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ORIGINAL RESEARCH ARTICLE

Predicting the secondary school students' intention to use e-learning technologies

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Technology acceptance studies are interesting because they are practical and theoretically helpful in explaining the adoption and intention to use a particular technology. There is a large amount of research on e-learning and other technologies in the literature, but there is limited evidence to explain why secondary school students' intention to use e-learning. This study explains secondary school students' intentions to use e-learning with an extended Technology Acceptance Model (TAM). TAM is a useful theory to explain how people adopt new technologies in different fields. Data were collected from 2739 secondary school students in Turkey (Mage = 11.95). Confirmatory factor analysis (CFA) and structural equation modelling (SEM) were used to test the conceptual model. The results are consistent with the original TAM model. The most critical variable affecting secondary school students' intention to use e-learning technologies is enjoyment. The results show that there may be differences in the intention to use e-learning technologies for secondary school students in different cultures and contexts.

Keywords: e-learning; TAM; technology acceptance; perceived enjoyment; secondary school students; K–12

Introduction

With the COVID-19 pandemic, popularity of e-learning has increased even more. Because face-to-face education, which was interrupted during the pandemic, was supported by online learning methods in higher education (Almaiah, Al-Khasawneh, and Althunibat 2020) and K–12 education (Asvial, Mayangsari, and Yudistriansyah 2021). When e-learning research trends are examined, it can be said that most of the studies have been carried out at the higher education level, and studies at the K–12 level are limited (Arnesen *et al.* 2019). The increasing use of e-learning is emerging as a new concept, sometimes as technology and sometimes as a method, especially for younger students (Bhaumik and Priyadarshini 2020). For this reason, it is crucial to understand how students in the younger age group perceive e-learning and what factors affect their adoption of e-learning. In this way, better e-learning environments and applications can be designed.

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This study aims to understand secondary school students' intentions to use e-learning in Turkey. For this purpose, an extended theoretical model based on TAM is proposed. The TAM argues that user acceptance of technology may occur depending on the variables of perceived usefulness (PU) and perceived ease of use (PEU) (Davis 1989). TAM is a powerful theory that contributes to understanding the factors that affect individuals' adoption and acceptance of new technologies in different fields (Marangunić and Granić 2015). Also, many studies based on TAM have been carried out to understand the factors affecting the adoption of e-learning-related technologies by students (Abdullah and Ward 2016; Nguyen *et al.* 2020). These studies have shown that TAM is also a viable and valid model for e-learning applications. When the e-learning and TAM-based researches are examined, although much research has been carried out at the higher education level, studies at the K–12 level are pretty limited (Cheng and Yuen 2018, 2019; Teo *et al.* 2019; Zhao *et al.* 2021). On the other hand, studies based on TAM emphasise that cultural differences can affect the acceptance and adoption of e-learning (Zhao *et al.* 2021). No study up to date has been found that deals with the variables that affect the adoption of e-learning by students studying at the K–12 level in Turkey within the framework of TAM.

Online learning applications to support face-to-face teaching at the K–12 level have been used for a long time in Turkey. Examples of these are the Educational Information Network (EBA) (Aktay and Keskin 2016) and TV broadcasts (Bozkurt 2017) created by the Ministry of National Education. However, there is no regular distance education practice in Turkey, where students carry out their main education processes online until the pandemic (Fiş Erümit 2021). With the COVID-19 pandemic, students continued their interrupted teaching processes with online live lessons and previously available e-learning resources (Can 2020). Therefore, it can be said that students at the K–12 level in Turkey have encountered e-learning applications in real terms during the pandemic period.

In recent years, the increasing popularity of e-learning applications and worldwide health concerns have increased the importance of the factors that will impact the use of these technologies in secondary schools. However, knowing little about the factors affecting K–12 students' intention to use e-learning creates a significant gap, both theoretically and practically. This research is significant as it is the first study to determine the intention of secondary school students in Turkey to use e-learning technologies. In addition, considering the limited number of studies in the literature explaining the intention of students at this level to use e-learning technologies, it is thought to contribute to the literature.

Research model and hypotheses

In this section, the research model and hypothesis are explained. The basis of this study is TAM, and the model has been expanded with two external (Perceived Enjoyment and Computer Self Efficacy) variables to explain students' adoption of e-learning. Figure 1 presents the research model used in this study. In the study, 7 hypotheses were tested to explain the secondary school student's behavioural intention (BI) from using the e-learning system in Turkey.

Technology acceptance model

Technology acceptance model (TAM) initially developed by Fred Davis (1989). TAM is the most known model for user adoption and acceptance of information

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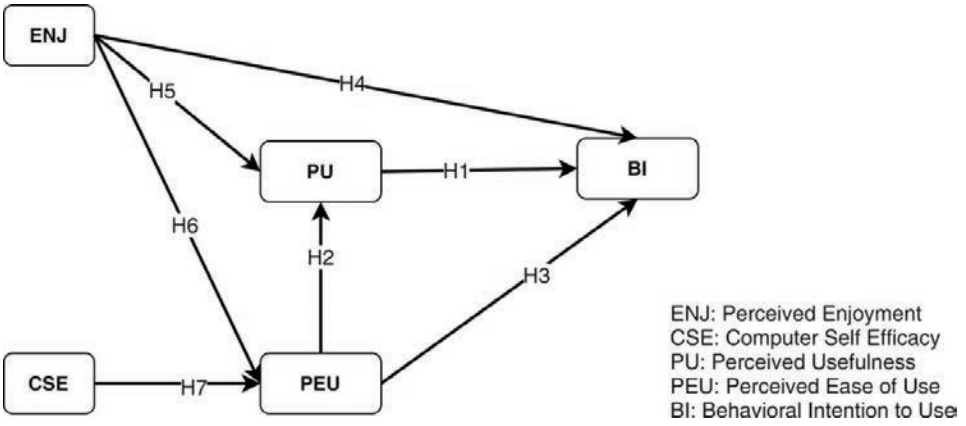

Figure 1. Research model.

technologies (Davis and Venkatesh 1996). TAM emphasises two key individual beliefs to understand a user's BI to use technology. These are PEU and PU. PU is defined as 'the prospective user's subjective probability that using a specific application system will increase his or her job performance' and PEU refers to 'the degree to which the prospective user expects the target system to be free of effort' (Davis 1989). BI is expressed as an important indicator of an individual's exhibiting a given behaviour (Ajzen & Fishbein 1980). Attitude construct included in original TAM excluded from the final TAM model. Because empirical evidence showed that attitude did not fully mediate the effect of PEU on BI (Davis and Venkatesh 1996).

TAM is a valid and useful model for various information technologies, work environments and individuals (Legris, Ingham, and Collerette 2003). Similarly, TAM reveals that it is an effective model in explaining students' acceptance and adoption of e-learning in different educational contexts (Cheng 2011; Purnomo and Lee 2013; Salloum *et al.* 2019). Previous studies show that, as indicated in the main TAM model, PU affects BI positively (Cheng and Yuen 2018, 2019; Teo *et al.* 2019; Zhao *et al.* 2021), PEU affects BI positively (Cheng and Yuen 2018, 2019) and PEU also affects PU positively (Cheng and Yuen 2018, 2019; Teo *et al.* 2019; Zhao *et al.* 2021).

Based on TAM's theory, the following research hypotheses included:

H1: Perceived usefulness (PU) is positively related to one's intention to use (BI) e-learning
H2: Perceived ease of use (PEU) is positively related to the PU of e-learning
H3: Perceived ease of use (PEU) positively affects one's intention to use (BI) e-learning

Perceived enjoyment

Perceived enjoyment (ENJ) is an indicator of intrinsic motivation and is the degree to which the user's computer use is perceived as enjoyable (Davis, Bagozzi, and Warshaw 1992). Intrinsic motivation means that an individual does an activity for its own sake because she/he finds it interesting or satisfying for her/him (Lee, Cheung, and Chen 2005). Prior studies have found ENJ has a direct influence on individual's PEU (Cicha

et al. 2021; Findik-Coşkunçay, Alkiş, and Özkan-Yildirim 2018; Rizun and Strzelecki 2020), PUS (Abdullah and Ward 2016; Chang, Hajiyev, and Su 2017; Teo *et al.* 2019) and BI (Findik-Coşkunçay, Alkiş, and Özkan-Yildirim 2018; Teo *et al.* 2019; Vladova *et al.* 2021). Thus, it is hypothesised that:

H4: Enjoyment (ENJ) is positively related to one's intention to use (BI) e-learning
H5: Enjoyment (ENJ) is positively related to the PU of e-learning
H6: Enjoyment (ENJ) is positively related to the PEU of e-learning

Computer self-efficacy

Self-efficacy is the belief that an individual can do a job that has an impact on his/her life at the specified level of success (Gallagher 2012). Efficacy beliefs affect people's feelings, thoughts, self-motivation and behaviours (Bandura 1993). Computer self-efficacy (CSE) also refers to an individuals' beliefs about their abilities to efficiently use computer technologies (Compeau and Higgins 1995). Studies in the literature generally emphasise that CSE has a positive direct and significant effect on PEU (Kanwal and Rehman 2017; Salloum *et al.* 2019; Teo *et al.* 2019). Although there are studies reporting a significant positive effect of CSE on PU (Abdullah and Ward 2016; Cicha *et al.* 2021; Rizun and Strzelecki 2020), this effect was generally insignificant (Chang, Hajiyev, and Su 2017; Kanwal and Rehman 2017; Salloum *et al.* 2019). Therefore, in this study, it is hypothesised as follows:

H7: Computer self-efficacy (CSE) is positively related to the PEU of e-learning

Method

Participants and data collection

Convenience sampling method was used as the sampling method due to the ease of access to the participants due to the pandemic conditions. With the convenience sampling method, data can be obtained easily and quickly from appropriate data sources (Lavrakas 2008). Before the data collection process, necessary permissions were obtained from the national education directorate and the university's ethics committee. The participant population of the research consists of secondary school students studying in the 2019–2020 academic year. Necessary information was given to the families of the students through the Directorate of National Education, and the questionnaire was delivered in the online form. The data were collected anonymously. A total of 2890 students responded voluntarily to the study. In preliminary analysis, all of the answers with missing data, the participants who entered the same answer to all the questions, the records where the same answer was entered consecutively were excluded. A total of 2739 (female = 56.7% and male = 43.3%) valid responses were collected and adopted for further data analysis. The ages of the students range from 9 to 15, with a mean age of 11.95 (standard deviation [SD] = 1.2).

Students' e-learning experiences

The distance education process was carried out in a similar way throughout the country. This process is carried out by the Ministry of National Education and its affiliated

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units. Students experienced e-learning for the first time with the interruption of formal face-to-face education during the COVID-19 pandemic. E-learning activities continued in the form of synchronous online learning. Weekly and daily lesson plans were created for online education like face-to-face education. In this way, they have been provided to learn various lessons online live at different times of the day. Synchronous lessons were carried out on the EBA Live Course Application (Atmaca 2021), which is similar to Zoom application.

Instrument

The questionnaire for the study distributed to respondents in Turkish language and consisted of two parts. The first part contains information about demographic variables – gender and age. The part two contains 18 survey items to test the research hypotheses. The items were developed by adapting from the existing literature to make them consistent with the requirements of the current study. In order to make sure that the students understood the adapted questionnaire items correctly, each question was evaluated together with a questioner and a student by the researcher, and necessary adjustments were made. The items and references were given in Table 1. Data were analysed by exploratory factor analysis and confirmatory factor analysis (CFA). The final version of the instrument comprised 18 items using a five-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*) for five constructs.

Table 1. Instrument and resources.

Constructs	Items	Measures	Resources
Behavioural intention to use (BI)	BI1	I intent to frequently use of the e-learning system now.	(Salloum *et al.* 2019; Venkatesh and Bala 2008)
	BI2	I will recommend using an e-learning system in the future.	
	BI3	I will use an e-learning system in the future.	
Perceived ease of use (PEU)	PEU1	It is easy for me to use the e-learning system.	(Teo *et al.* 2019; Venkatesh and Bala 2008)
	PEU2	It is easy for me to attend the e-learning courses.	
	PEU3	I find the e-learning system to be easy to use.	
	PEU4	Using the e-learning system does not require a lot of my effort.	
Perceived usefulness (PU)	PU1	Using the e-learning system improves my learning performance.	(Teo *et al.* 2019; Venkatesh and Bala 2008)
	PU2	Using the e-learning system makes easier my learning.	
	PU3	Using the e-learning system enhances my effectiveness	
	PU4	I find using the e-learning system to be useful.	
Perceived enjoyment (ENJ)	ENJ1	I find using the e-learning system to be enjoyable.	(Teo *et al.* 2019; Venkatesh and Bala 2008)
	ENJ2	The e-learning system is a pleasant environment.	
	ENJ3	Using the e-learning system increases my curiosity.	
	ENJ4	I like the lessons in the e-learning system.	
Computer Self-efficacy (CSE)	CSE1	I could use the e-learning system even if there was no one around to tell me what to do.	(Salloum *et al.* 2019; Venkatesh and Bala 2008)
	CSE2	I have sufficient skills to attend the e-learning courses.	
	CSE3	I could use the features of the e-learning system by on my own.	

Table 2. Descriptive statistics of the study constructs.

Construct	Item	Mean	SD	Skewness	Kurtosis
BI	3	3.27	1.27	−0.292	−1.061
PU	4	3.13	1.30	−0.156	−1.161
PEU	4	3.87	1.08	−0.871	−0.065
ENJ	4	3.15	1.32	−0.187	−1.164
CSE	3	4.42	0.91	−1.915	3.359

Note: SD = standard deviation; BI = behavioural intention to use; CSE = computer self-efficacy; ENJ = perceived enjoyment; PEU = perceived ease of use; PU = perceived usefulness.

Data analysis

The data were analysed using Microsoft Excel, SPSS 22 and AMOS 22. To examine the hypotheses stated in the research model, a two-stage approach proposed by Anderson and Gerbin (1988) was adopted in this study. Accordingly, first, the measurement model was tested, and then the structural model was analysed.

Results

Descriptive statistics

The descriptive statistics of each construct are given in Table 2. All means of constructs are above 3.00, and the SDs range from 0.91 to 1.32. The kurtosis (from −1.164 to 3.359) and skewness (from −1.915 to −0.156) values are within the acceptable limits suggested by Kline (Kline and Rex 2011).

Testing the measurement model

CFA with maximum likelihood estimation was used to evaluate the measurement model. For assessing multivariate normality, the Mardia coefficient was calculated. The value of 132 244 obtained in this study was lower than the suggested value $n(n + 2)$ (where n is the total observed number of items) (Raykov and Marcoulides 2008). This value shows that the multivariate normal distribution criterion was obtained for CFA.

To examine the reliability and validity of the model; construct reliability, and convergent and discriminant validity were used. Construct reliability was tested using Cronbach's α (>0.7), and composite reliability (CR > 0.7) and the internal consistency of the items in each construct were assumed valid (Fornell and Larcker 1981). Teo and Noyes (2014) stated that average variance extracted (AVE) and CR values of 0.50 or above can demonstrate the acceptable reliability of the measurement model. Also, the standardised estimate (SE) of each item was tested. It determines whether an item contributes significantly to explaining its underlying construct. The values calculated for each item were found to be higher than 0.50. This value shows that the contribution is sufficient (Hara, Takemura, and Yoshida 2010). Table 3 lists the factor loadings of the items – CR, AVE and Cronbach's α for various constructs.

To evaluate the discriminant validity, first, the square root of the AVE of each construct is calculated. If these values are greater than the correlation coefficients between the construct and other constructs, it is accepted that discriminant validity

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Table 3. Analysis summary of measurement model.

Variables	Item	SE	USE	t-Value	CR	AVE	Cronbach's α
ENJ	ENJ1	0.826	1		0.893	0.675	0.900
	ENJ2	0.838	1.007	62.074			
	ENJ3	0.818	0.991	48.328			
	ENJ4	0.804	0.955	47.276			
PU	PU1	0.835	1		0.941	0.800	0.916
	PU2	0.900	1.084	65.847			
	PU3	0.887	1.051	51.111			
	PU4	0.952	1.16	44.825			
PEU	PEU1	0.827	1		0.841	0.576	0.836
	PEU2	0.840	0.998	47.675			
	PEU3	0.792	0.885	44.612			
	PEU4	0.535	0.711	27.478			
BI	BI1	0.739	1		0.821	0.606	0.823
	BI2	0.812	1.146	39.701			
	BI3	0.782	1.043	38.458			
CSE	CSE1	0.733	1		0.797	0.567	0.790
	CSE2	0.793	0.891	34.168			
	CSE3	0.731	0.915	32.856			

Note: BI = behavioural intention to use; CSE = computer self-efficacy; ENJ = perceived enjoyment; PEU = perceived ease of use; PU = perceived usefulness; USE = unstandardised estimates; SE = standardised estimates; CR = composite reliability; AVE = average variance extracted.

Table 4. Square root of AVE and correlations between the constructs.

	BI	ENJ	PU	PEU	CSE
BI	**0.778**				
ENJ	0.771	**0.822**			
PU	0.737	0.786	**0.894**		
PEU	0.560	0.550	0.489	**0.759**	
CSE	0.372	0.367	0.293	0.592	**0.753**

Note: BI = behavioural intention to use; CSE = computer self-efficacy; ENJ = perceived enjoyment; PEU = perceived ease of use; PU = perceived usefulness. All correlations are significant at the 0.001 level. Values in bold are the constructs' square root of the AVEs.

is provided (Fornell and Larcker 1981). As shown in Table 4, the value calculated for each construct in this study meets the relevant criteria.

To analyse the fit of the measurement model, several fit indices were used: the chi-square test (χ^2) with degrees of freedom (df), comparative fit index (CFI), Tucker-Lewis Index (TLI), root mean square residual (SRMR) and the root mean square error of approximation (RMSEA). According to the limits specified by Hair *et al*. (Hair, Page, and Brunsveld 2019), the model fit indices used for the measurement model, the ratio of the minimum fit function (χ^2) and the minimum fit function to χ^2 degrees of freedom (χ^2/df) are less than 5, the CFI and TLI, with values greater than 90, which is acceptable. In addition, it is desirable that the SRMR and RMSEA values are less than 0.08. Based on these thresholds, the CFA results confirmed that the measurement model has an acceptable fit to the sample data (χ^2 = 559.366, df = 119, χ^2/df = 4.701, CFI = 0.986, TLI = 0.982, SRMR = 0.0308, RMSEA = 0.037 [0.034, 0.040]).

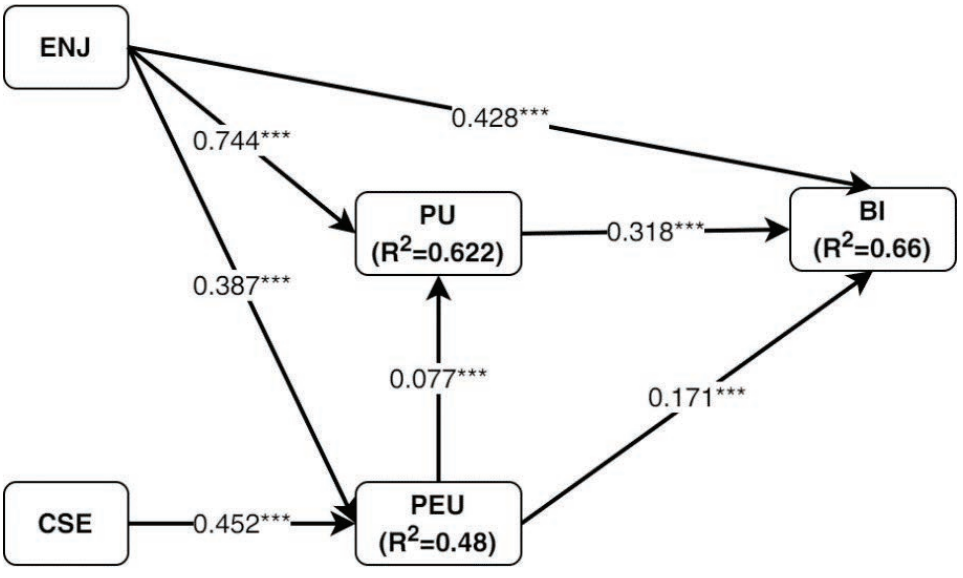

Figure 2. The structural model results.

Table 5. Path coefficients and hypothesis results.

Path	Path coefficient (β)	p	Support
H1. PU→BI	0.318	***	Yes
H2. PEU→PU	0.077	***	Yes
H3. PEU→BI	0.171	***	Yes
H4. ENJ→BI	0.428	***	Yes
H5. ENJ→PU	0.744	***	Yes
H6. ENJ→PEU	0.387	***	Yes
H7. CSE→PEU	0.452	***	Yes

Note: BI = behavioural intention to use; CSE = computer self-efficacy; ENJ = perceived enjoyment; PEU = perceived ease of use; PU = perceived usefulness.
***$p < 0.001$.

Test of the structural model

The structural model results are shown in Figure 2, together with the path coefficients (i.e. standardised beta coefficients) and their significance. The structure model received an acceptable fit (χ^2 = 567.582, df = 121, χ^2/df = 4.691, CFI = 0.986, TLI = 0.982, SRMR = 0.0312, RMSEA = 0.037 [0.034, 0.040]). All the hypothesised relationships were supported (see Table 5). For the three endogenous constructs in this study, PU was significantly influenced by PEU and ENJ, and they explained 62% of the variance. PEU was significantly influenced by ENJ and CSE, with 48% of variance explained. Finally, 66% of the total variance in BI was explained by PU, PE and ENJ.

Discussion and conclusion

E-learning applications are widely used, especially in higher education. E-learning applications have played a critical role in the sustainability of teaching, especially

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during the pandemic period. There is a lot of work to be done to understand the adoption and intentions to use e-learning applications in higher education. However, little is known about the factors that influence K–12 students' intentions to use e-learning. This creates a crucial knowledge gap. Understanding how K–12 students intend to use e-learning will help fill in the gaps in research and lead to better ways of teaching. In this study, a TAM-based model is proposed to fill this gap.

This study expanded TAM with the exogenous variables of enjoyment and CSE and investigated the factors that affect the intention to use e-learning technologies of secondary school students in Turkey. All hypotheses of the research were supported. The research results showed that TAM is a powerful model in predicting secondary school students' intention to use e-learning technologies in Turkey, as revealed in previous studies (Cheng and Yuen 2018; Kuliya and Usman 2021). Together with the exogenous variables, the model explained 66% of secondary school students' intention to use e-learning technologies.

Students' intentions (BI) are most strongly influenced by enjoyment ($\beta = 0.428$, $p < 0.001$), compared to PU ($\beta = 0.318$, $p < 0.001$) and PEU ($\beta = 0.171$, $p < 0.001$). When students perceive e-learning technologies as enjoyable, this situation increases their intention to use these technologies more than PEU and PU. Similarly, in their study with Nepali students, Teo *et al*. (2019) stated that ENJ is the variable that most affects students' intention to use it. On the other hand, in the study of Hwang *et al.* (2021), it was reported that the relationship between ENJ and the intention to use computer-based educational technologies of Malaysian students was not significant. Compared to similar studies in higher education, the ENJ→BI relationship is consistent with this study and Teo *et al*. (2019). This situation once again reveals the importance of cultural differences in adopting new technologies. Different results suggest that student characteristics and related technology are critical in revealing the intention to use a technology (McCoy, Galletta, and King 2007; Teo, Luan, and Sing 2008). However, these results differ from the results of Teo *et al*. (2019), who worked with a similar age group. In their study, only the effect of PU on intention was hypothesised, and no significant relationship was found (Teo *et al.* 2019).

PU ($\beta = 0.318$, $p < 0.001$) and PEU ($\beta = 0.171$, $p < 0.001$) also positively affect students' intention to use e-learning technologies. It shows that secondary school students in Turkey increase their intention to use e-learning technologies when they perceive e-learning technologies as requiring little or no effort and when they perceive using e-learning technologies as beneficial. The findings are consistent with the original TAM model (Davis 1989) and higher education level e-learning studies (Cheng and Yuen 2018; Kuliya and Usman 2021).

ENJ ($\beta = 0.744$, $p < 0.001$) explained the PU variable better than PEU ($\beta = 0.077$, $p < 0.001$). In other words, the fact that students perceive the use of e-learning technologies as easy and especially enjoyable increases them to find these technologies useful. These findings are consistent with similar studies in the same age group (Teo *et al.* 2019) and at the university level (Al-Rahmi *et al.* 2019; Chang, Hajiyev, and Su 2017; Salloum *et al.* 2019).

Considering the findings in terms of the PEU variable, it was found that both CSE and ENJ variables had a positive and significant relationship with the PEU variable. In other words, as students' self-efficacy towards e-learning technologies and their perceived fun in these technologies increase, their belief that they can use these technologies more easily or effortlessly also increases. In terms of the effects of the variables, CSE ($\beta = 0.452$, $p < 0.001$) explained PU better than ENJ ($\beta = 0.387$, $p < 0.001$). In a

comprehensive literature review, including the e-learning context, the essential variables that affect PEU were identified as CSE and ENJ, consistent with this study (Castiblanco Jimenez *et al.* 2020). However, studies examining the effect of ENJ on PEU show sometimes negative (Salloum *et al.* 2019) and sometimes insignificant (Teo *et al.* 2019) results.

In summary, this study shows that the TAM model successfully explains secondary school students' intention to use e-learning technologies in Turkey. The most critical variable affecting students' intention to use e-learning technologies is perceived enjoyment, which is included in the research as an exogenous variable. Finally, the results show that there may be differences in the intention to use e-learning technologies in different cultures and contexts.

Limitations and future work

This study aims to determine students' intentions at the K–12 level to use e-learning environments. There is a limited number of studies in the literature on this subject. The study is significant in this respect. However, the fact that it was carried out with the convenience sampling method due to the COVID-19 pandemic can be considered lacking in generalisability. Studies to be carried out with appropriate sampling approaches will contribute to the generalisability of the results. In addition, studies show that cultural differences can affect individuals' technology acceptance. This study was carried out in Turkey. And this only provides evidence for students in this culture. In the future, with cross-cultural studies, the factors that may affect the adoption of e-learning technologies by students at the K–12 level can be culturally compared.

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