Education and Information Technologies (2021) 26:4795–4820
https://doi.org/10.1007/s10639-021-10497-0

Factors influencing instructors' intentions to use information technologies in higher education amid the pandemic

Ferhan Şahin[1] · Ezgi Doğan[1] · Ulaş İlic[2] · Yusuf Levent Şahin[1]

Received: 31 December 2020 / Accepted: 7 March 2021 / Published online: 21 March 2021

Abstract

In today's world where digital transformation is taking place very strongly with the effect of the pandemic, there has been a transition from face-to-face education to online education. In this respect, examining variables that affect the instructors' intention to use these technologies during the pandemic has a critical role in terms of the quality of education both during and after the pandemic. The purpose of the study is to determine the variables that affect the instructors' intentions to use ITs by extending TAM and to examine the roles of individual differences (moderators) in the proposed model. Data were collected online from 321 faculty members working at various universities in fall semester 2020. PLS-SEM technique and multi-group analysis were used in data analysis. The proposed model explains 75.3% of the intention. The results showed that self-efficacy, perceived enjoyment, compatibility and facilitating conditions affect the intention to use IT. The most influential construct among these was compatibility. In addition, contrary to expectations, perceived usefulness and perceived ease of use, which are expressed as the most critical determinants, and openness and resistance to change, which are important personality traits, did not affect intention. The results provide valuable information about education during the pandemic, which can contribute to improving the quality of education during and after the pandemic. Multi-group analysis revealed that all of the moderators (gender, age, and experience) had an influence on the various relationships. Accordingly, implications for research and practice are discussed.

Keywords Technology acceptance · Higher education · Instructors · Information technologies · TAM · PLS-SEM

✉ Ferhan Şahin
ferhansahin@anadolu.edu.tr; sahinfrhn@gmail.com

Extended author information available on the last page of the article

1 Introduction

Although the use of technology in education has been continuing for years, the increase in integration studies carried out in recent years draws attention. Especially higher education institutions accelerate the integration of educational technology (Garone et al., 2019). Turkey is one of the countries where universities make significant investments in educational technology. In particular, higher education institutions offering a wide range of opportunities in terms of e-learning systems and distance education can be examples of Turkey's approach in the context of ITs and education. However, although the variety of technologies and access have increased over the years, it is obvious that this alone cannot provide the effective use of technology in education (Tondeur et al., 2016). In this context, in order for an institution to get efficiency from its investments in information systems, primarily the use of technology by its target audience (Yi & Hwang, 2003) and the acceptance of educational technologies by users play a key role in successful integration processes (Garone et al., 2019).

Despite the development of new technologies and access to these technologies have increased, it is observed that the potential of the use of information technologies in education has not been fully reached yet (El Alfy et al., 2017). At this point, the most striking factor can be expressed as whether educators exhibit the behavior of using instructional technologies. Considering that the training that learners receive with the effective and intensive use of instructional technologies will deeply affect their future technology use, it can be stated that the acceptance of technology among educators, especially by instructors, plays a key role. Accordingly, it is very important for instructors to be competent in this subject to create effective learning processes by using information technologies effectively (El Alfy et al., 2017).

Considering the importance of technology acceptance by instructors, variables that have the potential to affect the use of information technologies in educational settings especially come to the forefront. Analysis of the factors affecting the success or failure of integration is among the most salient studies in education. In the context of examining these factors in studies, it is observed that technology acceptance models are emphasized as the most used tools (Sánchez-Prieto et al., 2017). Many theories have been created since the emergence of technology acceptance models, and the most widely used and accepted one among them is the Technology Acceptance Model (TAM). TAM, is addressed as a strong, reliable and operationally effective (Davis, 1989) and as the most frequently used model in studies conducted in terms of the adoption of technology. In addition, TAM stands out with its simple and adaptable structure, allowing models to be extended without making them complicated (Al-Emran et al., 2018; King & He, 2006; Teo et al., 2008) and to better explain intention parsimoniously (Venkatesh et al., 2003). Due to these features, the authors preferred TAM instead of other dominant theories and models such as UTAUT and TPB (Williams et al., 2015) as the basis of the model to be developed. However, it is observed that the number of up-to-date IT acceptance studies covering university instructors

in Turkey is not sufficient. Furthermore, studies on the acceptance and use of technology mostly focus on students, pre-service teachers, and teachers (Baydaş, 2015; Baydaş & Yilmaz, 2018; Teo et al., 2012; Ursavaş et al., 2014). In line with this, it can be said that there is a gap in the field due to the insufficient number of comprehensive technology acceptance studies focusing on university instructors. Moreover, under the effect of the pandemic, the fact that many institutions and educators around the world have changed their methods from the traditional education to information technologies such as e-learning and distance education has made the integration processes even more important (Lowenthal et al., 2020; Toquero, 2020; Trust & Whalen, 2020). Considering that the educators' use of educational technologies in terms of the quality of education in today's pandemic environment has become much more important and especially the importance of the successful distance education, examining the variables that have the potential to affect the IT acceptance of instructors is of key importance. Furthermore, it is thought that the applicability of the TAM in the context of university instructors in Turkey is not clear due to the small number of studies. In this context, this study aims to determine the variables affecting the instructors' intention to use IT, examine the role of individual differences (moderators), and verify an extended TAM for the IT acceptance of instructors in the context of Turkey.

2 Theoretical background

2.1 Technology acceptance model

Among acceptance theories, TAM stands out as a key model in explaining the acceptance of technology (Lu et al., 2019). TAM is regarded as the most frequently used model in studies conducted in terms of the adoption of technology and stands out with its simple and adaptable structure that provides high explanatory power, allowing models to be extended without making them complicated (Al-Emran et al., 2018; King & He, 2006; Teo et al., 2008). TAM consists of five basic constructs. These are expressed as Perceived Ease of Use (PEU), Perceived Usefulness (PU), Attitude (ATT), Intention (INT), and Actual Use (AU). Among these PEU, PU, and INT form TAM constructs of this study. PEU is explained as the degree of an individual's belief with how little effort a technology can be used (Davis et al., 1989). PU is expressed as the degree of an individual's belief in the increase in performance that he/she will achieve using a technology. Finally, INT is defined as the degree of the intention of an individual to perform a certain behavior (Davis et al., 1989).

It is observed that the relationships between PEU, PU, and INT have been determined in many TAM-based studies (Lee et al., 2003). In the same direction, it has been concluded that there are relationships between these constructs conducted with pre-service teachers (Baydaş & Göktaş, 2017; Sánchez-Prieto et al., 2017; Teo, 2009; Teo et al., 2019), teachers (Siyam, 2019; Teo, 2011; Ursavaş, 2014), and instructors (Fathema et al., 2015; Wang & Wang, 2009). Accordingly, the following hypotheses were created.

H1. Perceived ease of use has a significant effect on perceived usefulness.
H2. Perceived ease of use has a significant effect on intention.
H3. Perceived usefulness has a significant effect on intention.

2.2 External variables

2.2.1 Self-efficacy (EFF)

EFF is expressed as an individual's judgment about his/her capacity to fulfill a certain task (Bandura, 1977), and in terms of information technologies, it is explained as an individual's belief in his/her ability to perform a certain task using technology (Compeau & Higgins, 1995). It is observed that the effect of EFF on the acceptance of information technologies is studied extensively, especially in education (Baydaş & Göktaş, 2017; Nam et al., 2013; Sánchez-Prieto et al., 2017; Tarhini et al., 2014; Ursavaş, 2014). In the studies, it is stated that EFF affects the anxiety and behavioral intention, and beliefs of individuals about the difficulty of technologies. In line with the literature, the following hypotheses were proposed.

H4. Self-efficacy has a significant effect on perceived ease of use.
H5. Self-efficacy has a significant effect on intention.

2.2.2 Social influence (SI)

SI is expressed as an individual's perception of the opinions of the people he/she considers important for himself/herself (Ajzen & Fishbein, 1980). In the studies carried out on the technology acceptance in education, it is stated that SI is related to both fundemental and external variables that affect the technology acceptance (Abdullah & Ward, 2016; Chang et al., 2017; Teo, 2010; Ursavaş et al., 2019; Venkatesh et al., 2003; Wong, 2015). In parallel, the key role of SI in predicting the intention to use technology and its importance in the context of the PU structure are particularly emphasized (Tarhini et al., 2014; Ursavaş et al., 2019). Based on this, the following hypotheses were proposed.

H6. Social influence has a significant effect on perceived usefulness.
H7. Social influence has a significant effect on intention.

2.2.3 Facilitating conditions (FC)

FC is expressed as a factor that explains the perception of external control regarding the facilitation of resources (Taylor & Todd, 1995) and the user's perceptions of the factors that may affect the fulfillment of a task and the effect of the technical support and infrastructure that he/she will have when using technology (Teo, 2009; Venkatesh et al., 2003). It is emphasized that facilitating conditions such as material, technical, infrastructure, and educational support are effective in attitude towards information technologies (Lai et al., 2012; Ngai et al., 2007). FC is a useful factor in

acceptance studies conducted especially within the scope of universities (Buchanan et al., 2013). FC can be regarded as a factor that can provide a guide for the development of support and training activities as well (Garone et al., 2019). In this context, the following hypotheses were created.

H8. Facilitating conditions have a significant effect on perceived ease of use.
H9. Facilitating conditions have a significant effect on intention.

2.2.4 Perceived enjoyment (PEN)

PEN is based on intrinsic motivation (Ryan & Deci, 2000) and is expressed as the degree to which the use of a system is perceived as enjoyable (Park et al., 2012). It is emphasized that especially the enjoyment factor is effective on the PEU, PU, and INT in the use of instructional technologies (Teo & Noyes, 2011; Ursavaş et al., 2014). Furthermore, it is stated that educators may tend to abandon the technology when they think that the enjoyment provided by the use of technology does not affect their performance to the degree that justifies the effort spent (Sánchez-Prieto et al., 2019). In parallel, it can be said that the enjoyment in technology use affects educators' desire to use technology. Based on this, the following hypotheses were proposed.

H10. Perceived enjoyment has a significant effect on perceived ease of use.
H11. Perceived enjoyment has a significant effect on perceived usefulness.
H12. Perceived enjoyment has a significant effect on intention.

2.2.5 Anxiety (ANX)

ANX is expressed as the emotional reaction, concern, and fear that occur in an individual while performing a task (Venkatesh & Bala, 2008; Venkatesh et al., 2003). The negative emotions that may emerge in an individual while trying to perform a task using technology are emphasized (Sánchez-Prieto et al., 2017). In the literature, it is observed that anxiety is emphasized as one of the most important factors that can adversely affect the success of technology integration in education (Rahimi & Yadollahi, 2010). Furthermore, it is stated in acceptance studies conducted in education that anxiety affects various acceptance constructs (Baydaş & Göktaş, 2017; Nistor et al., 2013; Sánchez-Prieto et al., 2017; Ursavaş, 2014). In line with this information, the following hypotheses were created.

H13. Anxiety has a significant effect on perceived ease of use.
H14. Anxiety has a significant effect on intention.

2.2.6 Compatibility (COMP)

COMP is explained as the degree of compatibility of a technology that has been used or will be used by an individual with his/her work (Venkatesh & Davis, 2000). Accordingly, it is stated that users find technologies compatible with their own styles more

useful and prefer to use these technologies (Rogers, 1995; Ursavaş, 2014; Ursavaş et al., 2014). In parallel, it is emphasized that the incompatibility between the technology to be used in education and the teaching method preferred by the educator is one of the obstacles to the use of technology in education (Sánchez-Prieto et al., 2019). Furthermore, it is among the findings stated in the literature that compatibility in technology use studies in education affects the basic constructs of the TAM (Chen et al., 2002; Sánchez-Prieto et al., 2019). Based on this, the following hypotheses were proposed.

H15. Compatibility has a significant effect on perceived ease of use.
H16. Compatibility has a significant effect on perceived usefulness.
H17. Compatibility has a significant effect on intention.

2.2.7 Openness (OPN)

OPN is addressed as a concept that represents an individual's sensitivity to new ideas and experiences and is associated with reason and intelligence (John & Srivastava, 1999; Korukonda, 2007). Accordingly, the OPN can be interpreted as the tendency of an individual in the context of trying innovations and, therefore, the degree of willingness to use new technologies. In the domain of education, it is stated that openness to change affects the desire to integrate technologies into lessons and that openness to change facilitates the technology acceptance. Moreover, OPN is regarded as a feature that affects educators' beliefs in trying new teaching innovations and their ability to take risks in teaching (Baylor & Ritchie, 2002). In this context, the following hypothesis were presented.

H18. Openness has a significant effect on intention.

2.2.8 Resistance to change (RC)

RC, which reflects individuals' tendencies to resist changes (Oreg, 2003), is expressed as one of the key factors for the acceptance of technologies (Nov & Ye, 2008). RC is explained as having difficulty changing the normal routine and stress when an individual is faced with a change (Guo et al., 2013). It is stated that resistance, which is regarded as an important determinant in the use and adoption of IT in education, is an obstacle that should be overcome (Bhattacherjee & Hikmet, 2007). In the same direction, there are findings indicating that RC affects many acceptance constructs in education (Sánchez-Prieto et al., 2019). Based on this, the hypothesis presented below were formed.

H19. Resistance to change has a significant effect on intention.

2.3 Moderators

2.3.1 Age, gender and experience

There are several findings in the studies carried out in the context of the acceptance of technology that the age and gender of users may affect the relationships between variables. In the literature, it is stated that effort expectation, performance expectation, perceived usefulness, perceived ease of use, social influence, attitude, and behavioral intention may differ according to the gender and age (Dündar & Akçayır, 2014; Lu et al., 2019; Teo & Noyes, 2014; Venkatesh & Morris, 2000; Venkatesh et al., 2003). Previous studies have revealed that gender plays a critical role in usage behavior in the domain of IT, while the age is an important moderator in the context of intention, adoption, and acceptance (Chung et al., 2010; King & He, 2006; Tarhini et al., 2014; Venkatesh et al., 2003; Wang et al., 2009). Although the effects of age and gender in technology acceptance have been examined, it is observed that different results have been obtained. It is also emphasized that the effects of these moderators on the relationships between technology use and its factors have not been extensively tested (Lu et al., 2019). Thus, it can be mentioned that there is a requirement for testing moderators and it would be useful to examine the effects of age and gender on the relationships between the variables in the proposed model.

It has been determined in previous studies that the relative experiences of users affect the relationships between TAM constructs as moderators (Tarhini et al., 2014; Venkatesh et al., 2003). It is emphasized that experience has a continuous and strong moderator effect on expectation, intention, and behavior (Bandura, 1977). There are many studies in which experience is addressed both as a moderator and as a direct determinant related to the use of technology (Abdullah & Ward, 2016; Venkatesh & Morris, 2000).

It is among the points emphasized in the studies that the relationships between individuals' perceptions of the usefulness and ease of use of technologies and their intention to use technology are affected by their experience (Lu et al., 2019). In parallel, it is stated that experience plays a key role in explaining the adoption of technologies such as e-learning systems (Abdullah & Ward, 2016; Al-alak & Alnawas, 2011). It can be said that the experience of users can affect their competencies in using technology, especially the relationships between perceived ease of use, efficacy and intention. Accordingly, it was tested whether the hypotheses formed in the study differed according to the experience.

3 Method

3.1 Participants

The personal information form and the data collection tool consisting of two sections in which the scale takes place were delivered online to participants working as instructors at various universities in Turkey. At the end of the data collection process, 321 instructors participated in the study. Among these data obtained,

those who gave the same responses to all or most of the questions, and outliers were excluded from the study. At the end of the elimination process, the responses given by 300 instructors formed the data set. Information on the profile of the participant group in the study is presented in the Table 1.

3.2 Data collection

The measurement tool used in the study consists of two sections. The first section consists of questions on the demographic characteristics (age, gender etc.) of users and their technology competencies. The second section contains 40 items of 5-point Likert type (1 = strongly disagree; 5 = strongly agree), aiming to measure variables. In this section, adaptations were made from studies in the literature to measure the constructs in the model. As the criteria for inclusion in the study, teaching online in the spring and fall semesters of 2020 was taken as a basis. Participants from 17 different universities across the country were reached via e-mail and it was clearly stated that participation in the study was entirely voluntary and that all data to be obtained would only be used for scientific purposes. In this direction, the instructors participated by filling out the data collection tool in Google form. The first part of the data collection tool has been designed to obtain information about the moderators to be employed in multi-group analyzes. The second part is composed of items that can effectively measure the constructs selected according to the theoretical foundations for the proposed model. In line with this purpose, items were adapted from measurement tools that employed the same theoretical background as the study and verified with participants with similar characteristics in the field of education. The items used to measure PU and PEU were adapted from Teo et al. (2012). The items used to measure INT, PEN, SE, FC, SI, COMP, and ANX were adapted from Ursavaş et al. (2014). Finally, RC and OPN were adapted from Kılıçer and Odabaşı (2010).

3.3 Data analysis

For data analysis, the Partial Least Squares Structural Equation Modeling (PLS-SEM) method and SmartPLS 3 software were used. PLS method is recommended if the model tested in the study (11 constructs) is complex (Hair et al.,

Table 1 Participants' demographic characteristics

Instructors		*f*	%
Title	Research Assistant	103	32.2
	Teaching Assistant	67	20.9
	Assist. Professor	105	32.8
	Assoc. Professor	32	10.0
	Professor	13	4.1
Gender	Female	153	47.8
	Male	167	52.2

2017). Furthermore, its features such as the fact that PLS is effective in using it to predict the target variable (Sánchez-Prieto et al., 2019), its compatibility in determining the existence and power of the tested relationships and its applicability in explanatory models come to the forefront (Hair et al., 2011). Accordingly, PLS method was used for analyzes. At the first stage of the analysis, validity and reliability analyses were performed. The discriminant and convergent validities of the measurement model were examined, and the relationships between the external model and its indicators were evaluated. At the second stage, whether the relationships were significant or not, the explained variance values of the variables and their predictive power were examined (Hair et al., 2017).

4 Results

4.1 Evaluation of the measurement model

The evaluation of the measurement model includes the evaluation of its convergent and discriminant validity (Garson, 2016). Firstly, the items were examined. It was determined that the loads were between 0.654 and 0.956. Accordingly, reliability was established at the item level (Hair et al., 2010).

According to Table 2, all values related to the composite reliability (CR) were higher than 0.7, and in terms of Cronbach's alpha (α), the values were above 0.7 for all factors, except for the FC ($\alpha = 0.644$). Although reliability of FC was below the desired value, FC was included in the model since the value was marginal and CR of FC ($CR = 0.798$) was good. Finally, it was determined that the average variance extracted (AVE) was higher than 0.5 for all constructs (Hair et al., 2017). Convergent validity was established in line with these results. In the process of evaluating the measurement model, the FC1 and EFF2, which were problematic in the context of validity and reliability, were eliminated.

The HTMT ratio and Fornell-Larcker criterion were used to examine discriminant validity. According to Table 3 and Table 4, the square root values of AVE are higher than correlations between constructs, and all of the indexes obtained by HTMT ratio are blow 0.85 except COMP-INT which is under 0.90 (Fornell & Larcker, 1981; Hair et al., 2017; Teo et al., 2008). Thus, discriminant validity was established.

Before evaluating the structural model, multicollinearity was examined. Accordingly, the variance inflation factor (VIF) values of all predictors were examined (Table 5), and all the values were lower than 5 (Hair et al., 2011). The results demonstrated that there was no problem in terms of linearity among the predictors, and the consistency of the estimation coefficients was not affected by linearity (Mutambara & Bayaga, 2020). Moreover, it was determined that the model fit was good since the SRMR (standardized root mean square residual) value of the measurement model was 0.058.

Table 2 Validity and reliability analysis

Factors	Item	Item Loading	α	CR	AVE
Intention	INT1	0.914	0.931	0.951	0.829
	INT2	0.861			
	INT3	0.948			
	INT4	0.916			
Perceived Usefulness	PU1	0.879	0.891	0.932	0.821
	PU2	0.919			
	PU3	0.920			
Perceived Ease of Use	PEU1	0.895	0.887	0.930	0.816
	PEU2	0.911			
	PEU3	0.904			
Social Influence	SI1	0.896	0.840	0.903	0.757
	SI2	0.830			
	SI3	0.883			
Self-Efficacy	SE1	0.935	0.846	0.928	0.867
	SE3	0.927			
Facilitating Conditions	FC2	0.956	0.644	0.798	0.671
	FC3	0.654			
Perceived Enjoyment	PEN1	0.905	0.926	0.947	0.818
	PEN2	0.920			
	PEN3	0.886			
	PEN4	0.906			
Compatibility	COMP1	0.861	0.885	0.929	0.813
	COMP2	0.921			
	COMP3	0.922			
Openness	OPN1	0.771	0.830	0.880	0.595
	OPN2	0.834			
	OPN3	0.724			
	OPN4	0.759			
	OPN5	0.765			
Resistance to Change	RC1	0.741	0.849	0.888	0.569
	RC2	0.763			
	RC3	0.775			
	RC4	0.702			
	RC5	0.819			
	RC6	0.729			
Anxiety	ANX1	0.878	0.862	0.916	0.783
	ANX2	0.865			
	ANX3	0.911			

α Cronbach's alpha, *CR* Composite reliability, *AVE* Average variance extracted.

Table 3 Discriminant validity (Fornell-Larcker Criterion)

Factors	INT	PU	PEU	SI	EFF	FC	PEN	COMP	OPN	RC	ANX
INT	**0.910**										
PU	0.643	**0.906**									
PEU	0.614	0.602	**0.903**								
SI	0.447	0.427	0.437	**0.870**							
EFF	0.579	0.418	0.758	0.401	**0.931**						
FC	0.438	0.323	0.461	0.380	0.390	**0.819**					
PEN	0.727	0.676	0.669	0.412	0.534	0.333	**0.904**				
COMP	0.807	0.612	0.583	0.425	0.540	0.393	0.624	**0.902**			
OPN	0.485	0.458	0.462	0.316	0.534	0.365	0.497	0.496	**0.772**		
RC	-0.362	-0.362	-0.327	-0.125	-0.354	-0.246	-0.392	-0.376	-0.617	**0.755**	
ANX	-0.424	-0.382	-0.607	-0.281	-0.657	-0.352	-0.445	-0.393	-0.423	**0.501**	**0.885**

Values in bold represent the square root of the AVE (average variance extracted); Other values below the diagonal represent correlations between constructs

Table 4 Discriminant validity (HTMT Ratio)

Factors	INT	PU	PEU	SI	EFF	FC	PEN	COMP	OPN	RC	ANX
INT											
PU	0.705										
PEU	0.674	0.676									
SI	0.501	0.488	0.504								
EFF	0.652	0.481	0.874	0.471							
FC	0.546	0.417	0.536	0.490	0.426						
PEN	0.783	0.742	0.733	0.461	0.601	0.383					
COMP	0.889	0.686	0.656	0.484	0.628	0.498	0.686				
OPN	0.549	0.530	0.540	0.376	0.564	0.498	0.562	0.579			
RC	0.397	0.409	0.366	0.148	0.411	0.297	0.428	0.426	0.730		
ANX	0.469	0.428	0.691	0.325	0.766	0.373	0.489	0.444	0.501	0.572	

4.2 Evaluation of the structural model

As can be seen from the Fig. 1, the analysis results revealed that the model explained 69.9% of perceived ease of use, 54.2% of perceived usefulness, and 75.3% of intention. The analysis results demonstrated that 12 of the hypotheses were supported out of 19. Contrary to expectations, only EFF, FC, PEN, and COMP were found to have a significant relationship with INT. INT relationships for PU, PEU, SI, ANX, RC, and OPN were not significant.

The results showed that all hypotheses related to PU were accepted. It was observed that PEU, PEN, SI, and COMP have significant effects on PU. Within the scope of PEU, all hypotheses except one were supported. The relationships of EFF, FC, PEN, and ANX with PEU were found to be significant, but

Table 5 Path analysis

Path	Coefficient	T-Value	P-Value	f^2	VIF	Results
PU—> INT	0.097	$1.915^{(ns)}$	0.056	0.017	2.307	Not Supported
PEU—> INT	0.082	$1.362^{(ns)}$	0.173	0.008	3.605	Not Supported
PEU—> PU	0.173	2.615^{**}	0.009	0.032^{c}	2.038	Supported
SI—> INT	0.019	$0.547^{(ns)}$	0.585	0.001	1.450	Not Supported
SI—> PU	0.097	2.366^{*}	0.018	0.016^{c}	1.320	Supported
EFF—> INT	0.145	2.472^{*}	0.013	0.028^{c}	3.016	Supported
EFF—> PEU	0.438	7.844^{***}	0.000	0.289^{b}	2.203	Supported
FC—> INT	0.097	3.006^{**}	0.003	0.027^{c}	1.403	Supported
FC—> PEU	0.124	3.548^{***}	0.000	0.040^{c}	1.271	Supported
PEN—> INT	0.308	6.197^{***}	0.000	0.152^{b}	2.531	Supported
PEN—> PEU	0.303	4.657^{***}	0.000	0.166^{b}	1.837	Supported
PEN—> PU	0.371	5.276^{***}	0.000	0.140^{c}	2.153	Supported
COMP—> INT	0.498	7.990^{***}	0.000	0.468^{a}	2.149	Supported
COMP—> PEU	0.063	$1.333^{(ns)}$	0.183	0.007	1.882	Not Supported
COMP—> PU	0.239	3.984^{***}	0.000	0.068^{c}	1.842	Supported
ANX—> INT	0.017	$0.379^{(ns)}$	0.704	0.001^{c}	2.184	Not Supported
ANX—> PEU	-0.116	2.797^{**}	0.005	0.025^{c}	1.824	Supported
RC—> INT	0.013	$0.289^{(ns)}$	0.773	0.000	1.952	Not Supported
OPN—> INT	-0.017	$0.436^{(ns)}$	0.663	0.001	2.057	Not Supported

p: ns ≥ 0.05; * < 0.05;* * < 0.01;* * * < 0.001

[a]Large effect size

[b]Medium effect size

[c]Small effect size

not with COMP. In addition to these, it was determined that the effect size of COMP- > INT was large, EFF- > PEU, PEN- > INT and PEN- > PEU relationships was medium, and the other significant relationships had small effect sizes.

4.2.1 Effects of moderators

Before proceeding to the effects of the moderators (age, gender, and experience), measurement invariance between groups was examined with multi-group analysis. At the stage of the evaluation of measurement invariance, the MICOM (Measurement of Invariance of Composite Models) method was taken as a basis. Three recommended steps for the MICOM process were followed (Hair et al., 2017; Henseler et al., 2016). Accordingly, configural, compositional, and scalar invariance examined. Based on the fact that the groups had the same indicator and latent variables, and had gone through the same data collection process, configural invariance, was established. In the context of the compositional invariance, it was determined that

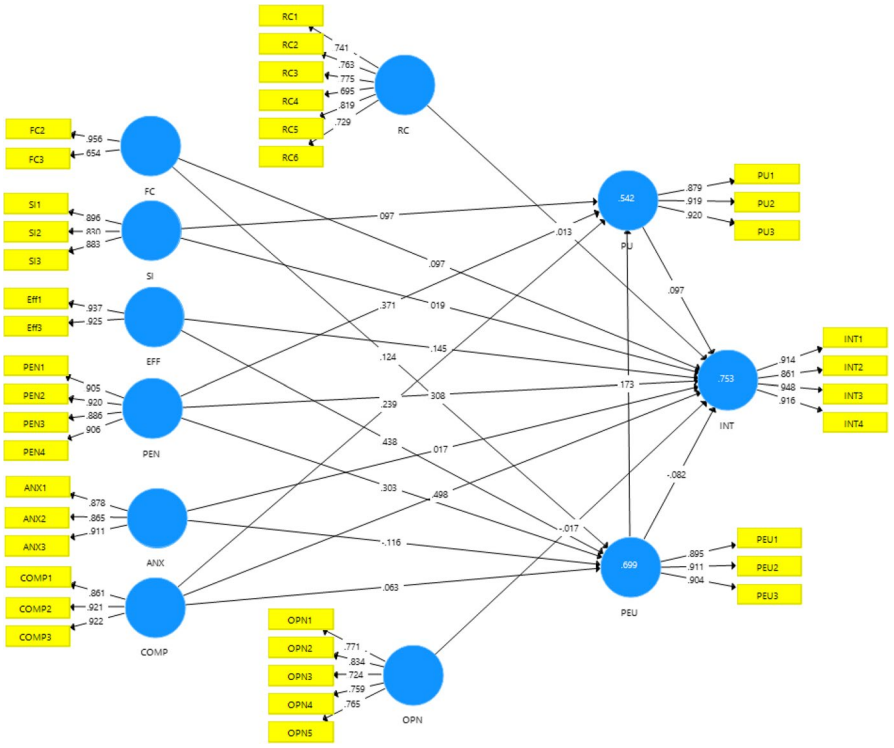

Fig. 1 Structural model of instructors' intentions to use ITs (PLS-SEM results)

the composites had similar values and did not differ between the female-male, young-old, and low–high experience groups.

For the scalar invariance, firstly, non-parametric tests were carried out over permutations. The results showed that some factors differed in all of the groups for gender, age, and experience. Therefore, configural and compositional invariance was established for all moderators, while scalar invariance was not. It is stated in the literature that full measurement invariance is generally not achieved due to its difficulty; however, establishing partial measurement invariance is sufficient to proceed to multi-group analyses (Hair et al., 2006; Henseler et al., 2016). Accordingly, multi-group analyses were performed. The analysis results are presented in the Table 6.

The results demonstrated that gender moderated two, age and experience moderated one relationship. It was determined that COMP- > INT and PEN- > INT relationships differed in terms of gender, ANX- > PEU and COMP- > INT relationships differed in terms of age, and FC- > INT relationship differed in terms of experience. Furthermore, COMP- > PEU, FC- > INT, and SI- > PU relationships were found to be significant only for females. In terms of age, EFF- > INT, PEN- > PEU, and SI- > PU relationships were significant only for the older group. Finally, in terms of the experience, it was revealed that COMP- > PU and PEU- > PU relationships were significant only for the more experienced group

Table 6 Multi-group analysis

Path	Female vs. Male		Age < 30 vs. Age > 29		H. Exp vs. L. Exp	
	t-Value	*p*-Value	*t*-Value	*p*-Value	*t*-Value	*p*-Value
PU—> INT	0.990$^{(ns)}$	0.323	1.254$^{(ns)}$	0.211	0.654$^{(ns)}$	0.514
PEU—> INT	0.713$^{(ns)}$	0.477	0.822$^{(ns)}$	0.412	1.609$^{(ns)}$	0.109
PEU—> PU	0.073$^{(ns)}$	0.942	0.394$^{(ns)}$	0.694	0.812$^{(ns)}$	0.417
SI—> INT	0.792$^{(ns)}$	0.429	0.548$^{(ns)}$	0.584	0.751$^{(ns)}$	0.453
SI—> PU	0.681$^{(ns)}$	0.496	0.703$^{(ns)}$	0.483	0.358$^{(ns)}$	0.721
EFF—> INT	0.196$^{(ns)}$	0.845	0.777$^{(ns)}$	0.438	0.000$^{(ns)}$	1.000
EFF—> PEU	0.454$^{(ns)}$	0.650	0.721$^{(ns)}$	0.472	0.357$^{(ns)}$	0.721
FC—> INT	0.545$^{(ns)}$	0.586	1.131$^{(ns)}$	0.259	2.201*	0.028
FC—> PEU	0.005$^{(ns)}$	0.996	0.829$^{(ns)}$	0.408	0.049$^{(ns)}$	0.961
PEN—> INT	2.455*	0.015	1.204$^{(ns)}$	0.230	1.276$^{(ns)}$	0.203
PEN—> PEU	0.268$^{(ns)}$	0.789	1.205$^{(ns)}$	0.229	1.389$^{(ns)}$	0.166
PEN—> PU	1.326$^{(ns)}$	0.186	0.659$^{(ns)}$	0.510	0.581$^{(ns)}$	0.562
COMP—> INT	2.164*	0.031	2.140*	0.033	0.750$^{(ns)}$	0.454
COMP—> PEU	1.113$^{(ns)}$	0.266	1.063$^{(ns)}$	0.289	1.464$^{(ns)}$	0.144
COMP—> PU	1.030$^{(ns)}$	0.304	0.933$^{(ns)}$	0.352	0.405$^{(ns)}$	0.686
ANX—> INT	1.307$^{(ns)}$	0.192	1.122$^{(ns)}$	0.263	0.844$^{(ns)}$	0.399
ANX—> PEU	0.552$^{(ns)}$	0.581	2.079*	0.038	0.047$^{(ns)}$	0.962
RC—> INT	0.385$^{(ns)}$	0.700	0.277$^{(ns)}$	0.782	0.671$^{(ns)}$	0.503
OPN—> INT	0.875$^{(ns)}$	0.382	0.348$^{(ns)}$	0.728	1.423$^{(ns)}$	0.156

p: ns ≥ 0.05; * < 0.05; * * < 0.01; * * * < 0.001

and FC- > INT and PEU- > INT relationships were significant only for the low experienced group.

5 Discussion

In this study, it was aimed to determine the variables that affect instructors' intentions to use IT and to understand the adoption processes better during the pandemic. Considering the explanatory power of the model (PEU- > 69.9%, PU- > 54.2%, INT- > 75.3%), it can be said that the explanatory power of TAM is further strengthened with this study (Davis, 1989; Lu et al., 2019; Venkatesh et al., 2003). In terms of INT, it is observed that the highest effect comes from COMP, followed by PEN, FC, and EFF, respectively. COMP is a relatively less studied construct in the acceptance studies. However, it is emphasized that COMP is an important factor and motivation source for intention to use IT, such as e-learning, and it affects attitude towards technology. At this point, it can be said that the effect of COMP on INT supports previous studies (Chen, 2011; Cheung & Vogel, 2013; Liao & Lu, 2008). The results indicate that instructors pay attention to the compatibility of IT with their expectations regarding teaching

processes rather than its characteristics or features. This result is regarded to be important concerning the IT perceptions of instructors.

The results showed that the effects of PEU and PU on INT were not significant. This striking finding contradicts the findings indicating that PU and PEU are the two most influential determinants of technology acceptance (Venkatesh & Davis, 2000), and the relationships with INT are significant (Bin et al., 2020; Scherer et al., 2019; Schoonenboom, 2014; Stewart et al., 2010; Wang & Wang, 2009; Wu & Chen, 2017; Yi & Hwang, 2003). Accordingly, the unexpected finding about PU and PEU is thought to cause the relationship between PEU-PU and INT to be weakened, as the use of IT ceased to be an option due to the pandemic and education programs had to be carried out over the internet, resulting in a mandatory situation for instructors. Findings obtained on the relationship between PEU, PU, and INT provide valuable information, especially in the context of education during the pandemic. The fact that PEU and PU act as the most influential determinants in the context of technology acceptance (Venkatesh & Davis, 2000) and that the ease of use and the benefits that can be obtained from technology are among the greatest motivation sources suggest that the technology acceptance of the instructors during the pandemic differs significantly from the pre-pandemic. The fact that previous studies in the field of education found strong effects of these two constructs on intention to a great extent (e.g. Baydaş & Yilmaz, 2018; Bin et al., 2020; Liu et al., 2019; Ursavaş, 2014; Ursavaş et al., 2019) supports this significant difference. Although online mandatory education enables the use of technology, the results of the study indicate that the effects of some of the important factors that have the potential to motivate educators are significantly weakened. This situation raises questions about the quality of education and the engagement of students during the pandemic. Accordingly, it can be inferred that taking these into account by policy makers, system and program designers will make valuable contributions to the field of education. Furthermore, based on the significant relationship of PEN, FC and EFF with INT, unlike PEU and PU, it can be inferred that emotional (PEN), institutional (FC), and individual (EFF) factors are regarded to be more important for the opinions on IT use in education during the pandemic for instructors. It is thought that these findings can provide important contributions to education during the pandemic.

In the study, it was determined that all hypotheses related to EFF were accepted. The findings related to EFF and PEU, which are closely related in the literature, confirms previous studies (Bin et al., 2020; Fathema et al., 2015; Yi & Hwang, 2003). Accordingly, the fact that instructors have the necessary knowledge and skills related to IT in education affects the level of effort required for using IT. Findings regarding EFF->INT relationship generally support the literature (Bin et al., 2020; Liaw et al., 2007; Schoonenboom, 2014; Yi & Hwang, 2003). The results indicate that if instructors consider themselves competent in using IT, they will tend to use IT.

All of the hypotheses related to FC are supported. However, it draws attention that there are studies that find the result of the effect of FC, which is a relatively less studied construct for instructors, on INT both significant and insignificant (Anderson et al., 2006; Mcgill et al., 2011; Nistor et al., 2012; Stewart et al., 2010). The results showed that if instructors had resources such as infrastructure and technical support,

they would tend to use IT. It can be stated that the opinions that the resources to be provided in terms of training and support are generally ignored and that these supports are among the main obstacles for the adoption, especially in the context of online education, support the study findings (Alavi & Gallupe, 2003; Muilenburg & Berge, 2001). On the other hand, FC->PEU relationship was found to be significant as well. Contrary to the findings of the study, it is observed that previous study results on this relationship are not generally significant (Fathema et al., 2015; Fearnley & Amora, 2020; McGill et al., 2011). According to the result of the study, FC and PEU are positively related and possible obstacles perceived by educators are linked to the resources (Scherer et al., 2019). If resources are provided such as technical support and training, instructors will find that effective IT use may require less effort than they think.

It was found that SI->PU relationship was significant, and SI->INT relationship was not significant. In terms of PU, it is indicated that the perceptions of instructors of the benefit they will gain using IT in their courses are affected by the thoughts of the people they consider important. The results confirm previous studies (Baydaş & Göktaş, 2017; Elkaseh et al., 2015; Sánchez-Prieto et al., 2019; Wang & Wang, 2009; Wong, 2015; Wu & Chen, 2017). The results for SI->INT relationship showed that SI was not effective on INT. The findings are generally in contrast with the literature (Huang et al., 2019; Sánchez-Prieto et al., 2019; Wang & Wang, 2009). Accordingly, it can be said that university instructors are not affected by the people around them in such a way as to affect their intentions to use IT. In addition, the mandatory use of IT during the pandemic may have been effective in this result.

The results showed that PEN affected PEU, PU, and INT. PEN->PEU relationship indicates that instructors find the technology easier to use if they see the use of teaching with IT as enjoyable. It can be said that the findings support the findings that enjoyment affects the belief of instructors regarding the level of effort required for the use of technology and that the attitude towards technologies such as e-learning perceived as enjoyable will be more positive (Liaw et al., 2007; Yi & Hwang, 2003). The PEN->PU finding reveals that enjoyment is regarded as an important element in the thoughts of instructors about the increase in performance they will achieve using IT. Results regarding PEN->INT showed that if instructors perceived the IT as enjoyable, they would tend to use it. Furthermore, the general findings for educators confirm the effect of enjoyment on the intention to use (Sánchez-Prieto et al., 2019; Teo & Noyes, 2011; Teo et al., 2019; Ursavaş, 2014). Considering the results obtained about PEN, it can be said that the enjoyment is related to the core constructs of TAM and that enjoyment is regarded as important for university instructors in the context of many dimensions of IT use in education.

The results regarding COMP demonstrated that it was effective on PU and INT but not on PEU. Instructors' expectations of their use of IT in teaching and the relevance of the related IT to their courses affect their thoughts about the performance they will obtain from it. In terms of INT, in parallel, the expectation and compatibility with regard to IT indicate that instructors will tend to use IT. In this direction, it can be said that the results supports the motivational feature of COMP in technology use and the results of previous studies (Chen, 2011; Cheung & Vogel, 2013; Liao & Lu, 2008). It can be said that the non-significant COMP->PEU relationship may be

due to the lack of expectations of instructors who see themselves as sufficient and have skills for IT.

The results revealed that the effect of ANX on PEU was supported, while its effect on INT was rejected. According to ANX- > PEU relationship, it adversely affects the perceptions of instructors regarding the effort required for the use of IT. The results coincide with previous studies (Baydaş, 2015; Baydaş & Göktaş, 2017; Ursavaş, 2014). In the literature, although it is emphasized that ANX is one of the most important obstacles in terms of technology integration in education (Rahimi & Yadollahi, 2010) and it is one of the most studied constructs within the scope of technologies such as e-learning (Abdullah & Ward, 2016), it is observed that it has not been adequately addressed in the context of instructors. The non-significant ANX- > INT relationship showed that the anxiety of instructors about IT did not affect their intentions. This can be interpreted as that the anxiety levels of instructors was not high enough that would affect their intentions to use IT in education due to the high level of competence of instructors.

Hypotheses regarding the RC and OPN were rejected. The insignificance of RC- > INT and OPN- > INT relationships can be considered as an unexpected result. In this respect, it was determined that the finding regarding RC- > INT path did not coincide with previous studies (Sánchez-Prieto et al., 2019). RC, which is regarded as an important precursor within the scope of the adoption of IT, is considered as an obstacle to be overcome (Bhattacherjee & Hikmet, 2007). In parallel, it is thought that the result obtained can be explained as the instructors have crossed the resistance barrier. Another explanation may be that as a result of the fact that educational practices during the pandemic require the use of technologies such as e-learning, instructors may perceive the use of IT as mandatory. Results regarding OPN- > INT which is similar to RC, showed that it may not matter whether instructors are open to changes or not, under the effect that using technology in education has ceased to be an option due to the pandemic. It can be interpreted that RC and OPN effects are weakened in cases when the use of IT in education is mandatory. This result provides valuable information for integration studies for both Turkish and foreign instructors.

5.1 Moderators

The results of multi-group analyses showed that COMP- > INT and PEN- > INT relationships differed in terms of gender, ANX- > PEU and COMP- > INT relationships differed in terms of age, and FC- > INT relationship differed in terms of experience. It was revealed that COMP- > INT relationship, which differed in terms of both gender and age, was stronger for male and young instructors. The fact that males are more pragmatic in terms of technology use and focused on performance enhancement (Minton et al., 1980) and ITs such as e-learning systems with high compatibility in education effectively help improve performance (Xu & Wang, 2006) support the conclusion that the effect of COMP on INT is more important for the male group. Likewise, the findings indicating that young users' performance expectations are stronger in terms of intention (Venkatesh et al., 2003) are in line

with the fact that the young group regards compatibility more important than the older group. The results demonstrated that the effect of ANX on PEU was stronger for the older group. Accordingly, it is observed that the perception of the level of effort towards using IT is more affected by anxiety for older instructors. Considering that young people have lower anxiety compared to the elderly (Chaffin & Harlow, 2005; Saunders, 2004) and older individuals often think that they are too old to learn new technologies (Tarhini, 2013), it can be said that the findings support previous studies. Finally, in terms of gender, it was determined that PEN- > INT relationship was stronger for females. According to the findings, it can be interpreted that if female instructors find the IT enjoyable, their tendency to use it will be higher compared to males, and the enjoyment factor is regarded more important for females. It was revealed that FC- > INT relationship, which was the only relationship that differed in terms of the experience, was stronger for the group with low experience. Resources such as training and technical support, have a higher impact on intention for the low experience group compared to the experienced. Considering factors such as the fact that the effort towards the use of technology is more critical for users with low experience (Taylor & Todd, 1995; Venkatesh et al., 2003), and in parallel, resources such as training and technical support to be provided will facilitate the use of IT. Thus, the results obtained are similar to the literature.

The multi-group analysis results demonstrated that COMP- > PEU, FC- > INT, and SI- > PU relationships were significant only for females. Result regarding COMP- > PEU relationship, considering the views that females' perceptions of ease of use are stronger depending on their self-efficacy (Tarhini et al., 2014). It can be said that their expectations for their use of IT in education may also be focused on ease of use. At this point, it can be stated that the fact that female instructors' perceptions of the effort required for the use of IT are more influenced by the compatibility of IT, is in parallel with the literature. Likewise, it can be said that the stronger effect of FC on INT for females can be explained by the fact that accessible resources and supports are regarded to be more important for females in relation to self-efficacy and ease of use. Furthermore, given that the scarcity of support and resources is one of the main obstacles to the adoption process (Alavi & Gallupe, 2003; Muilenburg & Berge, 2001), it can be noted that the finding is expected. In terms of SI- > PU, it is observed that the perceptions of the female group of the performance they can obtain from IT are more influenced by the opinions of the people they consider important. This result coincides with the fact that females are more motivated by social pressure and close relationship needs compared to males and they attach more importance to the opinions of others (Hofstede & Hofstede, 2005; Venkatesh & Morris, 2000).

EFF- > INT, PEN- > PEU, and SI- > PU relationships were found to be significant only for the older age group. These findings can be interpreted as the increase in the possibility of remaining under the effect of the ease of use of users with the advancement of age may originate from factors such as a decrease in the belief in their knowledge and skills (Venkatesh et al., 2003) and the increase in the need for close relationships (Morris & Venkatesh, 2000). In terms of the experience, COMP- > PU relationship were significant only for the more experienced group, while FC- > INT and PEU- > INT relationships were significant only for the low-experienced group.

Considering that inexperienced users regard ease of use as a more important factor and those without prior knowledge prefer easy-to-use technologies (Tarhini et al., 2014; Venkatesh et al., 2003), it can be stated that this finding is an expected result. In parallel, it can be said that the fact that FC facilitates the use of IT and PEU- > INT relationship support the effect of FC on INT for the inexperienced group.

6 Conclusion and implications

One of the main contributions of this study is to better understand the intentions of instructors towards information technologies, which has become more important due to the pandemic. Moreover, considering the insufficient number of technology acceptance studies for instructors and the need for comprehensive and up-to-date studies addressing the Turkish instructors' intentions to use IT in education, this study is expected to provide valuable contributions. In addition, TAM was extended by adding generally overlooked constructs such as COMP, RC and OPN. The proposed model can explain 75.3% of intention to use. As for the moderators, individual differences (gender, age and experience) were included in the model and their potential effects were tested as well.

The most influential constructs on INT are COMP and EFF. This result indicates that instructors will be more inclined to use IT in their lessons if technology meets the expectations of instructors for education and they have the necessary knowledge and skills for using it effectively. Compatibility with its motivating effects (Chen, 2011), competence that facilitates participation in activities and determines the perceptions of task difficulty (Bandura, 1977; Tschannen-Moran & Hoy, 2007), and efficacy that is a potential obstacle or incentive in terms of intention to use IT in education (Scherer et al., 2019) points out that both compatibility and self-efficacy are factors to be considered in IT integration. Another result showed that all of the hypotheses regarding PEU and INT about FC are supported. In this regard, it is necessary to consider the compatibility of the technologies planned to be used in the integration process. In terms of effective use, provision of resources and facilitating conditions such as training and technical support has a critical role for the success of IT integration in education both during the pandemic and afterwards.

PEU and PU, which are regarded as the two main determinants in TAM, were not found to have significant effect on INT. Moreover, RC and OPN, which can be addressed as two important individual differences, also did not affect INT. It can be said that these unexpected findings provide important information in the context of education during the pandemic. From this point of view, there are two types of barriers in terms of the use of technology in education. These barriers, which are widely accepted in the literature, are expressed as first-order or external and second-order or internal barriers. External barriers are generally related to the resources owned and include factors such as equipment, training, time and technical support provided by the institution (Sánchez-Prieto et al., 2019). The large-scale investments made during the pandemic indicate that external barriers may not be very effective on this issue. In this direction, second-order barriers come to the fore as the main

factors. Second-order barriers are related to how instructors perceive their teaching practices and the specific technologies they use (McLoughlin et al., 2008). Accordingly, second-order barriers are closely related to motivation, teaching styles, and social influence (Sánchez-Prieto et al., 2019) and suggest that the compatibility of technology, individual differences and motivation play a critical role in education during the pandemic. At this point, the results indicate that second-order barriers may have been partially ignored as a result of a very rapid transition to online education. In addition, it is thought that the fact that the use of technology in education is a choice or a necessity serves as an important determinant. The results indicate that the effects of motivating factors such as PEU and PU and personality traits such as RC and OPN for instructors are weakened when the use of technology is deemed mandatory. In this regard, it is predicted that taking these into account in technology integration design and conducting further research in this direction will provide valuable contributions in order to maintain the quality of education with technology both during and after the pandemic.

Based on the results that are inconsistent with the literature on the relationships between social influence, anxiety and intention, it may be worthwhile to focus on detailed studies focusing on social norms and anxiety, which are considered among the important constructs that influence technology acceptance in education (e.g. Baydaş, 2015; Şahin, 2016; Ursavaş, 2014; Ursavaş et al., 2019). It can be said that such studies can contribute to the field of education in terms of the effective use of technologies such as e-learning systems and distance education platforms throughout the pandemic, especially in the context of the continuance intention to use ITs in mandatory situations.

It has been determined that PEN affects all core constructs (PEU, PU, INT) of TAM. The findings indicate the importance of enjoyment and motivation for ease of use, perception of the performance to be achieved, and intention. In this regard, a comprehensive examination of the effects of emotional factors (fear, failure, enjoyment, etc.) on beliefs, intentions, and behaviors (Beaudry & Pinsonneault, 2010; Chang et al., 2017) in the acceptance of technology can make significant contributions to the success of integration processes. The results showed that all moderators had several effects. Considering the lack of sufficient testing of moderators, a more frequent and comprehensive examination of moderator effects is seen as an important need for the success of educational technology such as e-learning and distance education, especially during the pandemic.

Acknowledgements The authors thank the Editor and anonymous reviewers for their outstanding feedback on the previous versions of the manuscript. The authors also thank Prof. Dr. Yavuz Akbulut for his suggestions.

Declarations

Conflicts of interest/Competing interests Not applicable.

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Authors and Affiliations

Ferhan Şahin[1] · Ezgi Doğan[1] · Ulaş İlic[2] · Yusuf Levent Şahin[1]

Ezgi Doğan
ezgidb@anadolu.edu.tr

Ulaş İlic
uilic@pau.edu.tr

Yusuf Levent Şahin
ylsahin@anadolu.edu.tr

[1] Department of Computer Education & Instructional Technology, Faculty of Education, Anadolu University, Eskişehir, Turkey

[2] Department of Computer Education & Instructional Technology, Faculty of Education, Pamukkale University, Denizli, Turkey