third factor, the pedagogy dimension was estimated to be .960. The composite reliability for the entire 17-item scale was estimated to be .974. Hair, Anderson, Tatham and Black (1998) stated that the composite reliability values should be .70 and above. In this context, it can be stated that composite reliability is provided for both the factors and the entire scale.

Lastly, The Average Variance Extracted (AVE) was calculated as part of the scale development study. Convergent validity states that the statements about the variables are related to each other and the factor they create. For convergent validity, all CR values for the scale are expected to be greater than the AVE values and the AVE value to be greater than 0.5 (Yaşlıoğlu, 2017). AVE was calculated as .756 for the first factor, the social dimension; .556 for the second factor, the technology dimension; .778 for the third factor, the pedagogy dimension. The AVE calculated for the entire 17-item scale was found to be .695. According to these values, it can be stated that AVE values of 0.5 and above are sufficient to ensure convergent validity (Henseler, Ringle, & Sinkovics, 2009). There is no negative item among the developed final scale items. The highest score that can be obtained from the scale is 170 and the lowest score is 17.

DISCUSSION AND CONCLUSION

In this research, the scale development process carried out to reveal the socio-technical and pedagogical usability of mobile applications is discussed.

With the constant evolution of technology, mobile devices have become an integral part of our lives. Thanks to mobile applications, many activities in daily life can be carried out on mobile devices. Mobile applications have gone beyond just providing communication and have become tools that facilitate our lives in many different fields from health to finance, from sports to education. The constant increase in the number of mobile applications used for educational purposes has brought their usability into focus in terms of comparison and selection between applications. Not only the physical usability of these applications but also their social, technological, and pedagogical usability have emerged as issues that need to be tackled from a wider perspective. It can be said that measuring the usability of mobile applications using the socio-technical pedagogical usability scale developed in this research will be beneficial for practitioners, decision-makers, and researchers. It is suggested that researchers apply this scale to students who have had a learning experience on different mobile applications and that mobile applications used in different educational contexts should be compared with each other.

The STPU scale, which was developed based on the social, technological, and pedagogical usability model prepared by Jahnke et al. (2020), has a three-factor structure consisting of 17 items. Thanks to this scale, it is thought that a contribution to the literature has been made by transforming the structure put forward by Jahnke et al. (2020) into a scale. The dimensions of the scale are social, technical, and pedagogical. The social dimension of the scale consists of four items, the technical dimension consists of six items, and the pedagogical dimension consists of seven items. The contribution of the factors of this three-factor structure to the total variance is 74.75%. The findings obtained from the CFA in the study showed that the construct validity of the model was ensured. The validity of the construct revealed by EFA was also confirmed by CFA. Therefore, since valid validity and reliability are provided for the STPU scale, it can be said that the scale can be used as a valid and reliable scale.

Mobile technologies in education; considering its advantages such as lifelong learning and learning independent of place and place, it is of great importance to conduct research on the use of these newly widespread technologies in education (Çam & Uysal, 2017).

Lim & Lee (2007) have prepared a checklist on their pedagogical usability for e-learning environments. It can be stated that the items obtained on pedagogical usability are in parallel with the items obtained in this study. In his scale adaptation and structural equation modeling study, which Güler (2019) carried out to address the usability status of mobile applications, the usability status of mobile applications was discussed in the context of loyalty and loyalty to the brand and willingness to use the mobile application. In this study, it differs from the aforementioned research since the usability of mobile applications in the educational context is discussed. Çam & Uysal (2017) obtained a six-factor scale in their scale development study in which they discussed the usability of mobile applications in an educational context. The factors they obtained are; sharing, access to resources, material preparation and transmission, course follow-up, communication and use of application stores. In this study, on the other hand, the usability situation differs as it is handled in the context of STPU. Şenel, Şenel & Günaydın (2019) examined mobile language learning applications according to universal design principles. Thus, they emphasized the importance of the principles of universal design in mobile learning processes. In the related research, dimensions such as content presentation, usage and interaction options, and increasing motivation were determined and discussed in this context. It can be said that the use and interaction dimension can be associated with the socio-technological dimension in this research.

This research has some limitations. The sample of the research consists only of students studying at Uşak University. The developed scale consists of 3 factors and 17 items. It is predicted that higher reliability can be achieved by creating a larger item pool.

With this developed STPU scale, it is thought that it will guide practitioners and researchers in determining the STPU status of mobile applications, especially in determining and selecting efficient mobile applications in the educational context.

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Appendix

Table 7. Socio-Technological Pedagogical Usability Scale of Mobile Applications

(In Turkish)

Madde No	Maddeler	Kesinlikle katılmıyorum	⟺								Kesinlikle katılıyorum
		1	2	3	4	5	6	7	8	9	10
M7	İş birliği faaliyetlerinde bulunabiliyorum	□	□	□	□	□	□	□	□	□	□
M20	Grup çalışmaları yapabiliyorum	□	□	□	□	□	□	□	□	□	□
M3	Arkadaşlarıma beraber çalışabiliyorum	□	□	□	□	□	□	□	□	□	□
M17	Faydalı etkileşimler sağlıyorum	□	□	□	□	□	□	□	□	□	□
M24	Uygulamayı kullanırken kaybolmuş gibi hissetmiyorum	□	□	□	□	□	□	□	□	□	□
M5	Uygulamayı kullanırken zorlanmıyorum	□	□	□	□	□	□	□	□	□	□
M2	Uygulamayı kullanmayı kolayca öğrendim	□	□	□	□	□	□	□	□	□	□
M6	Uygulamayı kullanırken kontrolün hep kendimde olduğunu hissediyorum	□	□	□	□	□	□	□	□	□	□
M10	Uygulamayı verimli şekilde kullanabiliyorum	□	□	□	□	□	□	□	□	□	□
M11	Karşılaştığım sorun/hatalara kolayca çözüm bulabiliyorum	□	□	□	□	□	□	□	□	□	□
M22	Kalıcı öğrenmeler sağlıyorum	□	□	□	□	□	□	□	□	□	□
M1	Öğrenme sürecime katkı sağlıyor	□	□	□	□	□	□	□	□	□	□
M9	Öğrenme konusunda motive oluyorum	□	□	□	□	□	□	□	□	□	□
M8	Öğrenme hedeflerinden haberdar oluyorum	□	□	□	□	□	□	□	□	□	□
M23	Verimli bir öğrenme süreci geçiyorum	□	□	□	□	□	□	□	□	□	□
M13	Öğrendiklerimi mesleki hayatımda da kullanabileceğim	□	□	□	□	□	□	□	□	□	□
M4	Ölçme ve değerlendirme süreçleri beni düşünmeye sevk ediyor	□	□	□	□	□	□	□	□	□	□