



# Factors Influencing Polytechnic Educators' Behavioural Intentions to use Technology Enhanced Learning Tools: The Structural Equation Modelling Approach

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This study examined factors that affect educators' behavioural intention to use Technology Enhanced Learning (TEL) tools in a polytechnic in Singapore. Five hundred and twenty-five educators completed a survey measuring their responses to six variables in the extended Technology Acceptance Model (TAM). This study is related to the sub-theme of reconnecting people with educational technologies. Social and environmental constructs were included to measure the influence of other persons and the facilitating conditions on the educators' intention to use (IU) TEL tools. Structural Equation Modelling was used to test the research model. The results showed that attitude towards usage (ATU) of TEL tools was the dominant determinant of educators' IU. Overall, attitude toward usage (ATU), perceived usefulness (PU), perceived ease of use (PEU), subjective norm (SN) and facilitating conditions (FC) explained 65.3% of the variance in IU. SN had positive and significant effects on PEU and PU, whereas FC significantly influenced PEU. Finally, the implications of findings for polytechnic educators are discussed in the paper.

Keywords: Technology acceptance model, structural equation modelling, subjective norm, facilitating conditions

## Introduction

Digital transformation has escalated in many industries during the COVID-19 pandemic. Higher education also rode the wave of transformation and adopted technology to create effective and seamless learning for students. Despite the promises of technology to improve the quality of teaching and learning, the adoption of TEL tools might be limited by some intrinsic and extrinsic barriers. The intrinsic barriers are typically rooted in educators' underpinning attitudes toward technology and their perceptions of its usefulness and ease of use. Meanwhile, the extrinsic challenges are the constraints of external resources (e.g., technical support, provision of equipment, etc.) (Davis, 1989; Ertmer, 1999). Research showed that teachers' positive attitudes could be fostered by overcoming logistical issues and providing user-friendly tools (Lee et al., 2021). Studies have identified various factors that determine teachers' intention to use technology in teaching and learning and are well conceptualised in Technology Acceptance Model (TAM) (Park et al., 2019; Venkatesh et al., 2003). Hence, this study aims to examine the efficacy of extended TAM to understand polytechnic educators' intention to use technology-enhanced learning (TEL) tools. TEL tools broadly refer to technology applications that enhance teaching, learning and assessment. The application of TEL tools can include but is not limited to Learning Management System, immersive learning (e.g., AR/VR and Mobile/ Web-based interactive software/app), and adaptive learning and assessment (e.g., learning analytics and assessment analytics).

## Literature review

### Technology Acceptance Model

The initial Technology Acceptance Model (TAM) is a model that posits users' attitude toward the usage (ATU) is influenced by their behavioural intention to use (IU) (Davis, 1989). It postulates that attitude could be predicted by perceived usefulness and perceived ease of use. Perceived usefulness (PU) is defined as the degree of a person's belief that using a system or tool will improve their work performance in productivity and effectiveness. On the other hand, perceived ease of use (PEU) is defined as how a person considers that using a system or tool requires minimum effort, and it is easy to get the tool to do what they intend to do (Davis, 1989).

Studies have shown that perceived ease of use influenced perceived usefulness (Park et al., 2019; Teo, 2010). Four hypotheses were developed based on the initial TAM model.

- H1: Attitude towards usage will have a significant influence on intention to use.  
 H2: Perceived usefulness will have a significant influence on attitude toward usage.  
 H3: Perceived ease of use will have a significant influence on attitude toward usage.  
 H4: Perceived ease of use will have a significant influence on perceived usefulness.

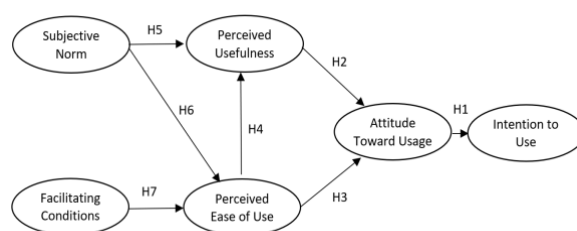
### Subjective norm and facilitating conditions

Besides the individuals' perceptions, social and environmental factors also influence the degree of technology adoption. Subjective norm (SN) is defined as a person's perception of other persons who are important to them and think they should or should not perform the behaviour (Ajzen, 1991). Based on Ajzen's (1991) theory of planned behaviour, human beings' intention is contingent upon the social pressure they receive from the opinion of others. In the context of adopting technology tools, studies (Agudo-Peregrina et al., 2014; Teo, 2010) have found that the opinion of significant others, such as co-workers and leaders may influence users' intention to use technology in their workplace. Facilitating conditions (FC) are perceived as enablers or barriers in an environment that influence a person's perception of the difficulties in performing a task (Teo, 2010). The facilitating conditions, such as the availability of technical and administrative support, were found to positively affect attitude toward technology use (Ngai et al., 2007; Teo, 2010).

Based on the above-mentioned empirical studies, the three hypotheses below were formulated in this study.

- H5: Subjective norm will have a significant influence on perceived usefulness.  
 H6: Subjective norm will have a significant influence on perceived ease of use.  
 H7: Facilitating conditions will have a significant influence on perceived ease of use.

The impact of SN and FC on educators' perceptions and attitudes toward the usage of technology tools was inconclusive. For example, Teo (2009) found that SN can predict pre-service teachers' PU significantly, but in his other study (i.e., Teo & van Schaik, 2009), preservice teachers' PU was not influenced by their SN significantly. Furthermore, the participants in these studies were pre-service teachers, and they did not have co-workers or supervisors to interact with. Thus, the influence of SN on their perceptions and intention might not be the same as the educators who had begun their teaching at the polytechnic. Since the impact of social and environmental factors is inconclusive, we decided to investigate the influence of SN and FC in the extended TAM among polytechnic educators. The four constructs selected in the extended TAM are similar to the four direct determinants (i.e., performance expectancy, effort expectancy, social influence, and facilitating conditions) of users' intention and behaviour in the Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003). We did not measure technology self-efficacy and anxiety in this study because they are not the direct determinants. Thus, we adopted the extended TAM model (Figure 1) in this study.



**Figure 1: Proposed research model**

## Method

### Research design

This study aims to analyse an extended TAM that predicts the intention to use TEL tools among educators in a polytechnic in Singapore. Initial TAM focuses on the influence of individual perceptions (i.e., PU and PEU) on educators' ATU and IU. In the extended TAM, social and environmental factors (i.e., SN and FC) are included in the model to investigate the influence of other persons and facilitating conditions on educator's perceptions,

attitudes, and intention to use TEL tools. A validated survey of the extended TAM used in Teo's study (2009) was adopted in this study. A structural equation modelling (SEM) approach (Kline, 2015) was adopted to analyse the relationship among six variables: intention to use, attitude toward the usage, perceived usefulness; perceived ease of use, subjective norm; and facilitating conditions. Data were collected using a self-report questionnaire that comprised demographic questions and multiple items for each variable. Informed consent was obtained from all the participants, and all ethical requirements were observed. Firstly, data were screened for missing data and outliers. This was followed by establishing convergent and discriminant validity.

## Measure

A survey consisting of 17 items, measured with a five-point Likert scale, was used in this study. They were attitude toward usage (ATU) (three items), perceived usefulness (PU) (three items), perceived ease of use (PEU) (three items), subjective norm (SU) (two items), facilitating conditions (FC) (three items), and intention to use (IU) (three items). These items were adapted from a validated survey in Teo's (2010) study.

## Research participants and data collection

Participation in this study was voluntary, and 525 faculty members (268 males and 257 females) who served in a polytechnic were recruited. The mode category for participants' age was 41 to 50. This sample represented 41% of the polytechnic's teaching staff total population.

## Findings

### Descriptive statistics

Table 1 shows that the means of all items were above the midpoint of 3.00, and the standard deviation ranged from 0.54 to 0.73, indicating a narrow spread around the mean. The skewness ranged from -.10 to 0.82, and Kurtosis ranged from 0.29 to 4.03. The data were considered normally distributed based on Kline's (2005) recommendation that the skew and kurtosis indices should be below 3.0 and 8.0, respectively.

### Convergent validity

The convergent validity was assessed through (a) item reliability, (b) composite reliability, and (c) the average variance extracted (AVE). Following the recommendation used by Teo (2020), Table 1 shows all items obtained factor loading greater than 0.7 that indicated reliability at the item level. For composite reliability, each variable obtained the value of above 0.7. The convergent validity was adequate as the AVE was greater than 0.5.

**Table 1: Result for the measurement Model**

Latent variable	Mean (Standard deviation)	Item	Factor loading (>0.7)*	Composite reliability (≥.70)*	Average variance extracted (≥.50)*	t-value
Perceived Usefulness (PU)	3.81 (0.62)	PU1	0.87	0.85	0.66	17.62**
		PU2	0.87			17.67**
		PU3	0.70			-
Perceived Ease of Use (PEU)	3.22 (0.71)	PEU1	0.83	0.83	0.61	15.48**
		PEU2	0.84			15.58**
		PEU3	0.67			-
Subjective Norm (SN)	3.57 (0.70)	SN1	0.96	0.71	0.55	21.37**
		SN2	0.86			-
Facilitating Conditions (FC)	3.30 (0.73)	FC1	0.92	0.89	0.73	23.03**
		FC2	0.86			21.70**
		FC3	0.79			-
Attitude Toward Usage (ATU)	4.00 (0.54)	ATU1	0.81	0.86	0.67	21.19**
		ATU2	0.81			21.13**
		ATU3	0.83			-
Intention to Use (IU)	4.02 (0.57)	IU1	0.82	0.75	0.89	25.23**
		IU2	0.86			26.70**
		IU3	0.91			-

\* Indicates an acceptance level; \*\*p<0.001

### Discriminant validity

The discriminant validity was assessed by comparing the square root of the AVE of each variable with the correlation between that variable and all other variables. Discriminant validity was obtained for all variables (see Table 2) as the square roots of AVEs are higher than the correlations of the variable with all other variables.

**Table 2: Discriminant validity**

Variables	PU	PEU	SN	FC	ATU	IU
PU	(0.81)					
PEU	0.48**	(0.78)				
SN	0.36**	0.34**	(0.74)			
FC	0.29**	0.49**	0.52**	(0.86)		
ATU	0.70**	0.43**	0.38**	0.20**	(0.82)	
IU	0.57**	0.45**	0.45**	0.31**	0.71**	(0.95)

Notes: Diagonal: square root of average variance. Off-diagonal: correlational between variables \*\*p<.01

### Test of the measurement model

This study employed the SEM approach with the software program AMOS (version 22.0) (Arbuckle, 2019) to test the research model. Multiple fit indices with the recommended guidelines were used to evaluate the overall model fit. Table 3 indicates that the measurement model has a good fit.

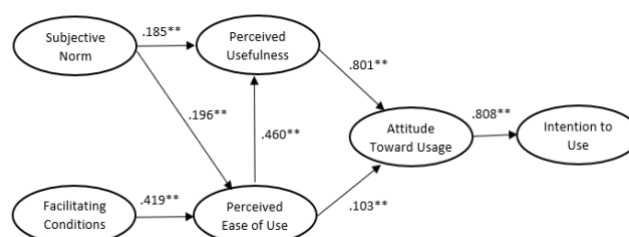
**Table 3: Fit indices for the measurement model**

Model fit indices	Measurement model	Research model	Recommended guidelines*
Chi-square ( $\chi^2$ )	268.94 p<.001	306.53 p<.001	Non-significant
$\chi^2/df$ (Normed Chi-square)	2.59	2.81	3
Standardised root mean residual (SRMR)	0.04	0.05	<0.05
Comparative fit index (CFI)	0.97	0.97	$\geq .9$
Tucker-Lewis index (TLI)	0.96	0.96	$\geq 0.9$
Root mean square error of approximation (RMSEA)	0.06	0.06	<0.08

\* (Kline, 2015; McDonald & Ho, 2002)

### Hypothesis testing and effects of determinants

Overall, all seven hypotheses were supported by the data. Figure 2 depicts the path coefficient of each path in the model. ATU, PU, PEU, SN and FC explained 65.3% of the variance in intention IU (see Table 4,  $R^2=0.653$ ). Meanwhile, the other three endogenous variables, ATU, PU and PEU, had their variance explained by their determinants in amounts of 74.1%, 32.1% and 30.8%, respectively. The most dominant determinant of IU was ATU, with a large total effect of  $\beta=0.808$ ,  $p<0.01$ . The external variables, FC and SN had indirect total effects on IU ( $\beta=0.195$  and  $\beta=0.160$ ,  $p<0.01$ ), and these were mediated by PU, PEU and ATU. Moreover, the path coefficients showed that FC had larger effect ( $\beta=0.419$ ,  $p<0.01$ ) on PEU compared to SN ( $\beta=0.196$ ,  $p<0.01$ ). Meanwhile, PEU had a smaller effect on educators' ATU ( $\beta=0.103$ ,  $p<0.01$ ) compared to PU ( $\beta=0.801$ ,  $p<0.01$ ).



**Figure 2: Model of best fit**

**Table 4. Direct, Indirect, and Total Effects of the Research Model**

Outcome	Determinant	Standardised Estimates		
		Direct	Indirect	Total
Intention to Use (IU) R <sup>2</sup> =0.653	ATU	.808	-	.808
	PU	-	.647	.647
	PEU	-	.381	.381
	SN	-	.195	.195
	FC	-	.160	.160
Attitude Toward Use (ATU) R <sup>2</sup> =0.741	PU	.801	-	.801
	PEU	.103	.368	.472
	SN	-	.241	.241
	FC	-	.197	.197
Perceived Usefulness (PU) R <sup>2</sup> =0.321	PEU	.460	-	.460
	SN	.186	.090	.276
	FC	-	.193	.193
Perceived Ease of Use (PEU) R <sup>2</sup> =0.308	SN	.196	-	.196
	FC	.419	-	.419

## Discussion

The results show that extended TAM is an efficient model for predicting educators' intention to use TEL tools in the polytechnic setting. Similar to existing findings (Ngai et al., 2007; Teo, 2010), educators' IU and ATU are predicted by the core variables (PU and PEU) in TAM and the external variables (FC and SN). When educators believe that TEL tools are easy to use and could improve their work performance, they are likely to use them. However, these perceptions do not remain positive if they do not have the opportunity to develop their technical and pedagogical knowledge continually (Teo, 2010). Lee et al. (2010) also found that providing updated professional development programmes could sustain teachers' positive attitudes towards TEL tools. Thus, the polytechnic should be aware of the teaching staff's learning needs and continue to provide timely and relevant professional development to sustain their intentions and support their technology adoption.

This study found that the external variables (FC and SN) interacted well with TAM core variables (PEU and PU) in explaining ATU and IU. The extended TAM has achieved great explanatory power of educators' intention to use TEL tools. Since FC has a direct effect on educators' PEU and an indirect effect on their IU, we suggest the polytechnic and other higher education institutes put in the effort to improve the technical support and reduce the technical hurdles. This effort will subsequently promote positive intention to use TEL tools. Besides technical support, communities of practice may also encourage teaching staff to adopt TEL tools because members in the communities could be the significant others (i.e., SN) who can influence educators' PEU directly and IU indirectly. Institutes can consider having mentors to encourage their mentees to use TEL tools explicitly. For individual educators, active participation in communities of practice may be a good approach to cultivating positive perceptions and attitudes toward adopting TEL tools.

## Limitation of study and further research

The variance of intention to use was explained by 65.3%, but the remaining 34.7% of the variance was left unexplained. Some variables have been excluded in this study to determine educators' intention to use. Future studies could design qualitative inquiry to explore other factors that have not been included in the extended TAM. In addition, longitudinal studies may be conducted to trace the changes in the variables that affect educators' IU across times so that the institute could provide timely support when needed.

## Conclusion

Overall, the findings show that the extended TAM is efficient in explaining educators' intention to use TEL tools. Understanding the multiple factors that affect educators' intention directly affects institute administrators and educators. The administrators should continue improving the facilitating conditions and cultivating a supportive social environment to promote positive attitudes. Meanwhile, future study can explore whether participation in communities of practice will help to sustain positive perceptions and attitudes of educators.

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