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Acceptance Scale of Tablet Computers by Secondary Education Students: Validity and Reliability Study

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Abstract: The purpose of this study is to develop a reliable tool for measuring the acceptance scale of tablet computers by secondary education students by involving the factors of social influences (SIs) and interactive perception. During the development process, the participants of the research consisted of 550 students from a private secondary educational institution during 2016–17. The survey form is comprised of six factors in total. These factors are perceived ease of use, perceived usefulness, attitude towards use, SIs, perceived interaction (PI) and intention to adopt. The PI factor was deemed important after an examination of the literature and is included in the study. By applying exploratory factor analysis and confirmatory factor analysis of the gathered data, a valid and reliable measuring tool, including 29 statements and six factors that measured the acceptance scale was developed. The study can also be improved by including new factors or supported by conducting comparative studies.

Keywords: Human–computer interface, improving classroom teaching, interactive learning environments, secondary education
Categories: L.3.1, L.3.6

1 Introduction

Rapid changes in technology necessitate the progressive training of persons on new technologies and operating environments. These developments in the literature have prompted the educational institutions to instruct their students to use the technologies in question and make research on their acceptance. In light on the conducted research, models intending to clarify the students' acceptance of technology were developed. In the study conducted [Venkatesh 03], have examined different technology acceptance and usage models and compared their weaknesses with their strengths. After concluding the study, they developed the unified theory of acceptance and use of technology (UTAUT) which was included in the social influences (SIs) factor. Students are also affected by the rapid development of technology. Nowadays, students are required to be technologically literate. Despite various scientific research in the literature, the students' acceptance progress of technology is not yet fully clear. However, the acceptance of an implementation based on technology is related to the acceptance and usage of the technology in the final test. This is because of the fact that whatever new or efficient the technology or application may be, it will not benefit the student as long as it is unaccepted. In this regard, it is important that the students

have positive beliefs, attitude and intentions towards the related technology. In this respect, it is necessary for the students to accept technology.

1.1 Technology acceptance model

Technology acceptance model (TAM) is a theoretical structure that treats the factors that partake in the technology acceptance progress of individuals. This structure aims to explain the factors that have an effect on accepting technology. The model was developed by [Davis 03] and was influenced by [Fishbein 75] the theory of planned behaviour. Especially in computer technologies, the researchers frequently try new factors and aim to make developments. Figure 1 presents the TAM. Accordingly, acceptance of technology refers to the willingness of an individual to use technology in order to actualise an objective. During the studies in which the TAM was used, the intention was to clarify the factors that affect the integration of technology and its acceptance. These research studies ensured the emerging of various technology acceptance related models. In computer technology related research, two basic TAMs have come into prominence among others [Moon 01; Yuen 02; Punnoose 12; Venkatesh 00; Sadaf 12; Wardley 16; Verizon 15; Karasar 11]. The TAM developed by Davis [93] is a predictor model focused on the using of computers or technology and is one of the first models and involves fewer factors for scaling. The decomposed theory of planned behaviour model developed by Taylor and Todd is more extensive when concerning the factors that it includes on understanding the intention to adopt (IA) to computers or technology.

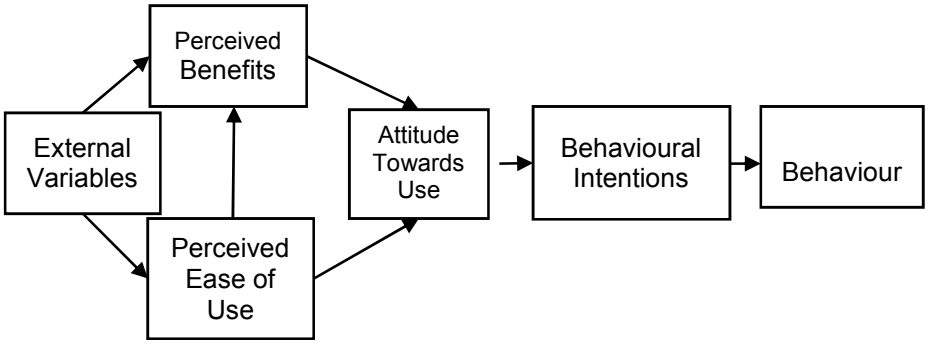


Figure 1: TAM (Davis, 1993)

One of the most important determinants concerning is the integration of computer technologies to the learning–teaching process in the students. Within this scope, determining the variables that affect the students' acceptance and use of the related technologies is crucial for a successful integration process. Especially, during the process of using computer technology, appealing to individuals of all ages, in education, TAM is revered as an efficient theoretical structure in revealing the reasons behind the students' acceptance of these technologies [Sumak 16].

TAM being the strongest and most commonly used model with a behaviourally theoretical substructure and that research the acceptance of new technologies on an individual level has taken its place within the literature of information systems. In the TAM, it is stated that a student's use of technology is affected by intentions of use, intentions by an attitude towards use (ATU), perceived ease of use (PEU) and perceived benefits. Meanwhile, PEU and perceived benefits are affected by external variables [Davis 93]. TAM is used in various technology acceptance studies that include computers [Ling 16], the Internet [Boateng 16] and learning management systems [Alotaibi 17; Uzunboylu 17). Especially in the latest years, when it is aimed to form a bridge between digital divisions and providing equalised education quality by using budget-friendly learning technologies such as tablet computers [Pruet 16; Suarez-Guerrero 16], it can be observed that the research on the students' acceptance of tablet computers has become importance.

1.2 Acceptance of tablet computers and technology

Tablet computers are similar to others; however, as they can be advantageous when concerning functionality, ease of use, interaction and its haptic interface, they can also be disadvantageous in using productive tools. These advantages have provided the tablet computers a place among the potential tools that can be used in education. The adjuvant effect of tablet computers on student performance interaction, communication [Voogt 17], classroom dynamics, learning efficiency and the students' learning along with cooperation within groups and problem solving skills has ensured the increased usage of these tools in education. For the efficient reflection of the benefits emerging with the use of tablet computers, the importance of tablet computer acceptance is increasing.

While observing tablet computer acceptance related research, several university level studies that examine the acceptance of tablet computers with the 'UTAUT' model have been observed. From these studies, it has been brought to light that the UTAUT model has revealed the meaningful prediction of 288 college students on the acceptance of tablet computers. In the study, self-efficacy has been determined as the behavioural intention predictor of the attitude towards the use of technology and concern. In the study in which structural equation modelling had been used, the strongest effector of intention was determined as the attitude towards the use of variable technology. The model was also used in another study conducted by Punnoose [12] on 249 higher education students, where similar results were obtained. In another study where a different model was chosen, similar results were obtained and attitude towards technology was again determined to be the most efficient variable. In a study conducted by [Okumus 16] with the participation of lecturers, their ATU and intentions were determined to be positive despite the negative effects of the software, hardware and communication factors on their acceptance of tablet computers.

The acceptance of tablet computers was examined in a different two-phased study conducted in a faculty of architecture. After the second phase of the research, it was observed that in phase one, the use of tablet computers was more beneficial and easily used in comparison with phase two. In the basis of this finding, it was stated that in phase two, the self-efficacy perceptions of the individuals were less in comparison to those in phase one. Majority of the participants of phase one have stated that they

faced no problems in using tablet computers, and they were inclined to use them as learning tools during their classes. In a study in which the acceptance of primary education students' acceptance of tablet computers was examined, it was observed that the students had a positive attitude. In addition, it was stated that the students choosing the programs according to their own preferences, and the features of the programs increased their interactive perception and thereby, the acceptance of tablet computers.

1.3 Perception of social influence and interaction

SI is one of the factors included in TAM, in TAM 2 by Venkatesh and Davis (2000), in order to better explain the variables affecting the students' acceptance of technology. As a result, it was found that SI affected the acceptance of the technology user. However, in the literature, studies suggesting that SI that is more effective on other variables also exist. For example, studies that suggest it effects of perceived benefits and attitude [Sadaf 12] have taken their places in the literature. The inclusion of the SI factor in this study, regarded as an important factor for the TAM, was deemed suitable.

Perceived interaction (PI) reflects the students' beliefs on tablet computers and the basic functions of the used applications [Wardley 16]. For example, in a study where how the tablet computers were to be used in classrooms were researched on the interactive level, the opinions of both teachers and students were taken under consideration. According to the results, the students wanted to be more flexible on their tablet computers (setting up the required application, unlimited access to social media applications, etc.), while the teachers stated that along with the advantages such as facilitating learning, providing materials and saving of time, the tablet computers also had the disadvantage of causing a deficit in attention [Ditzler 16]. In another study referring to the importance of PI, thorough examination of the factor was suggested despite the positive attitudes of the students towards tablet computers [Pruet 16]. In light of this data [Verizon 15], states that PI is among the important factors affecting the students' acceptance of tablet computers.

In the studies conducted during the recent years, it can be observed that its aim was to clarify which applications to be used during the learning process along with the methods and environments [Uzunboylu 17; Kanbul 17]. Tablet computers are being used as a learning tool in many educational institutions worldwide and the acceptance of students towards these tools is deemed important. Despite the existence of research studies focusing on the tablet computer acceptance of students, the absence of studies including SI and interactive factors has been established. Concordantly, the development of a TAM-based scale, which can evaluate the secondary education students' acceptance while involving the interactive and SI factors, is aimed in this study.

1.4 Aim of the study

The aim of this study is to develop a scale which can provide TAM-based evaluations on factors affecting the tablet computer use of secondary education students, while also involving the interactive and socially influencing variables.

2 Method

The research is designed with a survey model which is a descriptive research model. 'Survey model is a design which is created on an entire universe or a group, for example, or a sample thereof with the purpose of reaching a general judgement about a universe of multiple elements' [Herrero 17; Karasar 17; Mortenson 16]. In this study, TAM was taken as a basis framework, with interaction and SI variables, in order to determine the factors affecting technology acceptance and usage behaviours of secondary students who use tablet computers as a supportive material.

2.1 Participants

During the development stage of the tablet computer acceptance scale, the participants of the research were 550 students from different education institutions. 292 (53.1%) of the participants are female and 258 (47.9%) are male. The students are between the ages of 11 and 13; the majority of them are 11 and 12.

2.2 Scale

The tablet computer acceptance scale has been developed by taking Davis's TAM as a basis. This model includes four factors. These factors are those which are also included in the TAM; perceived benefits, PEU, ATU and intention towards use. The SI factor is included in the enhanced TAM developed by Davis [93] by adding additional factors to their previously developed model. The PI factor was included to the scale after an examination of the literature, which leads to the realisation of its importance by the researchers. Thereafter, the total number of the factors was six. While developing the scale, the researchers primarily made an examination of the literature to form items which can apply to all factors and these items were afterwards prepared in accordance with the using of tablet computers. The prepared survey consists of six factors; PEU, perceived benefits, ATU, intention of use, PI and SIs.

In the researchers' item pool, the first three factors are composed of 10 items, the fourth is composed of four items, the fifth includes eight items and the last one follows with seven items. For the participation rate of the item pool, a five-point Likert-type scale was chosen and the results gathered according to the following options: 'strongly agree (5), agree (4), undecided (3), disagree (2) and strongly disagree (1)'.

2.3 Procedure

Framework, face and construct validities were taken under consideration during the validity studies of the scale. For framework and face validity sections, the experts to be presented with the scale were chosen among academicians from the fields of computer and instructional technologies, assessment and evaluation, developmental psychology and Turkish language. Five experts examined the factors and items, and suggested the removal of two items from the ease of use factor, one item from perceived benefits, three items from ATU, two items from PI and one item from SI. They also requested alterations to be made on one item from each of the SI, PI and ATU factors. All of the readjustments suggested by the experts were applied and nine

items were removed from the scale. The ensuing state of the scale after the framework and face validities was composed of 40 items.

After these procedures, it was proceeded with the concrete and reliability validation studies. In the concrete validity of the scale, its structure was examined through the exploratory factor analysis (EFA). For the pilot study, the scale was distributed to 244 students for validation studies and 225 of the scales were returned. 11 of them were removed because only one 'agree' related item was marked in each. Additionally, if any of the items were left unmarked, the scale was also removed from the data research. As a result, the analysis was conducted from 214 students' surveys. The relationship between the factors that form the scale was also taken under consideration. After the EFA results, data collection for the confirmatory factor analysis (CFA) was performed. The scale was distributed to another 306 students for validation studies and 282 of the scales were returned. 27 of them were removed because only one 'agree' related item was marked in each. Additionally, if any of the items were left unmarked, the scale was also removed from the data research. As a result, the analysis was conducted from 255 students' surveys. As the resultant, the scale has a six-factorial structure with 29 items (Appendix A). The package software was used for this procedure; SPSS v24.0 for EFA and correlation and Amos v24 for CFA.

3 Findings

Primarily, EFA was applied to determine the scale's factorial structure and that process was followed by the CFA. The EFA was done with the 40 items included in the tablet computer acceptance scale. The sample's efficiency was examined by using the Kaiser–Meyer–Olkin (KMO) value in the EFA and its accordance to the factor analysis was examined by using Bartlett's sphericity value. The KMO value was found as 0.90, and as the result of the Bartlett's test, the statistically significant different was measured as (χ^2 = 4911.729, p = 0.001). In light of these values, the probability of the appliance of EFA has been confirmed. Forty items of the scale were taken into a maximum probability test by taking 'six' as the number of factors and a varimax rotation was carried out. As a result of the EFA, the scale consisted of 29 items and six factors. The scree plot graphic of the scale provides evidence of the scales' six-factorial structure. The scree plot graphic of the scale is presented in Figure 2.

The first factor of the scale was formed by the PEU with eight items, an eigenvalue of 11.77 and an explained variance of 30.42%. The second factor of the scale is the perceived usefulness (PE) with nine items, an eigenvalue of 2.61 and an explained variation of 7.52%. The third factor is ATU with seven items, an eigenvalue of 1.15 and an explained variation of 3.88%. The fourth is IA with four items, an eigenvalue of 1.30 and an explained value of 3.27%. The fifth is the PI with six items, an eigenvalue of 1.11 and an explained variation of 2.77%. Finally, the factor is SI with six items, an eigenvalue of 0.87 and an explained variation of 2.18%. The total variance result of the tablet computer acceptance scale's EFA is 50.07%. The explained variance, especially in social sciences, is observed to be between 40%–60%. Thus, it can be said that the variance criterion defined by the scale is thoroughly

efficient. As the resultant, the scale has a six-factorial structure with 29 items. Table 1 can be examined for the EFA findings.

Item	Factor loading					
	PEU	PU	ATU	IA	PI	SI
1	0.80					
6	0.77					
4	0.71					
2	0.67					
3	0.54					
8	0.52					
26		0.74				
25		0.66				
27		0.61				
28		0.57				
24		0.53				
22		0.52				
21		0.51				
19		0.50				
38			0.66			
36			0.63			
39			0.63			
35			0.54			
37			0.54			
9				0.75		
10				0.67		
11				0.50		
29					0.64	
31					0.64	
32					0.52	
14						0.63
7						0.55
15						0.53
13						0.51
Eigenvalue	11.77	2.61	1.15	1.3	1.11	0.87
Explained variance (Total = 50.07)	30.42	7.52	3.88	3.27	2.77	2.18

Table 1: EFA table for tablet computer acceptance scale

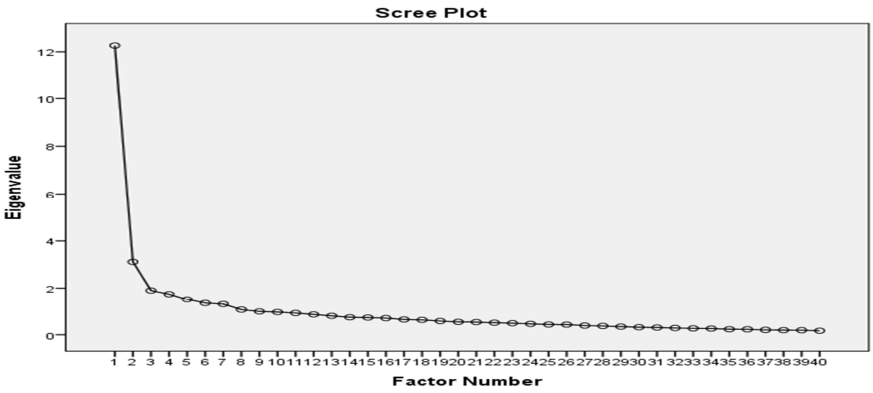


Figure 2: Scree-plot graphic of the scale

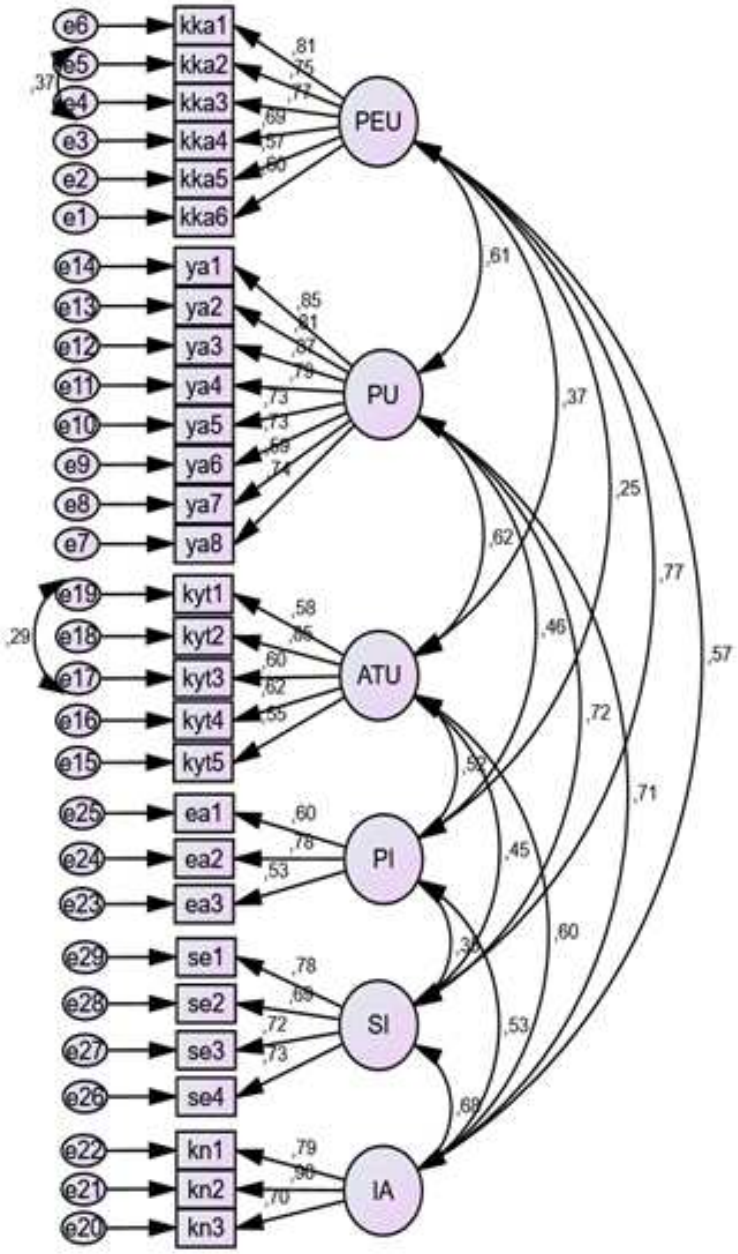
After the analysis, items with lower factor loads of 0.50 have been removed from the scale. The scale is observed to have a total of 29 items and a six-factorial structure that includes six factors for PEU, eight for PU, five for ATU, three for IA, three for PI and four for SI.

3.1 CFA related findings

This scale was re-applied to different students (N = 255) from the students who were applied in the pilot study for CFA. So, the six-factorial structure of the tablet computer acceptance model which includes 29 items has been tested via CFA. Firstly, with CFA, the fit indices of the six-factorial model that include 29 items have been examined.

In the CFA, it has been observed that the PEU factor has respectively 77, 0.82, 0.81, 0.64, 0.57, 0.58, 0.53; PU has respectively 0.85, 0.80, 0.88, 0.79, 0.73, 0.70, 0.55, 0.75; ATU has respectively 0.61, 0.85, 0.62, 0.62, 0.55, PI has respectively 0.58, 0.79, 0.52; SI has respectively 0.78, 0.72, 0.70, 0.75 and IA has respectively 0.79, 0.90 and 0.69 standard solutions. Since all factors have a value over 0.45, it can be inferred that all 29 items are of importance for these six factors (Figure 3).

In the CFA, a suggestion for making alterations on the first and the third items of ATU had been put forward and the alterations were made accordingly. As a result of the CFA, the $\chi 2/df$ = 2.01, SRMR = 0.071, RMSEA = 0.063, GFI = 0.84 and CFI = 0.91 fit indices have been observed. According to [Mertler 16], the fit indices are accordant and acceptable as CFA results.



Chi -Square=723.089 df=360 p-value=0,00000 RMSEA=0.63

Figure 3: Path diagram for the CFA Results

3.2 Scale validity

Total score of the tablet computer acceptance scale and each of the correlation coefficients between the six factors are examined for the scale's validity.

It has been observed that the scale's total score and the correlation values of the six factors have high levels and that these values have a significant correlation of 0.01. The scale's coefficient of correlation with the factors varies between 0.21 and 0.58 and these values once again show a significant correlation of 0.01. Related findings to the coefficient of correlation show a compatible and relatable relationship between the factors that compose this scale (Table 2).

	PEU	PU	ATU	PI	SI	IA
PEU	—	0.47**	0.28**	0.21**	0.57**	0.36**
PU		—	0.51**	0.40**	0.57**	0.58**
ATU			—	0.36**	0.33**	0.45**
PI				—	0.30**	0.40**
SI					—	0.46**
IA						—

**$p < 0.01$.

Table 2: Tablet computer acceptance scale correlation values between factors

3.3 Findings on Reliability

Internal consistency and the total item correlation values related to the reliability of the tablet computer acceptance scale have been examined. The internal consistency coefficient of the scale's 29 items was found as 0.92, while the items' total correlation varies between 0.062 and 0.703. The internal consistency coefficient for the PEU factor is 0.85, followed by 0.88 for PU, 0.78 for ATU, 0.80 for IA, 0.66 for PI and 0.80 for SI. In proof of reliability, the correlations of all 29 items show that all factors below 0.90 are also higher than 0.66.

4 Discussion, conclusion and suggestions

As a result of technology development, the use of smaller and portable devices has become a necessity. Portable devices defined as mobile devices such as cellular phones, tablet computers etc., have started being used in the educational field similar to all others. It can be observed that tablet computers are frequently used in especially primary and secondary educational institutions. Conducted studies show that the use of mobile devices in education motivate the students, generate their interest, provides a more flexible environment for learning and aids in efficient management of time.

Thus, these mentioned benefits support the opinion of practicing mobile technologies in educational environments [Ditzler 16].

Tablet computers, a part of mobile technologies, show a rapid development and is being used in education like other congeneric devices. There are studies that display positive opinions about students benefiting the advantages of tablet computers during classes [Baumgart 17; Crompton 17] as well as some critiques [Montrieux 2017] and others which argue that student interaction is inadequate in education with tablet computers [Ackermann 17; Walczak 18]. The use of tablet computers directs us to the question; 'Are students adopting to tablet computers?' With the steering of this question, a study in accordance with the TAM was formed and it was aimed to develop a TAM Scale with the literature reviews.

As a result of the research on the TAM which has 29 items and six factors, a 5-point Likert scale was formed from the sub-factors; PEU, PE, ATU, SI, IA and PI (later included in the literature by experts). The total variance of the tablet computer acceptance scale, with its 29 items and six-factorial structure, is 50.07%. It has been found that the scale structure's variance efficiently clarifies the qualities it measures.

By examining the fit indices of the scale's structure, it has been observed that the indices are χ^2/df = 2.01 (Chi-Square Goodness of Fit, x^2), SRMR = 0.071 (Standardized Root Mean Square Residual), RMSEA = 0.063 (Root Mean Square Error of Approximation) , GFI = 0.84 (Goodness of Fit Index) and CFI = 0.91 (Comparative Fit Index) According to Mertler and Reinhard (2016), the χ^2/df, SRMR, RMSEA, GFI and CFI fit indices have an acceptable accordance. However, the fit indices for AGFI, GFI and NFI have lower values than 0.90, the acceptance boundary, yet the values of the indices are close to the boundary. In the literature, at least two or more fit indices are expected to be within the boundaries of acceptance. In this regard, it can be said that the scale has admissible accordance. Evidences for consistency and total item correlation values have been gathered for the scale's reliability. The value of Cronbach's alpha, that includes all 29 of the items for internal consistency, was measured as 0.92. These values being within the boundaries of reliability indicate the internal consistency of this scale being efficient.

Nowadays, the importance of accepting tablet computers, especially as a learning tool for secondary education students, is being frequently emphasised. In this regard, when the importance of adaptation is considered in the use of technological devices, the developed scale is of importance for determining the acceptance of secondary education students and conducting further studies on increasing their level of adaptation. During their content analysis study, which have emphasised the interest of many researchers on the subject and that the model can have several undiscovered factors. This finding is an indicator of this model's extensiveness and effectiveness in the field. The adaptation of a new tool also indicates the effectiveness of this model. In this aspect, the importance of a model-related measuring scale also emerges. With this scale, it can be indicated that the adaptation of tablet computers can be measured in a reliable fashion, and also, the scale can be beneficial in remedying the deficiencies for the lack of a measuring tool. These measurements are expected to provide both standardisation in country-wide measurements and equality in opportunities.

With the tablet computer acceptance scale, country-wide comparative studies can be conducted on secondary education students. In future studies, the existence of

similarities of a scale to be implemented with the participation of primary and secondary education students can also be examined. Additionally, with the data gathered from the scale, research studies on the existence of differences can be conducted depending on variables such as high school types, sex, age, demographic features of the students (such as the cities they are educated in), way of learning, their attitudes, strategies and preferences. The scale can also be used to compare the models which examine the external variables affecting the tablet computer acceptance of primary or secondary education students; such as, self-efficacy, concerns, trust, experience and entertainment. Additionally, the scale can also be used to conduct research on determining integration tools such as information, skill and affective features; and planning relative trainings for students.

Several limitedness examples can be observed in this research. The first is that during the validation studies, external criteria were excluded. To ensure the external criterion validation of the scale, a technology acceptance based measuring tool that focuses on sex, age and personal computers can be utilised in future studies. The secondary limitation occurs when the students from governmental secondary education institutions are not included in the sample survey. Similar or comparative studies can be conducted in the future by including samples from governmental education institutions.

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Appendix A

Perception of secondary school students as regards usage of tablet PC in courses SA: Strongly agree A: Agree NA: Neither agree nor disagree D: disagree SD: Strongly disagree						
No	Survey questions	SA	A	NA	D	SD
1	It is easy to use tablet PC in courses					
2	Learning how to use tablet PC is easy for me					
3	Interaction with tablet PC is clear and understandable (interface, menu, etc., of tablet PC)					
4	I can find information easily with tablet PC					
5	I can access information easily with tablet PC					
6	Doing homework is easy and fast with tablet PC					
7	In order to avoid the load of school bag, it is necessary to use tablet PC					
8	Tablet PC increases success at teaching					
9	Tablet PC increases my performance in my classes					
10	Tablet PC increases my creativity / efficiency in my classes					
11	Tablet PC makes sure that I do my class works more rapidly					
12	Tablet PC makes application of teaching activities easier					
13	Using tablet PC in courses will increase the quality of education without spending more effort					
14	Generally I would like to use tablet PC in my classes					
15	I believe that using tablet PC in courses is a stupid idea					
16	Using tablet PC is beneficial for me					
17	My courses are more fun with tablet PC					
18	I want to use tablet PC in all of my classes					
19	I will frequently make use of tablet PC					
20	I will frequently use tablet PC for my classes					
21	I will recommend using tablet PC in classes					
22	I discuss course topics with my classmates on tablet PC					
23	I establish communication with my classmates using tablet PC					
24	I use Facebook messenger on tablet PC for instant interaction with my classmates					
25	My friends in my environment who use tablet PC have more reputation / success compared to those who do not					
26	Students who use tablet PC in classes are more successful					
27	Me using tablet PC in my classes is an important event for my friends too					
28	My teachers who I take as an example think that I should use tablet PC in classes					
29	My friends think that I should use tablet PC in classes					