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Factors Influencing Teachers' Intention to Use Technology: Role of TPACK and Facilitating Conditions

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The behavioral intention (BI) of teachers to use technology is an important factor in the success of technology use in classrooms. Many models have been developed and extended in different contexts by adding various independent variables to the two initial variables of the Technological Acceptance Model (TAM) (Davis,1989): Perceived usefulness (PU) and Perceived ease of use (PEOU) to determine teachers' BI to use technology. However, not many have attempted to investigate the role of Technological pedagogical content knowledge (TPACK) and Facilitating Conditions (FC) in determining teachers' BI to use technology. Further, mediation through PU and PEOU from TPACK and FC to determine BI remains untested. To address these gaps, this study used an extended TAM (eTAM) model to investigate factors influencing teachers' BI to use technology. Employing convenience sampling technique, an electronic survey questionnaire consisting of 22 items was distributed across the schools in two western districts of Bhutan. A total of 207 in-service school teachers voluntarily responded to the survey. Structural equation modelling (SEM) was used to analyse the data; first, to examine whether there is any direct influence of TPACK and FC on BI or not, and then the mediating effects of PU and PEOU from TPACK and FC to BI. The findings revealed that there was no evidence of a direct influence from TPACK and FC on BI, though there was a significant effect of TPACK and FC on teachers' BI when mediated through PU and PEOU.

Keywords: TPACK, facilitating conditions, perceived usefulness, perceived ease of use, behavior intention to use technology

INTRODUCTION

Globally, the use of technology in schools has increased owing to the benefits it provides in teaching and learning (Koehler & Mishra, 2009; Wahyu et al., 2020). The

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expanding use of technology in education is unsurprising, as prior studies have demonstrated and documented numerous benefits of technology use, particularly in the classroom and for student learning. These include reducing classroom instructional time (Kaizer et al., 2020); improving communication between teachers and students (Liu et al., 2020); increasing students' classroom participation (Alokluk, 2018; Ghosh et al., 2019); and increasing students' academic achievement (Simes et al., 2022). As a result, educators are urged to incorporate technology into the classroom. However, it is believed that in order to effectively use technology in classrooms, teachers must have sufficient technological pedagogical content knowledge (TPACK) (Mishra & Koehler, 2006; Widyasari et al., 2022).

To help teachers achieve sufficient TPACK skills, policymakers and educational stakeholders must understand teachers' behavioural intention to use technology (Chai et al., 2011; Joo & Lim, 2018) in classrooms. Teachers' BI is a crucial aspect that impacts the effectiveness and success of technology integration in education (Wicaksono et al., 2020). The belief is that users' BI reflects their actual behaviour when interacting with technology (Chou et al., 2019), whether for classroom or non-classroom applications. To date, there are many established theories and models to assess users' behavioural intentions to use technology. Some widely accepted theories in business and education include the Technological Acceptance Model (TAM) (Davis, 1989), the Theory of Planned Behaviour (TPB) (Ajzen, 1991), and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). However, among these theories, TAM was found frequently used in the literature, primarily to explain teachers' behavioural intention to use technology (Tarhini et al., 2015).

Both TPACK and TAM have been extensively discussed in the literature. Despite their popularity in the educational fields, not many scholars have disturbed the combination of TPACK and TAM and its impact on teachers' BI, particularly in developing countries such as Bhutan, where technology is sparingly used for teaching and learning purposes (Choeda et al., 2016; Gautam et al., 2021; Wangdi & Rai, 2023). Additionally, the available literature revealed contradictory conclusions regarding TPACK's effect on BI. For example, while some researchers discovered a positive correlation between TPACK and teacher BI (Yang et al., 2021; Wei, 2021; Zhang & Chen, 2022), others discovered a negative correlation (Mohammad-Salehi et al., 2021; Joo et el., 2018). In this context, Legris et al. (2003) reported that the applicability of TAM's model is uncertain and it needs to be assessed and validated in different contexts by adding different exogenous variables to the TAM's model..This was an added reason to conduct this study as this study explored how adding TPACK and FC to the initial two variables of the TAM model influences teachers' BI to use technology.

The findings of this study are expected to contribute to the growing body of research on teachers' intentions to use technology. More importantly, in expansion of understanding to what extent teachers TPACK and FC influence their BI. To achieve this, the present study investigated the combined impact of TPACK and FC on BI, and the the mediating effects of PU and PEOU from TPACK and FC to BI.

The theoretical background

Technological Acceptance Model

Due to the importance of users' behaviour intentions to use technology and its beneficial impact on the effectiveness of technology integration in educational and corporate settings, prior researchers have developed a variety of models and theories to quantify users' intention to use technology or BI. The majority of these have sought to construct a model by extending the TAM model, especially in the field of education (Alfadda & Mahdi, 2021; Kamal et al., 2020; Kayali & Alaaraj, 2020; Pham & Tran, 2020; Rafique et al., 2020; Setiyani, 2021; Teo et al., 2019). The basic TAM model includes two exogenous variables: perceived usefulness (PU) and perceived ease of use (PEOU), and an endogenous variable: behavioural intention to use technology (BI). While Davis (1989) defines PU as "the degree to which an individual believes that utilizing a specific system would improve his or her job performance" (p.320); PEOU is defined as "the degree to which an individual believes that utilizing a particular system would be effort-free" (p.320). These two characteristics are thought to be strong determinants of users' business intelligence.

Technological Pedagogical Content Knowledge (TPACK)

TPACK is a theoretical framework developed by Mishra and Koehler (2006) to help teachers successfully integrate technology in the classrooms. The TPACK framework consists of three main components: Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). While TK refers to teachers' ability to use technology such as computers, software, and applications related to teaching and learning, PK refers to teachers' approach to teaching or simply the knowledge of how to teach. CK on the other hand is teachers' knowledge of subjects to be taught in the classroom (Koehler & Mishra, 2009). Other important components of the model are the inter-relationship between the model's knowledge components, namely, Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), and Technological Pedagogical Knowledge (TPK). According to Koehler and Mishra (2009), TCK is the understanding of the manner of technology and content to be used in addressing subject matter knowledge in the classroom. This helps teachers choose the most appropriate and effective technological tools for the subjects and students. PCK is teachers' pedagogical knowledge of the specific content to be taught. TPK is an understanding of the use of technology for specific purposes. The knowledge of TPK helps teachers to choose the best technological tools to be implemented in classrooms that support their pedagogical practices.

Research model and hypotheses

The TPACK framework has gained popularity in recent years. This framework enables researchers and practitioners to comprehend teachers' technological competencies to successfully integrate technology into teaching and learning. Teachers' TPACK is believed to affect their intentions to use educational technology (BI). Earlier research has found a significant positive correlation between teachers' TPACK and their BI. Yang et al. (2021) have examined possible associations between teachers' TPACK and their propensity to employ e-schoolbag in the classroom. The study reported that teachers' TPACK significantly influence their intentions to use the e-school bag in the classroom. The finding was not different from Wei (2021), who in his study reported that TPACK had a significant influence on elementary teachers' willingness to use technology. Zhang and Chen (2022) also found that teachers' TPACK had a positive impact on their technological use. However, very little has been discussed about the relationship between teachers' TPACK and BI (e.g., Mohammad-Salehi et al., 2021; Joo et el., 2018). While Mohammad-Salehi et al. (2021) stated that there is a minimal influence of teachers' TPACK on BI, Joo et el. (2018) divulged that TAPCK does not influence teachers' BI. Thus, this study attempted to affirm these confounding findings of the previous researchers by assuming that teachers' TPACK will have a positive influence on their BI.

H1. TPACK is positively related to Behavior Intention to use technology (BI).

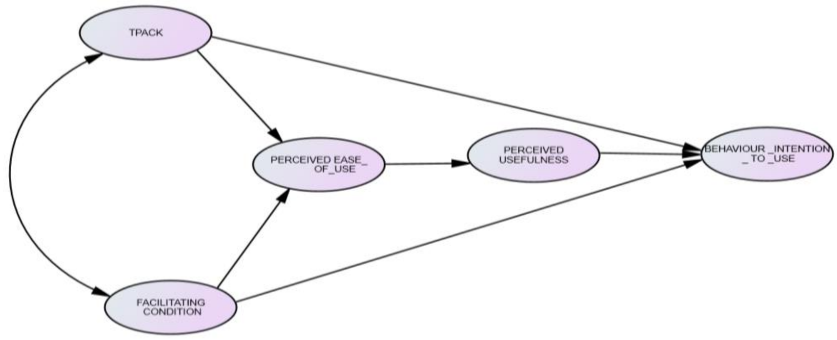

Figure 1
Proposed research model

Additionally, it is claimed that teachers' TPACK has a direct effect on Perceived Ease of Use (PEOU). Prior studies (Hsu, 2016; Jang et al., 2021; Joo et al., 2018; Mayer & Girwidz, 2019; Yang et al., 2021) have asserted that teachers' TPACK has a significant impact on PEOU, which in turn has a significant impact on their behavioural intentions to use technology (Alfadda & Mahdi, 2021; Davis, 1989; Kamal et al., 2020; Kayali & Alaaraj, 2020; Rafique et al., 2020). In other words, teachers are more likely to adopt technology if they believe it will make teaching and learning easier (Teo, 2011). Considering the literature discussed above, we hypothesized TPACK has a positive influence on PEOU even in the context of the study.

H2. TPACK is positively related to PEOU

Another important factor that determines users' intention to use technology is Facilitating Conditions (FC) (Pham & Tran, 2020; Reddy et al., 2020; Teo et al., 2019; Venkatesh et al., 2003). Facilitating condition in this study refers to teachers' perceived support from the government, organizations, or institutions to use technology in their respective classrooms. Teachers should be well supported because it gives them a sense of belonging to the institutions, which improves their overall participation also their productivity (Kachchhap & Horo, 2021). In the same vein, Teo (2011) claims that FC is one of the important factors that determines users' intentions to use technology.

However, the literature revealed inconclusive findings on the influence of FC on BI, while Chang et al. (2015) posited that there is a positive significant influence, others found that there is a non-significant influence of FC on BI (Guo et al., 2020; Liebenberg et al., 2018; Thomas et al., 2013). These confounding findings gave us reason to assume H3. Similarly, previous studies have shown that there exists a positive relationship between FC and PEOU (Al Shamsi et al., 2022; Ji et al., 2019; Zhong et al., 2021). Thus, we assumed that FC will have a positive influence on the BI and PEOU of the present participants as well.

H3. FC is positively related to Behaviour Intention to use.
H4. FC is positively related to PEOU.

Also, it came to our attention that there are many studies conducted that investigated the influence of TAM's variables: PEOU and PU on users' intention to use technology in the field of business and education. Many previous studies (Al-Emran et al., 2020; Berok & Md Yunus, 2019; Davis, 1989; Laosethakul & Leingpibul, 2021; Yuen et al., 2021) have indicated that PEOU and PU are good predictors of teachers' intention to use technology. Consequently, some studies have attempted to gauge the relationship between PEOU and PU, and most of them have found that there is a positive relationship between the two (Li et al., 2021; Verma & Sinha, 2018; Vululleh, 2018) However, not many studies are there, particularly in the Asian and Bhutanese context, that have explored whether PEOU and PU serially mediate the relationship between TPACK and FC with BI. For this reason, H7 and H8 were tested in this study. Further, this study attempted to investigate the following two hypotheses H5 and H6 to confirm the present context and built on previous students discussed above.

H5. PEOU is positively related to PU.
H6. PU is positively related to BI
H7. PEOU and PU serially mediate the relationship between TPACK and BI
H8. PEOU and PU serially mediate the relationship between FC and BI

METHOD

Research context

The present study was conducted in Bhutan, the scholarly least explored country (Wangdi & Tharchen, 2021) in South-central Asia. Bhutan is one among a few under-developing countries in Asia, with institutions across the country still lacking the proper ICT facilities, tools, and supports for any sort of e-learning activity. Only recently, with the call from the Department of Curriculum and Professional Development (DCPD) of Bhutan, ICT tools were found to be used at institutions across the country. Teachers in Bhutan are being encouraged by the Ministry of Education of Bhutan, in collaboration with the heads of institutions, to integrate ICT into teaching and learning, unlike in the past. In this context, DCPD states:

> "Technology has become an increasingly important part of learners' lives beyond school… ICT should be integrated into the curriculum as a teaching and learning tool to enhance deep and independent learning. The use of ICT as a teaching and

learning tool enables learners' access to large quantities of information online," (p.96).

Nevertheless, even to date, as stated earlier, technology is sparingly used in Bhutanese classrooms, owing to inevitable challenges (Dhendup & Sherab, 2023; Wangdi & Rai, 2023). One among them is teachers' incompetency to operate educational ICT tools due to the lack of proper training and hands-on experience (Wangdi & Rai, 2023). This should not be surprising because the advent of technology itself in Bhutan happened a bit later compared to other Asian countries (Wangdi & Rai, 2023). Thus, to successfully pursue the practice of technology used in Bhutan, the government, policymakers, and institutions need to understand the factors affecting teachers' behavioural intentions (BI) to use technology as many studies have proven how teachers' BI positively impacts the effectiveness of technology use in educational settings.

Research design and participants

The study employed a quantitative approach. The data was collected from 207 (male = 86, female = 126) in-service teachers who agreed to participate in this study from two districts of Bhutan (Thimphu and Paro). The participants' ages ranged from 25 to 52. Of 207 participants, 54% taught in primary schools, 30% in Middle secondary schools, and 15% in Higher secondary schools. They were teaching different subjects such as Sciences (24%); Math (20%); Social Sciences (33%), and English (23%) at their respective schools. As for their qualifications, the majority of these participants held Bachelor's in Education (B.Ed.: 69%); followed by a Master's (20%); Post-graduate Diploma in Education (PGDE: 11%), and none held Ph.D. The detailed information of the participant is presented in Table 1.

Table 1
Demographic information of the participants

	N	Freq	Percent
Gender	Male	81	39
	Female	126	61
	Total	207	100
School Type	Primary	112	54
	Middle	63	30
	High	32	15
	Total	207	100
Teaching Qualification	B.Ed	142	69
	PGDE	24	11
	Masters	41	20
	PhD	0	0
	Total	207	100
Teaching Subjects	Science	49	24
	Math	41	20
	Arts and Social Sciences	69	33
	English	48	23
	Total	207	100

Instrument

A modified 7-point Likert scale survey questionnaire, ranging from strongly disagree (1) to strongly agree (7) was used in this study. The survey had 22 items. The first section of the survey asked for participants' demographic information (eg., district, gender, school type, age; teaching qualification, and teaching subjects). The second section of the survey had six items on TPACK (adapted from Chai et al., 2011); five items on perceived usefulness, five items on perceived ease of use, and three items on behavioral intention to use technology, all of which were adapted from Davis (1989). The final section included three items on facilitating conditions (adapted from Thompson et al., 1991).

Procedure

Using the convenience sampling technique, the data were collected from Bhutanese in-service regular teachers teaching in 19 different public schools located in two western districts of Bhutan (Thimphu and Paro). Before proceeding to data collection, as this study involved human subjects, a letter of consent was first obtained from the Ministry of Education of Bhutan and selected schools. The electronic survey questionnaire was administered to teachers only in those schools that granted permission to distribute our survey questionnaire. When the survey was distributed, teachers were told/informed not to respond if they did not feel comfortable. For this reason, although the survey was administered to more than 300 teachers teaching in two selected districts, only 207 responded. The researchers ceased collecting data after the required sample size of more than 200 was met to perform structural equation modelling (Boomsma, 1987).

As for data analysis, it involved numerous stages. First, descriptive statistics such as mean and standard deviation were calculated, followed by Mardia's kurtosis and skewness measures to determine the data's multivariate normality (Teo, 2010). Second, two alternative methods were used to assess Common Method Bias (CMB): Harman's one-factor test and correlation matrix methods. This was followed by confirmatory factor analysis (CFA), which is frequently required before doing structural equation modelling (SEM) (Collier, 2020). Finally, full SEM was used in conjunction with maximum likelihood estimation (MLE) to assess and test hypothesized models.

FINDINGS

Descriptive analyses

The mean and standard deviation were calculated to determine the univariate normality of the data. The mean of the 22 elements varied between 4.97 and 6.43. Standard deviations ranged between 0.67 and 1.58. The values for skewness ranged from -1.18 to -0.66, whereas the values for kurtosis varied from -0.34 to 1.67. The dataset was considered normal and acceptable for multivariate analysis because the skewness and kurtosis z-values were between -1.96 and +1.96. (See Table 2).

Table 2
Descriptive statistics

	N	Mean	SD	Skewness	CR	Kurtosis	CR
TPACK1	207	5.551	1.225	-0.856	-4.968	0.405	1.176
TPACK2	207	5.357	1.298	-0.875	-5.075	0.251	0.73
TPACK3	207	5.430	1.154	-0.952	-5.526	0.785	2.278
TPACK4	207	5.319	1.192	-1.107	-6.422	1.003	2.911
TPACK5	207	5.348	1.094	-1.182	-6.859	1.674	4.857
TPACK6	207	5.628	1.015	-1.061	-6.158	1.653	4.796
PU1	207	6.290	0.808	-0.770	-4.471	0.848	2.459
PU2	207	6.174	0.817	-1.067	-6.189	1.574	4.567
PU3	207	6.242	0.870	-1.094	-6.348	1.344	3.898
PU4	207	6.285	0.830	-0.795	-4.611	1.448	4.202
PU5	207	6.295	0.827	-0.893	-5.183	1.527	4.43
PEOU1	207	5.348	1.301	-0.692	-4.012	-0.233	-0.675
PEOU2	207	5.507	1.109	-0.823	-4.778	0.475	1.379
PEOU3	207	5.676	1.012	-0.877	-5.086	0.792	2.297
PEOU4	207	5.556	1.112	-0.259	-1.501	-0.663	-1.924
PEOU5	207	5.203	1.396	-1.167	-6.769	0.832	2.415
BI1	207	6.430	0.678	-0.581	-3.374	-0.241	-0.698
BI2	207	6.430	0.739	-0.837	-4.857	0.681	1.975
BI3	207	6.343	0.705	-0.720	-4.176	0.347	1.007
FC1	207	5.425	1.300	-1.099	-6.377	0.913	2.649
FC2	207	5.145	1.454	-0.661	-3.837	-0.344	-0.998
FC3	207	4.971	1.585	-0.661	-3.837	-0.344	-0.998

Common Method Bias

This study used two statistical tests to determine the probability of common method bias (CMB) between the independent and dependent variables. First, Harman's one-factor test, in which all items from all constructions were combined into a single factor using unrotated exploratory factor analysis (EFA). This resulted in a total Eigenvalue of 7.83 and a variance extraction of 35.62 percent, which was less than the 50% proposed by Podsakoff et al. (2012) and less than the conservative thresh-hold of 40% variance suggested by Hair et al. (2019). Second, the correlation matrix approach was used to evaluate the CMB. The coefficients of correlation between the two variables were all less than the cutoff value of 0.90 (Kline, 2016). These two experiments yielded a non-significant value, indicating that CMB is a remote possibility for this inquiry.

Table 3
Total variance explained using Harman's one-factor test using unrotated EFA

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.836	35.617	35.617	7.836	35.617	35.617
2	2.256	10.254	45.871			
3	1.805	8.206	54.076			
4	1.381	6.278	60.355			
5	1.116	5.075	65.430			
6	.845	3.842	69.272			
7	.791	3.595	72.867			
8	.675	3.067	75.934			
9	.622	2.827	78.761			
10	.572	2.599	81.360			
11	.543	2.470	83.831			
12	.505	2.294	86.125			
13	.486	2.210	88.335			
14	.453	2.060	90.395			
15	.384	1.746	92.141			
16	.318	1.444	93.585			
17	.305	1.384	94.970			
18	.266	1.210	96.180			
19	.241	1.093	97.273			
20	.224	1.016	98.289			
21	.200	.910	99.199			
22	.176	.801	100.000			

Extraction Method: Principal Component Analysis.

Measurement Analysis

A Confirmatory Factor Analysis was performed for the 22 items used in this study using the Maximum likelihood estimation (MLE). MLE was used to estimate the parameters (Hair et al., 2019) of the proposed model. Following Hair et al. (2019) suggestion, we first tested the respective indicator variable loadings. A good rule of thumb is that the standardized loading estimates should be at least 0.50 or higher, ideally 0.70 (see figure 2). Following this, AMOS was used to test the model. The result suggested modification of indices to improve the model; we considered the suggestion by correlating (e7 ↔ e9) to obtain a better model for the current study. The model returned these values ($\chi2$= 389.83; $\chi2$/df=1.96; p=0.001), TLI=0. 928, CFI = 0.94, RMSEA = 0.069 |0.058 - 0.079|, SRMR = 0.05). The data of this study achieved the preferable relative chi-square test of <3 (Hair et al., 2019; Kline, 2016). The Tucker-Lewis index or TLI |0.928| has values close to |> 0.95| (Hu & Bentler, 1999). This indicated that we could proceed with convergent validity, discriminant validity, and reliability to see if the measurement model's psychometric properties were adequate.

Table 4
The measurement model-fit summary

Fit Index	Recommended value		References
χ2	NS at p < 0.05	389.833(p=.001)	
χ 2 /df	<5	1.969	
CFI	>0.90	0.939	Hu & Bentler, 1999
SRMR	<0.10	0.058	Hair et al. 2010
RMSEA	<0.08	0.069	Hair et al. 2010
TLI	>0.90	0.928	Hu & Bentler, 1999

Note. NS= Not significant; df = Degrees of freedom, CFI = Comparative fit index, RMSR= Root mean square residuals, RMSEA = Root Mean Square Error of Approximation, TLI = Tucker-Lewis Index

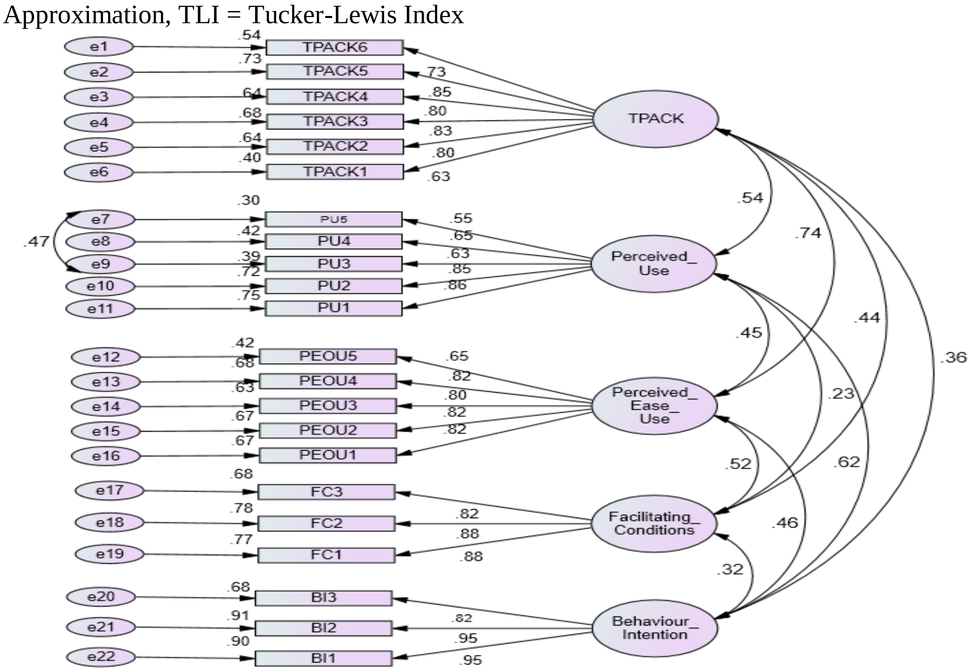

Figure 2
The measurement models

Construct reliability and convergent validity

To establish the internal consistency reliability of the constructs used in this study, Cronbach's alpha (α) and Composite Reliability (CR) were calculated; both values were greater than the cut-off value ≥ 0.70 (Collier, 2020; Kline, 2016) (see Table 5). Convergent validity was also achieved in this study because the value of CR for all constructs was greater than the average variance extracted (AVE). The AVE was also ≥ 0.50 (Fornell & Larcker, 1981).

Table 5
Internal consistency reliability and convergent validity results

Constructs	Cronbach's alpha α ≥ 0.70	Composite Reliability CR ≥ 0.70	AVE ≥ 0.50
TPACK	0.898	0.840	0.603
PU	0.853	0.840	0.519
PEOU	0.879	0.888	0.614
FC	0.892	0.896	0.743
BI	0.932	0.936	0.830

Further, the data presented in Table 6 clearly showed that the present data had no discriminant validity concerns. The HTMT values were ≤ 0.90, within the accepted threshold (Henseler et al., 2015) (See Table 7).

Table 6
Discriminant validity HTMT analysis

	TPACK	FC	BI	PEOU	PU
TPACK	1				
FC	0.44	1			
BI	0.36	0.32	1		
PEU	0.74	0.52	0.46	1	
PU	0.52	0.23	0.61	0.45	1

Structural Model and Hypothesis Testing Results

Following that, SEM was used to investigate the five proposed constructs for both direct and indirect relationships (see Figure 3). SEM is regarded as a robust measure because it accounts for measurement errors in all indicator variables within the model (Collier, 2020). Hair et al. (2019) suggested that multicollinearity assumptions between the variables should be assessed before estimating the model's structural part. Therefore, the multicollinearity assumptions were assessed for TPACK, FC, PU, PEOU, and BI by calculating collinearity statistics of variance inflation factor (VIF) and tolerance, where BI was taken as the dependent variable (see Table 7). A composite score for each item within the construct was also computed to generate VIF. The VIF and tolerance value is presented in Table 7 for TPACK, FC, PU, and PEOU. The VIF values were within the accepted threshold < 5 and the tolerance value for all four constructs was significant > 0.2, thus confirming that there were no multicollinearity issues.

Table 7
Collinearity statistics

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	TPACK_Comp	0.564	1.773
	PU_Comp	0.757	1.322
	PEOU_Comp	0.524	1.907
	FC_Comp	0.749	1.335

Dependent Variable: BI_Comp

Hence, the overall model fitness was assessed, and the model returned ($\chi2$= 364.376; $\chi2$/df=1.831; p=0.001), TLI=0.939, CFI = 0.947, RMSEA = 0.064 |0.053 - 0.074|; SRMR = 0.053). The result met the preferred relative chi-square test <3 (Hair et al., 2019; Kline, 2016). The Tucker-Lewis index or TLI (0.939) value was also close to > 0.95, a threshold value of 0.95.

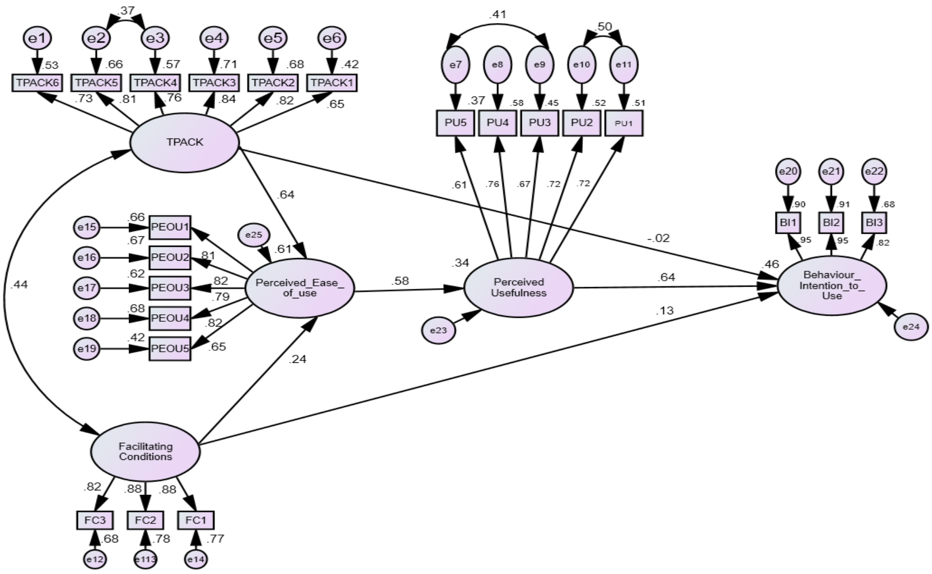

Figure 3
Structural research model

Hypothesis Testing

For hypothesis testing, we first examined six direct relationships without mediation. Of six hypotheses, while H1 and H3 were rejected, H2, H4, H5, and H6 were accepted. The detailed estimates (β), critical ratios, p-value, and CI are presented in Table 8. Further, to test the formulated hypotheses (7 and 8), a bootstrapping resampling method with 5000 replication was carried out. A serial mediation analysis was carried out in SEM to examine the mediation effect of PEOU and PU on TPACK to BI (TPACK>>PEOU>>PU>>BI) and then on FC to BI (FC>> PEOU>>PU>>BI). The result of the serial mediation of PEOU and PU from TPACK to BI was found significant at the 95% confidence level (β=0.238; CI=|0.126|-|0.418|; p<0.001) though there was a -ve non-significant direct effect from TPACK>BI. On the other hand, a significant positive indirect effect from PEOU>>PU was observed.

There was a significant positive effect from FC to BI (FC>>PEOU>>PU>>BI) when mediated through PEOU and PU (β=0.090; CI=|0.035- |0.174|; p<0.05). The standardized path coefficients, t-value, and the percentile bootstrap at a 95% confidence interval of direct and indirect effects are presented in Table 8 and Table 9 respectively.

Table 8
Direct effects with a 95% confidence interval

Relationships	Direct Effect	t-values	Confidence Interval		p-value	Decision
			Lower	Upper		
1 TPACK>BI	-0.016	-.213	-.203	.170	.822	Not supported
2 TPACK>PEOU	.641	6.91	.487	.771	.000	Supported
3 FC>BI	.127	1.83	-.071	.322	.209	Not supported
4 FC> PEOU	.243	3.65	.079	.411	.007	Supported
5 PEOU>PU	.579	6.25	.423	.736	.000	Supported
6 PU>BI	.640	7.33	.458	.850	.000	Supported

Note. Critical ratios are significant at $p < 0.001$ CR (t- values) exceeding 1.96

Table 9
Test of indirect effects of mediation

Relationships	Indirect Effect	Confidence Interval		p-value	Decision
		Lower	Upper		
7 TPACK >PEOU>PU>BI	.238	.126	.418	.000	Supported
8 FC>PEOU>PU> BI	.090	.035	.174	.003	Supported

Note. Standardized coefficients were reported. Bootstrap sample = 5,000 with replacement

DISCUSSION

The primary objective of the study was to develop and validate a model by adding two new variables TPACK and FC to TAM's initial variables (PU and PEOU). The proposed model's combined factors could account for 46% of the variance in teachers' behavioural intention to use technology. Six direct effects were hypothesized in this model (see Table 8). Following that, the mediation effects of PEOU and PU on the link between TPACK and BI and FC and BI were examined.

The SEM analyses revealed that TPACK had no significant direct relationship with BI; thus, no empirical support was received for H1. This result was in line with that of Joo et al. (2018) and Mohammad-Salehi et al. (2021). Mohammad-Salehi et al. (2021) found that teachers' TPACK had little influence on BI and Joo et al. (2018) reported that TPACK does not influence teachers' BI. This means that teachers' TPACK will not necessarily influence their behavioural intentions to use technology. A possible explanation for this result, particularly in the context of the study, could be associated with the teachers' perceived support from the organizations or institutions in which they are working. Many institutions across the country, more critically in rural areas of Bhutan still lack the proper technological infrastructure to use technology in classrooms (Wangdi & Rai, 2023; World Bank, 2019). The finding also indicate that teachers are less likely to intend to use technology if the facilitating condition is poor, regardless of whether they have adequate TPACK knowledge or not. Similar concern was reported in earlier studies (Choeda et al., 2016; Gautam et al., 2021; Wangdi & Rai, 2023). These studies highlighted that not many Bhutanese teachers use technology in their classrooms owing to the lack of proper facilities and infrastructure (Choeda et al., 2016; Gautam et al., 2021; Wangdi & Rai, 2023). Therefore, this study recommends policy makers, institutions, and educational stakeholders work on how to improve teachers' support.

Surprisingly, our findings showed that even the facilitating conditions had no discernible impact on teachers' BI (H3 was rejected). Nonetheless, FC had a positive but non-significant effect on teachers' BI. FC could explain 13% (non-significant) of the variance in BI. Similar findings were highlighted in previous studies such as Guo et al. (2020); Liebenberg et al. (2018), and Thomas et al. (2013). The present study however rejected the assumption made by Chang et al. (2015) that there is a strong positive influence of FC on BI. The possible non-significant influence of FC on BI in our context could be because of the lack of facilitating conditions in Bhutan, as noted earlier. In the same vein, teachers' BI is more likely to be influenced by personal interests and goals to learn new things (such as how technology can be integrated into teaching and learning in this case) rather than FC. Meaning perceived support from institutions may not have much impact on teachers' intention to use technology in their classrooms. This said, no matter how small the impact is, the positive impact of FC on BI cannot be overlooked. Thus, institutions are suggested to provide sufficient technical and infrastructure support to help teachers improve their willingness to use technology in classrooms (Koehler & Mishra, 2009).

The findings of the present study established a statistically significant relationship between TPACK to PEOU (H2), FC on PEOU (H4), PEOU on PU (H5), and PU on BI (H6). To this effect, for H2, our finding agrees with the findings of many prior studies (Hsu, 2016; Jang et al., 2021; Joo et al., 2018; Mayer & Girwidz, 2019; Yang et al., 2021) that have reported a positive statistically significant relationship between TPACK and PEOU. It seems that teachers with good TPACK might perceive technology as easy to use. This also indicates that teachers are likely to use technology if they perceive it is easy to use (Teo, 2011). As with other hypotheses, first, FC had a significant positive influence on PEOU (H4). This finding was in line with previous studies conducted elsewhere (Abdullah & Ward, 2016); Al Shamsi et al., 2022; Ji et al., 2019; Peñarroja et al., 2019; Zhong et al., 2021). Similarly, PEOU had a positive influence on PU (H5) (Laosethakul & Leingpibul, 2021; Li et al., 2021; Verma & Sinha, 2018; Vululleh, 2018; Yuen et al., 2021), and PU on BI (H6) (Al-Emran et al., 2020; Davis, 1989; Laosethakul & Leingpibul, 2021; Yuen et al., 2021).

Additionally, since this study found an insignificant influence of TPACK and FC on BI, a serial mediation analysis was performed. Firstly, this was done to observe the potential effect of teachers' TPACK and FC on BI when mediated through PEOU and PU. Secondly, although previous studies have used PEOU and PU to test their mediation effect with different exogenous and endogenous variables, none of the studies that could be reached have attempted to explore the influence of PEOU and PU as mediators on TPACK and FC with BI. In doing this, the analysis result revealed a significant positive influence of TPACK and FC on BI when mediated through PEOU and PU. This finding indicates that teachers' TPACK and FC may play a vital role in determining teachers' BI if they perceive technology to be used in the classroom as useful and user friendly.

CONCLUSION

This study proposes a validated extended TAM (eTAM) model to assess teachers’ BI in the context, which can be extended to other similar contexts like Bhutan. For this, we first tested six direct relationships: TPACK to BI; TPACK to PEOU; FC to BI; FC to PEOU, PEOU to PU, and PU to BI. In doing this, surprisingly, there was no influence from TPACK to BI and then from FC to BI. These findings suggest that TPACK and FC are not positive determinants of teachers’ intention to use technology. This indicates that having good TPACK knowledge and FC is not necessarily going to improve teachers’ behavioural intention to use technology. However, if TPACK and FC are mediated through PEOU and PU, TPACK and FC are likely to have a positive influence on teachers’ BI, as indicated by this study. It was found that TPACK and FC could explain 46% of the variance in BI if mediated through PEOU and PU.

LIMITATIONS

Although the proposed model's applicability could be extended to other contexts where technology is used at the infancy level, such as Bhutan, caution is advised because our study has limitations. First, self-reported data such as data from survey questionnaires are often criticized as unreliable. Second, the data for the study was collected using the convenience sampling method, so we could cover only two western districts of Bhutan. Therefore, the findings are not necessarily representative of all teachers in Bhutan. Future researchers may consider exploring the same phenomenon with a wider range of participants. More importantly, researchers and practitioners are recommended to assess and validate this present proposed model with TPACK and FC added on the two initial variables to the TAM’s model to improve the applicability of the model in different contexts. Further, as reported earlier, the model study could explain only 46% of the variance in BI. Future researchers may be interested in investigating the remaining 54% unexplained variance in BI by adding additional exogenous variables to the current model. Considering teachers' sense of belongingness, well-being, happiness, etc. as independent variables and how it influences their BI would be an interesting study.

REFERENCES

Abdullah, F., & Ward, R. (2016). Developing a general extended technology Acceptance Model for E-Learning (GETAMEL) by analysing commonly used external factors. *Computers in Human Behavior*, 56, 238-256. http://dx.doi.org/10.1016/j.chb.2015.11.036

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Al Shamsi, J. H., Al-Emran, M., & Shaalan, K. (2022). Understanding key drivers affecting students’ use of artificial intelligence-based voice assistants. *Education and Information Technologies*, 1-21.

Al-Emran, M., Arpaci, I., & Salloum, S. A. (2020). An empirical examination of continuous intention to use m-learning: An integrated model. *Education and information technologies*, *25*(4), 2899-2918.

Alfadda, H. A., & Mahdi, H. S. (2021). Measuring students' use of zoom application in language courses based on the technology acceptance model (tam). *Journal of Psycholinguistic Research*, *50*(4), 883-900.

Alokluk, J. A. (2018). The effectiveness of Blackboard system, uses and limitations in information management. *Intelligent Information Management*, *10*(06), 133

Boomsma, A. (1987). *The robustness of maximum likelihood estimation in structural equation models.* Cambridge University Press.

Chai, C. S., Koh, J. H. L., Tsai, C. C., & Tan, L. L. W. (2011). Modelling primary school pre-service teachers' Technological Pedagogical Content Knowledge (TPACK) for meaningful learning with information and communication technology (ICT). *Computers & Education*, *57*(1), 1184-1193.

Chang, S. S., Lou, S. J., Cheng, S. R., & Lin, C. L. (2015). Exploration of usage behavioral model construction for university library electronic resources. *The Electronic Library, 33*(2),292-307. https://doi.org/10.1108/EL-10-2013-0195

Choeda, Penjor, T., Dupka, D., & Zander, P. (2016). The state of integration of the virtual learning environment and ICT into the pedagogy of the Royal University of Bhutan: A descriptive study. *International Journal of Education and Development using Information and Communication Technology*, *12*(1), 71-88.

Chou, C. M., Shen, C. H., Hsiao, H. C., & Shen, T. C. (2019). Factors influencing teachers' innovative teaching behaviour with information and communication technology (ICT): The mediator role of organizational innovation climate. *Educational Psychology*, *39*(1), 65-85.

Collier, J. E. (2020). *Applied structural equation modelling using AMOS: Basic to advanced techniques*. Routledge.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS quarterly*, 319-340.

Department of Curriculum and Professional Development. (2022). *National School Curriculum: English Curriculum Framework Classes PP-XII*. Thimphu.

Dhendup, S., & Sherab, K. (2023). Exploring Bhutanese primary school teachers' technological knowledge. *Journal of Global Education and Research*, *7(*2), 116-130. https://www.doi.org/10.5038/ 2577-509X.7.2.1213

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50.

Gautam, K. P., Sharma, D., Wangpo, K., Dema, S. (2021). The acceptance and use of the Virtual Learning Environment (VLE) in higher education: A contextual study of Royal University of Bhutan. *Asian Research Journal of Arts & Social Sciences, 13*(3), 20-36. https://doi.org/10.9734/arjass/2021/v13i330215

Ghosh, A., Nafalski, A., Nedic, Z., & Wibawa, A. P. (2019). Learning management systems with emphasis on the Moodle at UniSA. *Bulletin of Social Informatics Theory and Application, 3*(1), 13-21

Guo, J., Huang, F., Lou, Y., & Chen, S. (2020). Students' perceptions of using mobile technologies in informal English learning during the COVID-19 epidemic: A study in Chinese rural secondary schools. *Journal of Pedagogical Research, 4*(4), 475-483.

Hair, J. F., Black, W. C., Babin, B., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 43*(1), 115–135.

Hsu, L. (2016). Examining EFL teachers' technological pedagogical content knowledge and the adoption of mobile-assisted language learning: a partial least square approach. *Computer Assisted Language Learning, 29*(8), 1287-1297.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural equation modelling: a multidisciplinary journal, 6*(1), 1-55.

Jang, J., Ko, Y., Shin, W. S., & Han, I. (2021). Augmented reality and virtual reality for learning: An examination using an extended technology acceptance model. *IEEE Access, 9*, 6798-6809.

Ji, Z., Yang, Z., Liu, J., & Yu, C. (2019). Investigating users' continued usage intentions of online learning applications. *Information, 10*(6), 198.

Joo, Y. J., Park, S., & Lim, E. (2018). Factors influencing preservice teachers' intention to use technology: TPACK, teacher self-efficacy, and technology acceptance model. *Journal of Educational Technology & Society, 21*(3), 48-59.

Kachchhap, S. L., & Horo, W. (2021). Factors influencing school teachers' sense of belonging: An empirical evidence. *International Journal of Instruction, 14*(4), 775-790.

Kaizer, B.M., Silva, C.E.S., de Pavia, A.P. and Zerbini, T. (2020), E-learning training in work corporations: A review on instructional planning". *European Journal of Training and Development, 44* (6/7),615-636. https://doi.org/10.1108/EJTD-08-2019-0149

Kamal, S. A., Shafiq, M., & Kakria, P. (2020). Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM). *Technology in Society, 60*, 101212. https://doi.org/10.1016/j.techsoc.2019.101212

Kayali, M., & Alaaraj, S. (2020). Adoption of cloud based E-learning in developing countries: a combination a of DOI, TAM and UTAUT. *Int. J. Contemp. Manag. Inf. Technol, 1*(1), 1-7.

Kline, R.B. (2016). *Principles and Practice of Structural Equation Modelling* (4th ed.). Guilford Press.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)?. *Contemporary issues in technology and teacher education*, *9*(1), 60-70.

Laosethakul, K., & Leingpibul, T. (2021). Investigating student perceptions and behavioral intention to use multimedia teaching methods for the SAP ERP System. *e-Journal of Business Education and Scholarship of Teaching*, *15*(1), 1-27.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & management*, *40*(3), 191-204.

Liebenberg, J., Benade, T., & Ellis, S. (2018). Acceptance of ICT: Applicability of the unified theory of acceptance and use of technology (UTAUT) to South African students. *The African Journal of Information Systems*, *10*(3), 1.

Liu, Z. Y., Lomovtseva, N., & Korobeynikova, E. (2020). Online learning platforms: Reconstructing modern higher education. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(13), 4-21.

Mayer, P., & Girwidz, R. (2019). Physics teachers' acceptance of multimedia applications—adaptation of the technology acceptance model to investigate the influence of TPACK on physics teachers' acceptance behavior of multimedia applications. *Frontiers in Education*, 4,1-12. https://doi.org/10.3389/feduc.2019.00073

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record*, *108*(6), 1017-1054.

Mohammad-Salehi, B., Vaez-Dalili, M., & Heidari Tabrizi, H. (2021). Investigating Factors That Influence EFL Teachers' Adoption of Web 2.0 Technologies: Evidence from Applying the UTAUT and TPACK. *TESL-EJ*, *25*(1), n1.

Pham, Q. T., & Tran, T. P. (2020). The acceptance of e-learning systems and the learning outcome of students at universities in Vietnam. Knowledge Management & E-Learning: *An International Journal*, *12*(1), 63-84.

Peñarroja, V., Sánchez, J., Gamero, N., Orengo, V., & Zornoza, A. M. (2019). The influence of organisational facilitating conditions and technology acceptance factors on the effectiveness of virtual communities of practice. *Behaviour & Information Technology*, *38*(8), 845-857. https://doi.org/10.1080/0144929X.2018.1564070

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual review of psychology*, *63*, 539-569.

Rafique, H., Almagrabi, A. O., Shamim, A., Anwar, F., & Bashir, A. K. (2020). Investigating the acceptance of mobile library applications with an extended technology acceptance model (TAM). *Computers & Education*, *145*, 103732. https://doi.org/10.1016/j.compedu.2019.103732

Reddy, P., Chaudhary, K., Sharma, B., & Chand, R. (2021). The two perfect scorers for technology acceptance. *Education and Information Technologies, 26*(2), 1505–1526.

Setiyani, L., Effendy, F., & Slamet, A. A. (2021). Using technology acceptance model 3 (TAM 3) at selected private technical high school: Google drive storage in e-learning. *Utamax: Journal of Ultimate Research and Trends in Education*, *3*(2), 80-89.

Tarhini, A., Arachchilage, N. A. G., & Abbasi, M. S. (2015). A critical review of theories and models of technology adoption and acceptance in information system research. *International Journal of Technology Diffusion (IJTD)*, *6*(4), 58-77.

Teo, T. (2010). Examining the influence of subjective norm and facilitating conditions on the intention to use technology among pre-service teachers: a structural equation modelling of an extended technology acceptance model. *Asia Pacific Education Review*, *11*(2), 253-262.

Teo, T. (2011). Modelling the determinants of pre-service teachers' perceived usefulness of e-learning. *Campus-Wide Information Systems*, *28*(2),124 – 140. http://dx.doi.org/10.1108/10650741111117824

Teo, T., Zhou, M., Fan, A. C. W., & Huang, F. (2019). Factors that influence university students’ intention to use Moodle: A study in Macau. *Educational Technology Research and Development*, *67*(3), 749-766.

Thomas, T., Singh, L., & Gaffar, K. (2013). The utility of the UTAUT model in explaining mobile learning adoption in higher education in Guyana. *International Journal of Education and Development using ICT*, *9*(3).

Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). Personal computing: Toward a conceptual model of utilization. *MIS quarterly*, 125-143.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

Verma, P., & Sinha, N. (2018). Integrating perceived economic wellbeing to technology acceptance model: The case of mobile based agricultural extension service. *Technological forecasting and social change*, *126*, 207-216.

Vululleh, P. (2018). Determinants of students’e-learning acceptance in developing countries: An approach based on Structural Equation Modelling (SEM). *International Journal of Education and Development using ICT*, *14*(1).

Wahyu, Y., Suastra, I. W., Sadia, I. W., & Suarni, N. K. (2020). The effectiveness of mobile augmented reality assisted stem-based learning on scientific literacy and students' achievement. *International Journal of Instruction*, *13*(3), 343-356.

Wangdi, T., & Rai, A. (2023). Teaching online during the Covid pandemic in rural Bhutan: Challenges and coping strategies. *South Asia Research, 43*(1), 83–96.

Wangdi, T., & Tharchen, N. (2021). Bhutanese school teachers' perceptions, challenges and perceived benefits in doing research. *Issues in Educational Research*, *31*(3), 990-1005.

Wei, S. H. (2021). Measuring self-efficacy of mathematics teaching with ICT for elementary teachers. *International Journal of Intelligent Technologies & Applied Statistics*, *14*(1).

Wicaksono, B. S., Jubaedah, J., & Hidayati, S. (2020). Understanding investment behavior intention to adopt online mutual funds based on Unified Theory of Acceptance and Use of Technology Model. *International Journal of Multicultural and Multireligious Understanding*, *7*(10), 94-107.

Widyasari, F., Masykuri, M., Mahardiani, L., Saputro, S., & Yamtinah, S. (2022). Measuring the Effect of Subject-Specific Pedagogy on TPACK through Flipped Learning in E-Learning Classroom. *International Journal of Instruction*, *15*(3), 1007-1030.

World Bank (2019) Poverty, Vulnerability, and welfare in Bhutan: Progress and challenges. URL (consulted 24 January 2022), from: https://elibrary.worldbank.org/doi/abs/10.1596/33366

Yang, J., Wang, Q., Wang, J., Huang, M., & Ma, Y. (2021). A study of K-12 teachers' TPACK on the technology acceptance of E-schoolbag. *Interactive Learning Environments*, *29*(7), 1062-1075.

Yuen, K. F., Cai, L., Qi, G., & Wang, X. (2021). Factors influencing autonomous vehicle adoption: an application of the technology acceptance model and innovation diffusion theory. *Technology Analysis & Strategic Management*, *33*(5), 505-519.

Zhang, M., & Chen, S. (2022). Modelling dichotomous technology use among university EFL teachers in China: The roles of TPACK, affective and evaluative attitudes towards technology. *Cogent Education*, *9*(1), 2013396.

Zhong, Y., Oh, S., & Moon, H. C. (2021). Service transformation under industry 4.0: Investigating acceptance of facial recognition payment through an extended technology acceptance model. *Technology in Society*, *64*, 101515.