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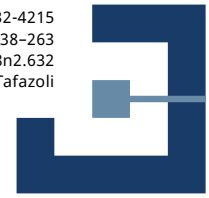

Castledown

The role of university teachers' 21st-century digital competence in their attitudes toward ICT integration in higher education: Extending the theory of planned behavior

Amir Reza Rahimi
rahimia891@gmail.com
Shahid Rajaee Teacher Training University, Iran

Dara Tafazoli
dara.tafazoli@newcastle.edu.au
The University of Newcastle, Australia

Due to the massive integration of Information and Communication Technologies (ICTs) in higher education, teachers need to be highly digital competent and have positive attitudes to manage their classes effectively. In this regard, the European Framework for the Digital Competence of Educators (DigCompEdu) introduces a paradigm known as 21st-century competence that all teachers should acquire. Recently, scholars have explored the dimension of teachers' digital competence in the 21st century relating to a digital context. Thus, this explanatory study wants to take a step forward to add to the literature the role of university teachers' 21st-century digital competence in their attitudes toward ICT integration. To meet the end, a questionnaire was designed and administered to 350 Iranian university teachers who implemented ICTs in their classes. The result of partial least squares analysis (PLS-SEM) reveals the significant relationship between university teachers' information and data literacy, digital content creation, communication and collaboration, and problem-solving skills with three antecedents of behavioral intention and actual behavior for employing ICTs. Related pedagogical implications are addressed, such as running some teacher training programs for teachers to escalate their 21st-century digital competencies and making teachers aware of the role of these factors in managing their classes with ICTs.

Keywords: 21st century abilities; information literacy; teacher professional development; post-secondary education

Introduction

The applications of information and communications technologies (ICTs) have driven the increment of a substantial number of educational opportunities (van Laar *et al.*, 2019). However, a successful technology integration relies on disparate factors of the core actors in educational contexts (i.e., teachers and students). One of the well-known factors is attitudes, displaying how individuals perceive target situations (Ajzen, 1991). Having been acknowledged by recent inquiries, positive attitudes toward ICTs have significantly correlated with the acceptance and utilization of education technologies (Swier & Peterson, 2018; Teo & Zhou, 2014; Unal & Uzun, 2020). Signifying this importance, studies have highlighted other factors that have a relationship with teachers' attitudes toward ICT integration. For example, teachers' computer self-efficacy (Teo, 2011), time and accessibility to technology (Siyam, 2019), motivation (Eksail & Afari, 2019; Stockwell & Reinders, 2019), information literacy (Nikou & Aavakare, 2021), and beliefs (Leem & Sung, 2018) were considered crucial for technology integration.

Furthermore, studies have tended to explore teachers and learners' attitudes toward ICT integration by selecting and extending the Technology Acceptance Model (TAM) (Davis *et al.*, 1989), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh *et al.*, 2003), and Theory of Planned Behaviors (TPB) (Ajzen, 1991) as the most dominant models and theories in technology-enhanced learning (Granić & Marangunić, 2019).

For example, Eraslan Yalcin and Kutlu (2019) investigated the students' attitudes toward Learning Management Systems (LMSs) by applying the uniform version of TAM. They adapted a TAM questionnaire (Teo, 2010) and collected data from 282 Turkish language learners. The path analysis's result depicted that perceived usefulness, perceived ease of use, and social norms affected the intention to use. Simultaneously, perceived usefulness is impacted by perceived ease of use, social norms, and user interface design variables. In addition, user interface design and computer self-efficacy variables affected the perceived ease of use. Likewise, Cheng and Tsai (2020) explored the role of motivation, learning strategies, and perceived immersion in their attitudes toward Immersion Virtual Reality (IVR). They applied the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich *et al.*, 1993), the Immersive Experience Questionnaire (IEQ) (Jennett *et al.*, 2008), and learners' attitudes toward technology integration (Teo, 2010). They gathered data from 76 science students from China using VR during their schooling. The PLS-SEM presented that motivation and self-regulation have a dominant role in learners' attitudes toward VR. Also, the IVR learning was substantially mediated by variables of students' immersive experiences of attention and enjoyment.

Along with the aforementioned factors, recent studies address the gap between teachers' digital competence and their attitudes toward ICT integration (e.g., Scherer & Teo, 2019). Also, recent surveys found that the successful integration of ICTs in education would not be feasible without reaching teachers' required skills and knowledge, such as problem-solving skills, digital content creation, digital literacy, collaboration, and reflection (Caena & Redecker,

2019). These core components mentioned above are known as the 21st-century skills by various organizations and associations such as Assessment and Teaching of Twenty-First Century Skills (ATC21S), Organization for Economic Co-operation and Development (OECD), and the European Union's (EU) (OECD, 2018; van Laar *et al.*, 2019). Thus, these skills are critical in the digital context (Caena & Redecker, 2019; Kereluik *et al.*, 2013), and scholars should determine whether these core competencies can relate to teachers' attitudes toward ICT integration (Eccles & Wigfield, 2020). Thus, based on the gap, the current study explored the role of university teachers' 21st-century digital competence in their attitudes toward ICT integration. Moreover, we want to extend the contemporary Theory of Planned Behaviors (TPB) by integrating university teachers' 21st-century digital competence.

Theoretical frameworks

21st-century digital competence

ICTs would facilitate the process of teaching, engagement, and productivity in education (Nikou & Aavakare, 2021), relying on teachers' computer and digital literacy (Fraillon *et al.*, 2019) and their technological, pedagogical, and content knowledge (Scherer *et al.*, 2018). However, there are more competencies and skills far beyond the teachers' computer literacy or pedagogical knowledge, known as the 21st-century competence developed by ATC21S (Caena & Redecker, 2019).

According to this model, teachers should at least acquire 4Cs (collaboration, creativity, critical thinking, and communication) and integrate them with technology skills in their classroom activities (Caena & Redecker, 2019). Moreover, "the OECD 2030 paper underlined these competencies as key to meet the challenges of a volatile, uncertain, complex and ambiguous world, harnessing digital tools and artificial intelligence" (Caena & Redecker, 2019, p. 3). Based on this, Rubach and Lazarides (2021) recently have developed a new framework specializing in 21st-century digital competence with six factors of "information and data literacy, communication and collaboration, digital content creation, safety and security, problem-solving, and analyzing and reflecting" (p. 1).

Theory of Planned Behaviour (TPB)

The theory of planned behavior (TPB), elaborated by Ajzen, is one of the most popular theories to display behavioral intentions and would be more potent in predicting users' attitudes toward ICT integration (Cheng, 2018). Recently, many studies underscored the practicality of this theory (e.g., Rana *et al.*, 2019). However, the applications of TPB in higher education focusing on university teachers' ICT integration is still rather limited.

According to Ajzen (1991), behavioral intention is affected by three components of attitude, subjective norms, and perceived behavioral control, leading to users' actual behavior. In other words, attitude, subjective norms, and

perceived behavioral control can predict users' behavioral intention and cognitive processes to meet their actual behavior.

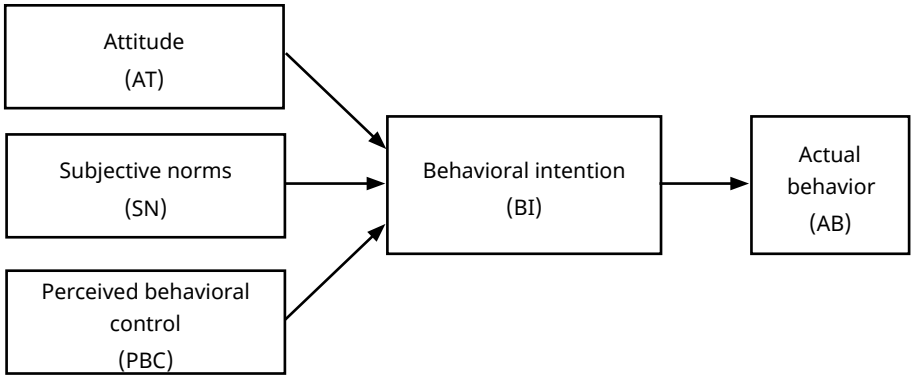

Figure 1. Theory of Planned Behavior (Ajzen, 1991)

The current study, research model, and hypotheses

The literature review confirmed that basic pedagogy and ICT competence are primary antecedents of integrating technology in an educational context (see Hatlevik *et al.*, 2018; Scherer *et al.*, 2018). However, very little has been placed on teachers' ICT pedagogical beliefs (Elstad & Christophersen, 2017). Moreover, a preponderant number of recent studies have investigated teachers or students' attitudes toward ICT integration (e.g., Eksail & Afari, 2019; Eraslan Yalcin & Kutlu, 2019). Previous studies extended one of the technology acceptance models, particularly TAM, TPB, and UTAUT with psychological factors such as motivation (Hsu, 2022) and pedagogical models such as technological pedagogical content knowledge (TPACK) (Hsu, 2016), in English as a Foreign Language (EFL) context based on teachers or students' attitudes toward ICT integration. Recent scholars highly recommended for future studies extend technology acceptance models by integrating teachers' professional knowledge (Hsu, 2016; Scherer & Teo, 2019). Further, Rubach and Lazarides (2021) introduced a new professional knowledge to the literature known as 21st-century digital competence and suggested validating its factorial structure in other school contexts, subjects, and countries. However, in their systematic literature review, Granić and Marangunić (2019) claimed that Taiwan, Malaysia, South Korea, and China were only among the Asian countries that have extended technology acceptance models in education, and Iran is not among these countries. Thus, the current study aimed at bridging the gap by extending TPB with Iranian EFL university teachers' 21st-century digital competence.

This study incorporates four variables of information and data literacy, communication and collaboration, digital content creation, and problem-solving into the original TPB model. *Information and data literacy* illustrate teachers' evaluation, maintenance, and management of their information through ICT tools in their educational context since teachers with higher digital information can effectively implement ICTs (Punie, 2007). Moreover, Eisenberg (2008) highlighted the role of information literacy, and Ng (2012) underlined the role

of digital literacy among 21st-century skills. In addition, the positive effect of digital literacy on users' attitudes toward technology integration extending the UTAUT theory is also confirmed (Nikou & Aavakare, 2021; Nikou *et al.*, 2020). What is not yet clear is the role of information and data literacy of university teachers and their attitudes toward ICT integration; thus, we hypothesize: (H1) University teachers' information and data literacy can positively predict their attitudes toward ICT integration. (H2) University teachers' information and data literacy can positively predict their subjective norms toward ICT integration. (H3) University teachers' information and data literacy can positively predict their perceived behavioral control toward ICT integration.

Communication and collaboration present the capability to transmit content knowledge and interpersonal impressions and derive desired results from their interaction within ICT integration. In their empirical study, Fraillon *et al.* (2015) found that teachers' digital literacy and communication skills strongly correlate with their age. Some research examined the relationship between teachers' years of experience and their communicative digital skills (Drossel *et al.*, 2016). Also, Gebhardt *et al.* (2019) have paid attention to teachers' gender and communicative digital skills. What is not clear is the relationship between university teachers' communication and collaboration and their attitudes toward ICT integration, which leads to the following hypotheses: (H4) University teachers' communication and collaboration competence can positively predict their attitudes toward ICT integration. (H5) University teachers' communication and collaboration competence can positively predict their subjective norms toward ICT integration. (H6) University teachers' communication and collaboration competence can positively predict their perceived behavioral control toward ICT integration.

Digital content creation refers to university teachers' appropriate use of technology to create digital content and creativity to manipulate their teaching procedure through ICTs. As ICTs boost the teachers' creativity, they can curb their 21st-century challenges with a creative solution (Kereluik *et al.*, 2013). Thus, recent studies have discovered the correlation between teachers' self-efficacy (Fraillon *et al.*, 2015) or TPACK (Caena & Redecker, 2019) and their digital content creation. Thus, little is known about the role of university teachers' digital content creation and their attitudes toward ICT. Therefore, we hypothesize: (H7) University teachers' digital content creation can positively predict their attitudes toward ICT integration. (H8) University teachers' digital content creation can positively predict their subjective norms toward ICT integration. (H9) University teachers' digital content creation can positively predict their perceived behavioral control toward ICT integration.

Problem-solving competence displays the university teachers' abilities to utilize ICTs to analyze a problem with the flexibility and effectiveness of those tools in education. According to Greiff and Funke (2018), problem solvers usually implement ICTs to generate information for a particular problem. And it is one of the essential dimensions of 21st-century teachers during this cutting-edge of innovation (Rubach & Lazarides, 2021). Therefore, if teachers can efficiently be digital problem solvers, they would have higher attitudes,

subjective norms, and perceived behavioral control. We hypothesize: (H10) University teachers' problem-solving competence can positively predict their attitudes toward ICT integration. (H11) University teachers' problem-solving competence can positively predict their subjective norms toward ICT integration. (H12) University teachers' problem-solving competence can positively predict their perceived behavioral control toward ICT integration.

Regarding the TPB model and the current study's operational definition, attitude is considered as teachers' positive or negative perceptions of ICT integration. Moreover, perceived behavioral control alludes to university teachers' perceptions of their capability to implement ICT materials in education. Moreover, subjective norms are mentioned as university instructors perceive the demands of the others (students or administrators) to apply ICT in their classrooms. Behavioral intention indicates teachers' readiness to utilize ICTs, and actual behavior represents university teachers' intention to implement ICTs in their future educational context. Hence, we hypothesize: (H13) University teachers' attitudes can positively predict their behavioral intention toward ICT integration. (H14) University teachers' subjective norms can positively predict their behavioral intention toward ICT integration. (H15) University teachers' perceived behavioral control can positively predict their behavioral intention toward ICT integration. (H16) University teachers' behavioral intentions can positively predict their actual behavior toward ICT integration.

Concerning the TPB model, the four 21st-century digital competence variables are supposed to be a variable that affects university teachers' actual behavior. Moreover, attitudes, perceived behavioral control, and subjective norms with behavioral intentions are supposed to be the mediator role for university teachers' actual behavior. Figure 2 displays the proposed research hypothesis.

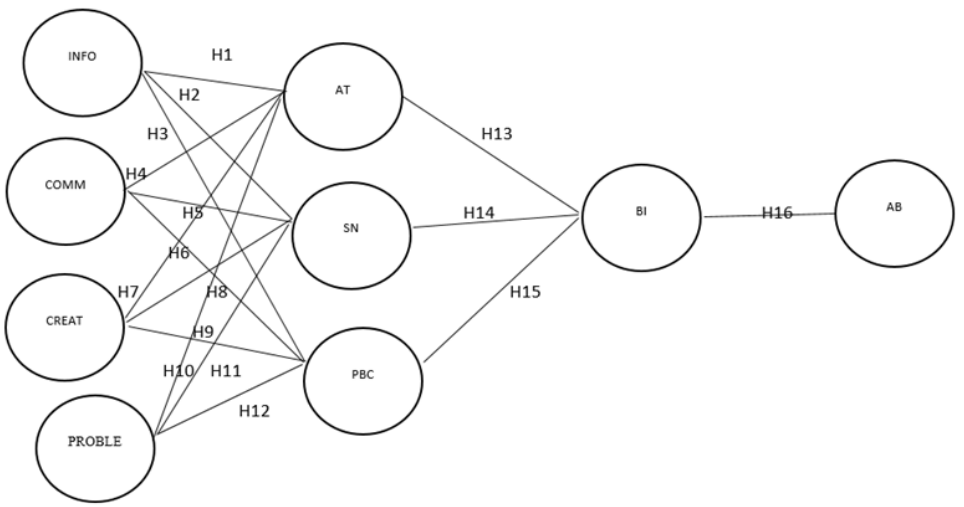

Figure 2. Proposed research model

Methodology

Participants

The current study's participants' sample was selected during the emergency remote language teaching by utilizing purposeful sampling of university teachers to provide rich information for the study goal. The selection criteria incorporated: (1) all the participants were university teachers, (2) the participants should be general English or English for Specific/Academic Purposes (ESP/EAP) teachers, (3) and they had employed ICTs in their classes. Thus, 350 Iranian higher education teachers from 37 public and private universities participated in the study. Table 1 illustrates the participants' demographic information.

Table 1. Participants' demographic information

		N	%
Gender			
	Male	219	62.6
	Female	131	37.4
Age			
	30–35	128	36.6
	36–41	159	45.4
	42–47	42	12.0
	48–52	21	6.0
	53+		
Teaching experience			
	1–5 years	203	58.0
	6–11 years	79	22.6
	12–17 years	57	16.3
	18–23 years	11	3.1
Academic degree			
	MA	33	9.4
	PhD student	114	32.6
	PhD	203	58.0

Data analysis

Due to the nature of this explanatory study, the present study selected Statistical Package for the Social Sciences (SPSS 23.0) and Partial Least Squares Structural Equation Modeling (ver. PLS.3) to analyze the data. Although a wide range of recent surveys in e-learning applied the PLS-SEM method for their small sample size (Lin *et al.*, 2019), this study employed PLS-SEM for its estimation of very complex models with many variables, particularly for the prediction of the university teachers' attitude toward ICT integration and non-normality distribution of the data. According to Hair *et al.* (2011), PLS-SEM specializes in theory development, prediction, and explanatory research as it is flexible for identifying the critical construct through incorporating reflective and formative

models to meet the identification requirements. In fact, in this complex statistical method, after going through three steps, including fitting the measurement model (relationships between questions and the latent variable), fitting the structural model (relationships between the latent variables), and fitting the general model, we will be able to test the hypotheses.

Instruments

For data collection, we designed a questionnaire consisting of three main sections of a) participants' demographic information, b) the four factors of the 21st-century digital competence questionnaire (Rubach & Lazarides, 2021), including INFO: 3 items, COMM: 4 items, CREAT: 4 items, and PROB: 4 items), and the TPB questionnaire (adapted from Teo *et al.* 2016, and Yusop, 2015) with 15 statements and five factors (AT: 4 items, SN: 4 items, PBC: 4 items, BI: 4 items; and AB: 3 items). Each item was measured through a seven-point Likert ranging from Strongly disagree (=1) to Strongly agree (=7). Table 2 illustrates the main variables using central indicators and dispersion.

Table 2. Descriptive statistics and normality test of the variables

Variables	Mean	Standard deviation	Variance statistic	Kolmogorov-Smirnov[a]	
				sig	statistics
INFO	4.7038	1.37734	1.897	.000	0.109
COMM	4.3086	1.05836	1.120	.000	0.089
CREAT	4.3093	1.16119	1.348	.000	0.074
PROBLE	4.4529	1.22690	1.505	.001	0.066
AT	3.8221	.97496	.951	.002	0.062
SN	3.9643	.93836	.881	.000	0.076
PBC	4.4129	1.03099	1.063	.000	0.082
BI	3.7607	.97151	.944	.004	0.060
AB	4.0295	1.18629	1.407	.000	0.093

a. Lilliefors Significance Correction

The mean scores of all the variables are more than 3.5 (center of the 7-point Likert). Also, the data distribution of all variables is non-normal distributed.

Results

Measurement model

Through the measurement model, the researcher can measure the possible relationships between observable and latent variables. The following criteria have been used to evaluate the fit of measurement models (Hair *et al.*, 2019):

1. Significance of factor load between items and their latent variables,
2. Reliability (Cronbach's alpha coefficients and composite reliability),

3. Convergent validity (mean of extracted variance (AVE), and
4. Divergent validity.

Significance of factor loadings. As shown in Figures 2 and 3, the values of the factor load and the statistical coefficients between the questions and the latent variables themselves are more significant than 0.4 and 1.96; respectively, this significantly correlates the relationship between each question with the related variable.

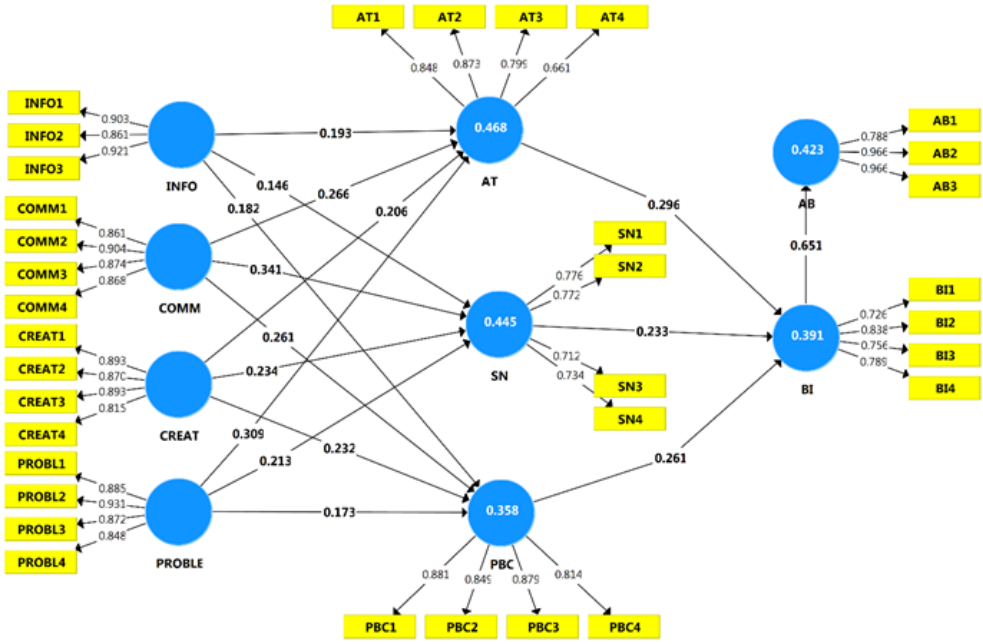

Figure 3. Research model with standardized factor load coefficients and path coefficients

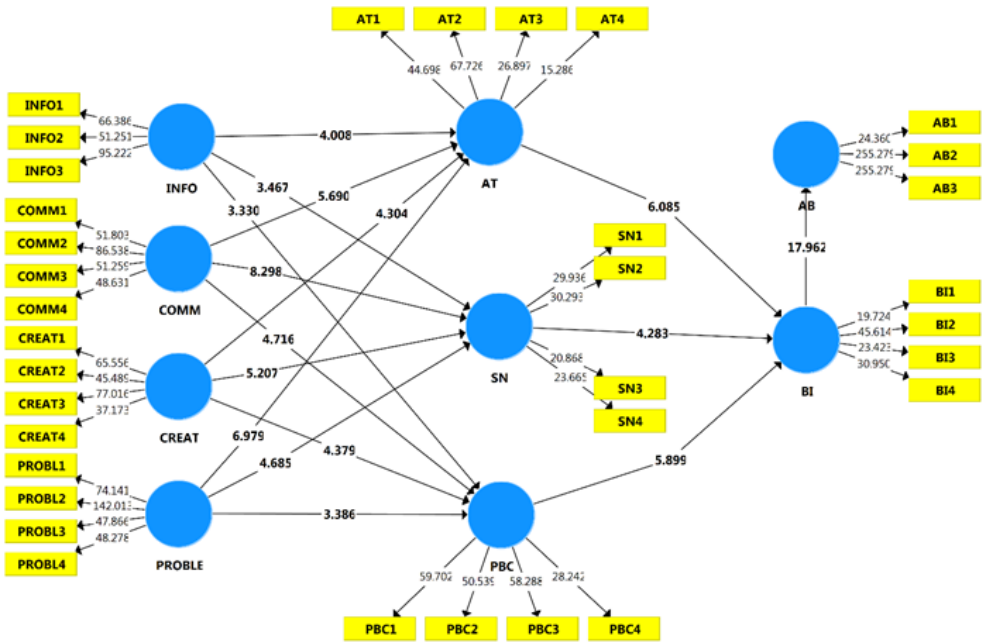

Figure 4. Research model with t-values

Cronbach's alpha coefficient and composite reliability. Cronbach's alpha for all research structures has been calculated, and it is found that the composite reliability and Cronbach's alpha values for all variables are above 0.7 and show the appropriate reliability of the model.

Convergent validity. The convergent validity was measured utilizing the average variance extracted (AVE), which is acceptable with a value equal to or higher than 0.05 (Hair *et al.*, 2019). As illustrated in Table 3, the research constructs enjoy convergent validity as the AVE of all variables constructs is higher than 0.05.

Table 3. Cronbach's alpha coefficient composite reliability and convergent validity of the research constructs

Variables	Composite reliability	Cronbach's alpha	AVE
AB	0.935	0.893	0.830
AT	0.875	0.809	0.640
BI	0.860	0.782	0.606
COMM	0.930	0.900	0.769
CREAT	0.924	0.891	0.754
INFO	0.924	0.876	0.802
PBC	0.916	0.878	0.733
PROBLE	0.935	0.907	0.782
SN	0.836	0.738	0.561

Discriminant validity. Fornell and Larker's (1981) criteria were used to examine the discriminant validity in which the values of √A should be more than the other variables and its correlation with other variables. Thus, it can be said that in the research model, latent variables interact more with questions related to themselves than the other variables.

Table 4. Result of the discriminant validity

	AB	AT	BI	COMM	CREAT	INFO	PBC	PROBLE	SN
AB	0.911								
AT	0.453	0.800							
BI	0.651	0.501	0.778						
COMM	0.548	0.522	0.660	0.877					
CREAT	0.185	0.447	0.296	0.311	0.868				
INFO	0.478	0.427	0.616	0.544	0.178	0.895			
PBC	0.388	0.293	0.463	0.481	0.415	0.395	0.856		
PROBLE	0.225	0.500	0.333	0.283	0.401	0.171	0.371	0.885	
SN	0.484	0.553	0.526	0.553	0.451	0.410	0.497	0.428	0.749

Structural model

The researchers can determine the possible relationships between the exogenous and endogenous latent variables through the structural model. The structural model examines only the latent variables and their relationships. Structural model test criteria include the following (Hair *et al.*, 2019):

1. Endogenous latent variable coefficient of determination (R^2),
2. Predictive Relevance of the Model,
3. Measuring effect size (f^2), and
4. Collinearity Statistics (VIF).

Endogenous latent variable coefficient of determination (R^2). The R^2 value indicates the value through which the exogenous variables describe endogenous variables. According to Hair *et al.* (2011), 0.25, 0.50, and 0.75 are the values that show the criterion values for weak, medium, and strong coefficient of determination (R^2). According to Table 5, the coefficient of determination (R^2) of AT (0.468), SN (0.445), PBC (0.358), BI (0.391), and AB (0.423) have been obtained at the desired level. Moreover, the variables of 21st-century skills accounted for 46.8% of the variance in AT, 44.5% in SN, and 35.8% in PBC were predicted, and the rest of their changes depend on other factors and variables that are not considered for this model. Equally important, 39.1% of BI variables' variance is predicted by AT, SN, and PBC variables. Also, 42.3% of the changes in AB are predicted by the BI variable.

Predictive relevance of the model (Q^2) and measuring effect size (f^2). Criterion (f^2) determines the intensity of the relationship between structures. The higher the value of this criterion, the higher the intensity of the effect (Hair *et al.*, 2019). The values of 0.02, 0.15, and 0.35, respectively, indicate the magnitude of one latent variable's small, medium, and substantial effect on another latent variable (Cohen, 1988). This criterion can be calculated for endogenous variables affected by more than one variable; for this reason, the criterion (f^2) can be calculated for the dependent.

Criterion (Q^2) determines the predictive power of the model in dependent variables (Hair *et al.*, 2016). Three values of 0.02, 0.15, and 0.35 have been determined as a low, medium, and substantial predictive power for all endogenous structures (Hair *et al.*, 2019). Illustrated in Figure 4, the value of the endogenous variables of the model, the determination of AT (0.292), SN (0.241), PBC (0.258), BI (0.233), and AB (0.348) are positive and at a suitable level, displaying the appropriate predictive power of the model regarding the mentioned variables.

The general model. The last criterion is a goodness of fit (GOF), estimating the general model hypothesis. According to (Wetzels *et al.*, 2009), three values of 0.01, 0.25, and 0.36 have been known as weak, medium, and substantial values for this criterion. The GOF value of the study was 0.459, representing a strong fit for the overall research model.

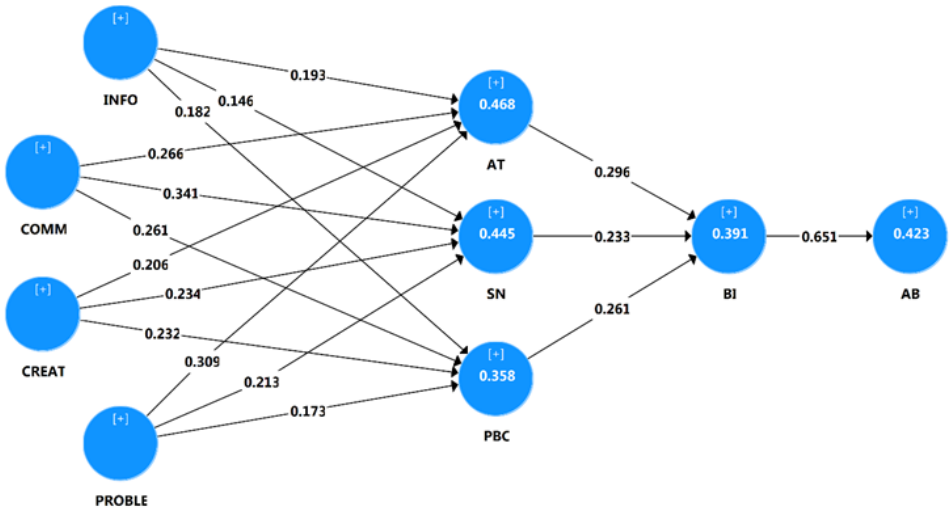

Figure 5. The structural model with standardized factor loads coefficients and path coefficients

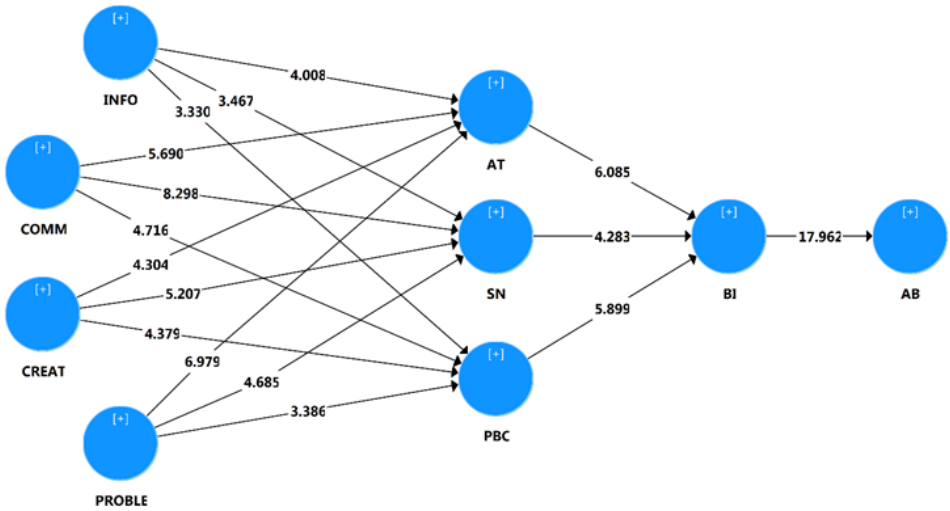

Figure 6. The structural model with t-values

Decisions to confirm or reject the hypotheses will be made based on the value of the t-value and the level of significance (p-value). A significance level of p-value should be less than 0.05 or equal; also, the t-value should be greater than 1.96 to indicate confirmation of hypotheses (Hair *et al.*, 2019). Table 6 illustrates the result of the study hypotheses.

Table 5. Results of the structural and general model

Paths	β	T-value	P-value	R^2 the endogenous variable	Q^2 the endogenous variable	f^2	VIF
AT → BI	0.296	6.085	0.000	0.391	0.233	0.10	1.442
BI → AB	0.651	17.962	0.000	0.423	0.348	-	-
COMM → AT	0.266	5.690	0.000	0.468	0.292	0.085	1.557
COMM → PBC	0.261	4.716	0.000	0.358	0.258	0.068	1.557
COMM → SN	0.341	8.298	0.000	0.445	0.241	0.134	1.557
CREAT → AT	0.206	4.304	0.000	0.468	0.292	0.064	1.255
CREAT → PBC	0.232	4.379	0.000	0.358	0.258	0.067	1.255
CREAT → SN	0.234	5.207	0.000	0.445	0.241	0.079	1.255
INFO → AT	0.193	4.008	0.000	0.468	0.292	0.049	1.422
INFO → PBC	0.182	3.330	0.001	0.358	0.258	0.036	1.422
INFO → SN	0.146	3.467	0.001	0.445	0.241	0.027	1.422
PBC → BI	0.261	5.899	0.000	0.391	0.233	0.084	1.329
PROBLE → AT	0.309	6.979	0.000	0.468	0.292	0.146	1.233
PROBLE → PBC	0.173	3.386	0.001	0.358	0.258	0.038	1.233
PROBLE → SN	0.213	4.685	0.000	0.445	0.241	0.066	1.233
SN → BI	0.233	4.283	0.000	0.391	0.233	0.051	1.750

$$GOF = \sqrt{\overline{Communalities} \times \overline{R^2}} = \sqrt{0.507 \times 0.417} = 0.459$$

Table 6. Results of the research hypothesis

Research hypothesis	Path exogenous → endogenous	β	T-value	P-value	Result
H1	INFO → AT	0.193	4.008	0.000	Confirm
H2	INFO → SN	0.146	3.467	0.001	Confirm
H3	INFO → PBC	0.182	3.330	0.001	Confirm
H4	COMM → AT	0.266	5.690	0.000	Confirm
H5	COMM → SN	0.341	8.298	0.000	Confirm
H6	COMM → PBC	0.261	4.716	0.000	Confirm
H7	CREAT → AT	0.206	4.304	0.000	Confirm
H8	CREAT → SN	0.234	5.207	0.000	Confirm
H9	CREAT → PBC	0.232	4.379	0.000	Confirm
H10	PROBLE → AT	0.309	6.979	0.000	Confirm
H11	PROBLE → SN	0.213	4.685	0.000	Confirm
H12	PROBLE → PBC	0.173	3.386	0.001	Confirm
H13	AT → BI	0.296	6.085	0.000	Confirm
H14	SN → BI	0.233	4.283	0.000	Confirm
H15	PBC → BI	0.261	5.899	0.000	Confirm
H16	BI → AB	0.651	17.962	0.000	Confirm

As shown in the above table, the t-value in all paths in the model is estimated to be more than 1.96, so it is inferred that all research hypotheses are statistically confirmed according to the collected data. It should also be noted that the standardized path coefficients in all paths and hypotheses are estimated to be positive, and this shows that the relationships between all variables are direct and positive.

Discussion

University teachers' 21st-century digital competence and their attitude

The study's first finding validated the factorial structure of the Iranian EFL teachers' 21st-century digital competence and TPB. Indeed the result presented that 21st-century digital competence in the Iranian EFL context comprises five factors: *information* and data literacy, communication and collaboration competence, digital content creation competence, and problem-solving competence. This finding echoed Rubach and Lazarides (2021), who validated the 21st-century digital competence in Germany. Moreover, the result supports the idea developed by ATC21S, OECD, and EU have asserted that teachers should acquire such 21st-century skills and transfer them into their teaching context (van Laar *et al.*, 2019). The OECD 2030 paper describes these competencies as the critical success to remedying the challenges of an uncertain, complicated, and unclear world harnessed by digital and artificial intelligence (Caena & Redecker, 2019; OECD, 2018). Similarly, TPB includes five factors subjective norms, perceived behavioral control, attitude, behavioral intention, and actual behavior in the Iranian EFL context. Consequently, this finding is in line with other studies, funding the similar factorial structure of TPB in different educational contexts (Hsu, 2016; Teo, 2011; Teo *et al.*, 2016).

University teachers' information and data literacy and three core antecedents

In the current study, the information and data literacy represents university teachers' knowledge about evaluating and managing their information with ICTs. The result can positively predict university teachers' three core antecedents of their behavioral intention. This result is in line with previous studies that found a positive relationship between users' digital literacy and their attitudes toward ICT integration, especially in higher education (Nikou & Aavakare, 2021; Nikou *et al.*, 2020). Similarly, Hoareau *et al.* (2021) found that teachers' literacy is one of the dominant antecedents for accepting techno gadgets to integrate into education. Furthermore, the study result correlates with previous studies, finding a positive correlation between EFL teachers' digital literacy and their attitudes toward ICT employment (Dashtestani, 2014b; Dehqan *et al.*, 2017).

Moreover, the higher the university teachers' information and data literacy, the higher the perceived behavioral control they would have. In other words,

the result signified that university teachers with a high level of information and data literacy enjoy a positive attitude toward integrating ICTs into their classes. This finding is in accordance with Nikou and Aavakare's (2021) findings, underlying the role of digital literacy in accelerating the users' perception and feeling of effortlessness while using ICTs. In this aspect, Teo (2010) claimed that when users have favorable judgment about their ability to use particular ICTs, they will incline more to implement them. Likewise, Califf and Brooks (2020) discovered the critical role of teachers' digital literacy in declining the techno-overload and complexity of utilizing ICTs in their classes. Furthermore, the result showed that teachers' information and data literacy could positively predict teachers' subjective norms. This result is in agreement with Sadaf and Gezers (2020) found that teachers' intention to use technology was influenced by the learners and administrator's perceptions. The result also supported Sadaf and Johnson (2017), who claimed that teachers' expectations from adminstartors and learners' were led to integrate more digital tools and help them have the technology-based vision, culminating in promoting their technical knowledge such as digital literacy. Likewise, in their study, Kundu and Bej (2020) found that teachers' sufficient knowledge regarding their technology, pedagogy, and integrative skills are the core factors for shaping learners' beliefs about ICT integration.

University teachers' communication and collaboration competence and three core antecedents

Communication and collaboration competence present the university teachers' ability to transform content knowledge and other social skills to reach their desired outcome via ICTs. The study showed a strong path coefficient between teachers' communication and collaboration competence and their attitudes toward ICT integration. This result is in line with Beardsley *et al.*'s (2021) findings that teachers' motivation and attitudes peaked by virtue of the remote education in which they interacted via ICTs. Likewise, Hoareau *et al.* (2021) have emphasized the role of social usability aspects of ICT in accepting such tools by teachers.

Additionally, the result illustrated the solid and positive correlation between the teachers' communication and collaboration competence and their perception of their ICT integration capability. This result is in accord with studies highlighting the role of digital collaboration, giving an excellent sense to teachers to implement ICTs (e.g., Hoareau *et al.*, 2021). The result further supports Dashtestani's (2014a) findings, who discovered that lack of communication impedes the integration of ICTs in EFL classes. This finding also bridges the gap addressed by Drossel *et al.* (2016), who emphasized uncovering the role of collaboration and communication skills in shaping teachers' attitudes toward ICTs.

University teachers' digital content creation competence and three core antecedents

In the current study, digital content refers to university teachers' appropriate use of technology to create digital content and creativity to manipulate their teaching procedure through ICTs. The PLS-SEM model presented the positive relationship between university teachers' digital content creation and their positive attitudes toward ICT integration. This result corroborates the idea that teachers' willingness to incorporate new methods, instruments, or ideas relies on their pedagogical creativity enhancement knowledge (PCeK) (Beghetto, 2021).

Moreover, the result responds to the recent studies' challenges that explored the role of creativity in teachers' dynamic and flexible relationships and their willingness to implement new methods and instruments in their classes (Beghetto, 2021). Equally important, there was a positive path between teachers' digital content creation and subjective norms. This finding aligns with Jahnke and Liebscher (2020), highlighting the role of creativity in online education, culminating in meaningful learning in higher education. The result is consistent with previous studies, indicating the mutual role of teachers' creativity within ICT integration and students' satisfaction (Roca & Ford, 2021). Likewise, the educational context as well as teachers' creativity, can enhance learners' goal orientation, networking, information sharing, and attitudes (Fan & Cai, 2020). Additionally, Beghetto (2016) claimed that teachers with pedagogical creativity enhancement knowledge (PCeK) could cultivate learners' attitudes, motivation, and action in understanding the target subject matter.

Furthermore, the path between CREAT and PBC showed that teachers with a higher level of digital content creation have more capability to employ ICTs. Since ICTs provide a flexible situation for teachers, they can choose from a broad palette of methods, approaches, and strategies, adjusting and mixing them with the target educational context (Caena & Redecker, 2019).

University teachers' problem-solving competence and three core antecedents

Problem-solving competence implies the university teachers' ability to efficiently implement ICTs to analyze and tackle the problem. The result indicated the positive path-coefficient between university teachers' problem-solving competence and their attitudes toward ICT use. The study confirms the previous findings, assuming that teachers who could analyze and reflect on teaching problems were more interested in applying digital tools in their university classes (Ertmer *et al.*, 2012; Rubach & Lazarides, 2019).

Another important finding was the positive path-coefficient between teachers' problem-solving competence and subjective norms. The finding provides conclusive support for the role of teachers' digital problem-solving competence on students' approval of ICT integration (Garcia & Badia, 2017). The result is also in line with Hsia *et al.* (2021), who found that problem-solving skills in flipped classrooms would stimulate learners to become creative thinkers.

Furthermore, the result closely matches with the OECD (2016), which highlights the role of digital problem-solving competence in higher education and culminates in producing more learners with a high level of digital literacy. Moreover, in student-centered ICT teaching practices in which learners gain knowledge autonomously and individually, teachers act as facilitators and analyze the learners' problems, culminating in shaping digital collaborative learners (Ertmer *et al.*, 2012).

The result illustrated the positive relationship between these two variables on the question of the relationship between teachers' problem-solving competence and their perceived behavioral control. This result substantiates previous findings in the literature, discovering the positive relationship between teachers' self-assessed skills and their capability to implement ICT (Sailer *et al.*, 2021). The study result supports Karami *et al.* (2013) finding that EFL teachers who implement ICTs were more problem-solver teachers.

The mediation role of attitudes, subjective norms, perceived behavioral control

The study's most striking finding is the mediation role of three predecessors between the university teachers' 21st -century digital competence and their behavioral intention toward the ICTs. Indeed, the higher the teachers' positive feelings, support from their students, and feeling the sense of ability to employ ICTs in their classes, the more they feel ready to use ICT in their classrooms. This result contradicts Teo *et al.* (2016) found that there was a negative relationship between teachers' subjective norms and their behavioral intention to integrate technology. Also, the result supports the idea of Hartwick and Barki (1994), who asserted that subjective norms could predict behavioral intention when students are mandatory to use ICT. Since the researchers collected their data during the emergency remote teaching, both students and teachers did not have any options to select ICTs for schooling and education. Moreover, the result differs from Sheeran *et al.* (1999) and Trafimow and Finlay's (1996) findings claiming that other peoples' opinions could not influence individuals influenced by their attitudes. In addition, researchers in the current study selected purposive sampling for data collection; thus, study results contrast with the idea of Lee *et al.* (2009) who declared that subjective norm would be a stronger predictor for intention with random participants. Moreover, this finding is in line with the original theory (Ajzen, 1991) and other studies, founding the relationship between three antecedents and individuals' behavioral intentions (Nie *et al.*, 2020).

The mediation role of teachers' behavioral intention between three core antecedents and actual behavior

In the current study, behavioral intention alludes to the states in which university teachers have a sense of readiness for ICT integration. The structural model revealed the mediation role of behavioral intention between three core

antecedents and their actual behavior. In a literal sense, the higher the university teachers' have a sense of readiness, the higher they would be willing to imbue their students with ICT tools in the future. This result supports the idea of Ajzen (2005) and Fishbein and Ajzen (1975), who claimed that behavioral intention is the strongest and immediate antecedent with actual behavior. Also, the study result confirms the mediate role of behavioral intention between individuals' three core antecedents and their actual behavior (Ajzen, 1991; Nie *et al.*, 2020).

To put the result into a nutshell, the study findings revealed a positive and strong relationship between university teachers' 21st-century digital competence and their attitudes toward ICT integration. Indeed, the study presents a new conceptual framework (Figure 6) for exploring teachers' attitudes toward ICT use by integrating their 21st-century digital competence.

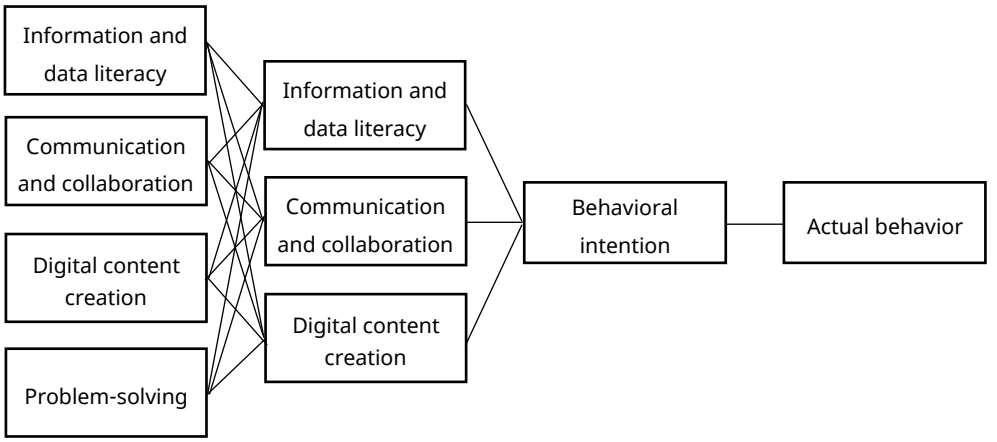

Figure 7. The conceptual model of the university teachers' attitudes toward ICT

Conclusion

By discovering university teachers' attitudes toward ICT integration in higher education by mixing TPB, and teachers' 21st-century digital competence, this study builds upon prior studies highlighting that future studies should cover the role of 21st-century competence in education (Caena & Redecker, 2019; European Council, 2018; OECD, 2018). Since Rubach and Lazarides (2021) was the first study that analyzed the multidimensionality of teachers' fundamental ICT competence, this study is one of the first inquiries to put one step forward to validate the factorial structure of the 21st-century digital competence and transfer them in English language teaching context and conceptualize the role of 21st-century digital competence in university teachers' attitudes toward ICT integration, particularly in EFL context. Our finding reveals that university teachers with a higher level of information and data literacy, communication and collaboration, digital content creation, and problem-solving competence can have positive attitudes toward utilizing ICTs in their classes. The findings have critical implications at both theoretical and practical levels.

Drawing upon the role of 21st-century digital competence and their relationship with TPB, teachers should boost their information and data literacy to manipulate and evaluate information through ICTs and perceive the sense of capability and positive attitudes toward ICT implementation. Moreover, teachers' information and data literacy competence is one of the prerequisite factors (Gupta *et al.*, 2020) that shape learners' opinions toward ICT integration as they are reluctant to utilize ICTs. Furthermore, educators should accelerate their communication and collaboration competence and utilize social-interpersonal strategies to reach their desired outcome to have positive attitudes and capabilities while using ICT. University teachers should also shift their role from being just facilitators or delivering the content course through ICTs to being the content creator of their classrooms via ICTs. Likewise, they should be more creative, develop their content course, and ask their students for comments about the course content to perceive more support. Additionally, instructors should be the analyzers and problem-solvers while using ICT rather than just transferring some PowerPoints or other digital content for learners. Last but not least is that university instructors should not ignore the role of students' attitudes and support toward ICT integration which can be one of the mediator roles between university teachers' 21st-century competence and their behavioral intentions.

This study is just the starting point for understanding university teachers' 21st-century digital competence concerning their attitudes. Thus, future research can validate this conceptual framework in other EFL or ESL contexts. Similarly, researchers might integrate teachers' 21st-century digital skills with other frameworks such as TAM and UTAUT. Moreover, due to the COVID-19 pandemic and the forced transition to online education, all the participants of this study were familiar with implementing ICTs in their classes. This familiarity with ICT integration might have an effect on the results of the current study; therefore, we would like to invite other researchers to apply the current conceptual framework and include teachers with less literacy in ICT integration through random sampling.

Declarations

Availability of materials. The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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