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DETERMINANTS OF TEACHERS' ICT ACCEPTANCE IN JEMBER SCHOOLS, INDONESIA: A CROSS-SECTIONAL SURVEY

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Abstract

The study was a cross-sectional survey of factors that affected teachers' use of ICT in Jember schools, Indonesia. The sample consisted of 1,137 teachers randomly selected from all of the SMAs, SMPs and SMKs in the district. A self-developed and adopted questionnaire based on an extended Technology Acceptance Model (e-TAM) measuring five hypothesized determinants of ICT acceptance, i.e. perceived usefulness, perceived ease of use, intention to use, computer self-efficacy and organizational support, was administered to the respondents with the help of Dispendik and school principals. Results of Structural Equation Modelling (SEM) applied on the data revealed all five constructs (perceived usefulness, perceived ease of use, intention to use, computer self-efficacy and organizational support) to be statistically significant determinants of Jember teachers' ICT acceptance. The hypothesized SEM model fitted the data adequately, accounting for approximately 63% of the variance explained. The structural model also produced a statistically significant change in the chi-square value when tested across gender, indicating that gender influenced teachers' acceptance of ICT. The findings have important implications for stakeholders and policy makers, particularly with respect to their efforts to galvanize greater ICT utilization among teachers in Indonesian schools.

Key words: technology acceptance model (TAM), technology information technology (ICT), structural equation modeling (SEM).

INTRODUCTION

In the context of modern day education, the use of information and communication technology (ICT) is a common feature in the classroom. A various forms of instructional ICT, such as the interactive whiteboard, IPADs, 3D models, the Internet, Second Life, video conferencing, software applications, educational software, multimedia, video clips, CD-ROMS, e-books and the like, are common tools used by contemporary teachers. Used appropriately with innovative teaching techniques, these tools affect learning in positive ways and have a huge potential in bringing about desirable student outcomes. For example, the interactive whiteboard has been shown to increase students' enthusiasm and motivation (Solvie, 2004; Serow & Callingham, 2008), while multimedia and 3D models have facilitated students' understanding of difficult concepts in science (Tao, 2004; Barton, 2005). The use of the Internet, for instance, extends knowledge acquisition beyond the four walls of the classroom, promotes lifelong learning, and provides greater opportunities for students to engage with knowledge in an active, independent, self-directed and constructive way (Volman & Van Eck, 2001). These findings are consistent with the results of a meta-analysis of 42 studies conducted by Waxman, Lin and Michko (2003), in which it was concluded that the teaching and learning process with ICT had positive and significant effects on students' cognitive, affective, and behaviourur outcomes.

Needless to say, the use of ICT enables educators to transform traditional ways of obtaining and presenting information to new methods of accessing, gathering, analysing, spreading and reproducing the information (See, 1994). Balanskat, Blamire and Kefala (2006) found that integrating ICT into teaching and learning increased students' performance significantly in different courses taught as compared to traditional methods. Therefore, it is not surprising to note the increasing interest and intention from many researchers to study the effects of ICT in education, and the efforts of governments across the globe to computerize their schools and education systems.

Recognizing the importance and benefits of ICT in education, the Indonesian government has formulated special projects and plans to enhance the use of ICT in schools. Over the last ten years, its Ministry of National Education (MONE) has set up various plans and projects on the use of ICT in education. As an example, in the year 2000 the Ministry launched a program called "Sekolah Menengah Umum 2000" or SMU 2000, aimed at connecting 2,000 high schools to the Internet through the development of an e-learning portal. Another project in the year 2002 initiated by the Centre of ICT for Education (Pustekkom) in collaboration with the directorate of senior high and vocational schools was to develop an e-learning programme called "e-edukasi". This network platform provided various electronic learning resources that could be accessed by teachers and students to enrich their teaching and learning materials (Yuhetty, 2002).

Furthermore, as an effort to ease the accessibility and connectivity of the schools, the Ministry also set up a network programme called "JARDIKNAS" (Jejaring Pendidikan National) or in English, The Indonesia National Education ICT-Network. Susilo Bambang Yudhoyono, the current President of Indonesia, officially launched this programme during the 42nd SEAMEO council conference in Bali 2007 (Dodi, Gatot & Soekartawi, 2007). JARDIKNAS is considered as one of the most salient programmes in the government's efforts to modernize and enhance education in Indonesia (Soekartawi, 2007).

THEORETICAL FRAMEWORK

Existing evidence suggests that despite all the efforts expended by the government to improve the quantity and quality of national education by emphasizing the use of ICT in schools, the dissemination and use of ICT among teachers are not encouraging. Yuhetty (2002) writes that the dissemination of ICT in Indonesian schools is considered quite slow compared to neighbouring countries such as Malaysia, Singapore and Brunei. In addition, the use of ICT in Indonesian schools is still far below expectations due to several barriers (Tian, 2003). Like schools in other countries, Indonesian schools face the same challenges and problems in disseminating and optimizing the use of ICT. A study conducted in Singaporean schools by Lim and Khine (2006) revealed that teachers' use of computers and other technological tools in the classrooms remains peripheral and teachers do not make much effort to use them effectively. The same problems due to teachers' lack of technology use were also reported in the United States (Teo, 2009).

Teachers' resistance to ICT adoption has been identified as the most problematic factor that hinders fostering ICT use in the school. Based on extensive review of the literature, there are two factors that significantly hinder teachers' ICT adoption; Psychological factors such as lack of computer self-efficacy and organizational factors such as lack of ICT facilities (Becta, 2004; Lim & Khine, 2006; Al-Senaidi, Lin & Poirot, 2009; Goktas, Yildirim & Yildirim, 2009). Eliminating these barriers is fundamental to creating a condusive environment for effective ICT use among teachers (Goktas et al., 2009). However, research focusing on teachers' ICT adoption is limited (Teo, 2009), and not only that, the findings of this limited body of work were not applicable to predict teachers' ICT adoption in school. This is caused by the various limitations of the previous research, one of which concerns the population of the study.

In two meta-analyses conducted by Yousafzai, Foxall and Pallister (2007), and by Schepers and Wetzels (2007), it was found that most of the previous studies used students as their samples, in which the findings could not be generalized to other populations within the educational field such as teachers. The findings drawn from student samples are more likely to produce better and superior results than non-student samples since students would likely be more willing to adopt and adapt with new technology (Ahmad, Basha, Marzuki, Hisham & Sahari, 2010). In contrast, teachers have different characteristics and different objectives compared to students in adopting technology (Hu, Clark & Ma, 2003). For instance, teachers are less competitive than other information system users, and have more freedom and autonomy to choose and use a variety of ICT tools to suit their pedagogical needs. Hence, expanding research by taking teachers as the study sample could yield an entirely different set of information about ICT acceptance (Gong, Xu & Yu, 2004).

The present study, therefore, set out to examine teachers' ICT acceptance based on the assumptions of the Technology Acceptance Model, but the model's predictive power is limited if its use is restricted only to its core constructs, perceived usefulness (PU) and perceived ease of use (PEU), as determinants of ICT acceptance. To improve the model's predictive power, recent research has recommended the inclusion of additional variables; computer self-efficacy (Paraskeva, Bouta & Papagianna, 2008; Teo, 2009) and organizational support (Hofmann, 2002; Williams, 2002) into the original TAM.

The Influence of Computer Self-Efficacy and Organizational Support

Adapted and modified from the general concept of self-efficacy proposed by Bandura (1986), computer self-efficacy refers to a person's beliefs about how good he or she is with the use of myriad computer applications and tools. The construct has been found to influence various computer-related behaviours and outcomes (Bassam, 2007). Quite a number of empirical studies have revealed the significant influence of computer self-efficacy on users' perceptions of computers' usefulness (PU) and ease of use (PEU), which later determined their intention to use computers (Paraskeva et al., 2008; Teo, 2009).

In the school context, having computer self-efficacy is crucial for teachers since it affects their willingness to use ICT for their instructional purposes (Teo, 2009). Teachers with a high sense of computer self-efficacy can adopt ICT and maximize its potential impact to transform teacher-centred traditional methods to more student-centred methods of teaching. Teachers with a high degree of computer self-efficacy would also appreciate the usefulness of ICT since it can enhance their performance in many ways. In addition, efficacious teachers would likely perceive that using ICT is easy and would not take much effort and time. Hence, including the computer self-efficacy factor into the original TAM is crucial to predict teachers' intention to use ICT in a broader context. Based these arguments, the following hypotheses are formulated;

Hypothesis 1: Computer self-efficacy directly influences teachers' perception of ICT's ease of use.

Hypothesis 2: Computer self-efficacy directly influences teachers' perception of usefulness using ICT.

Hypothesis 3: Computer self-efficacy indirectly influences teachers' intention to use ICT via perceived usefulness and perceived ease of use.

Organizational support (OS) is another factor that potentially influences teachers' ICT acceptance. Organizational support refers to conditions provided by the school management that facilitate teachers' acceptance and utilization of ICT. Organizational support comes in the forms of technical ICT support, ICT training, incentives for ICT use,

access to computers, ample preparation time, reduced workload and adequate resources. Previous studies found that lack of access to computers, inadequate technical support (Williams, 2002; Ngai, Poon, & Chan, 2007; Teo, Lee & Chai, 2008), and poor facilitating conditions were cited by teachers as barriers to ICT integration in the classroom (Lim & Khine, 2006), while lack of management support was reported in other studies as a barrier to effective information systems usage (Sharma & Yetton, 2003; Bassam, 2007). Therefore, providing necessary ICT facilities and technical support is part of school support that can eliminate teachers' ICT utilization barriers and enable them to use ICT tools according to their teaching and learning needs. Teachers who have support from the school management with necessary ICT resources would reduce the time required to accomplish ICT-based tasks, enabling them to enhance their work from its usage (Ngai et al., 2007). Based on these premises, the following hypotheses are formulated;

Hypothesis 4: Organizational support directly influences teachers' perception of ICT's ease of use.
Hypothesis 5: Organizational support directly influences teachers' perception of the usefulness of using ICT.
Hypothesis 6: Organizational support indirectly influences teachers' intention to use ICT via perceived usefulness and perceived ease of use.

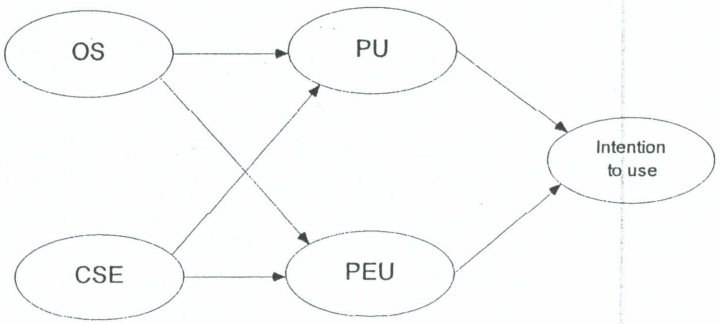
The current study applied an extended Technology Acceptance Model (Davis, 1989) to explain the relationships among the proposed determinants of ICT acceptance among teachers. The original TAM posits that two core constructs, perceived usefulness (PU) and perceived ease of use (PEU) influence teachers' intention to use ICT

Put in the context of this study, teachers are likely to develop an intention to use a certain technology when they perceive that using the technology would benefit and help them to accomplish their tasks, and when the technology is easy to use and does not require extra effort from them. If these two criteria are embedded into a technology, teachers are likely to develop an intention to use that technology, subsequently leading to their actual use of it. Therefore, the following hypothesizes are formulated;

Hypothesis 7: Perceived usefulness directly influences teachers' intention to use ICT.
Hypothesis 8: *Perceived ease of use directly influences teachers' intention to use ICT.*

The following figure presents the extended TAM as the theoretical framework of the study:

Figure 1: The Hypothesized Model of Teachers' Intention to Use ICT in Jember schools.



METHODOLOGY

Respondents

The respondents involved in the study were 1,137 teachers teaching in three categories of schools: Junior High School is known as *Sekolah Menengah Pertama* (SMP), Senior High school is known as *Sekolah Menengah Atas* (SMA) and Vocational schools which is known as *Sekolah Menengah Kejuruan* (SMK). This figure represents about 40% of the total population. This was decided based on the consideration of its representativeness of the population. As the size of the sample increases, the expected sample error decreases and the closer the sample in representing the population (Ary et al., 2006; Hair et al., 2006). A proportional stratified random sampling procedure was used to select the respondents of the study.

Table 1. Number of Population in Each School Category Finally Sampled in the Study Based on the Proportion of Each School

(n = 1,137)

School Category	Population	Percentage	Sample
SMP	1,328	46.8%	532
SMA	900	31.7%	361
SMK	610	21.5%	244
Total	**2,838**	**100%**	**1,137**

Instrumentation

The instrument used in this study was a questionnaire adapted from a previous study employing the Technology Acceptance Model. Leidner and Jarvenpaa (1995) suggested that it might be more useful to use well-established variables in information system (IS) research than to create new variables. Following this recommendation, the questionnaire items used in this study were adopted and modified from previous research in order to meet the context of the study.

The questionnaire consisted of two sections. The first section contained several items on the respondents' demographic information, which included gender, school level or category, teaching experience and other relevant data. The demographic data were needed to provide descriptive information of the respondents and to ensure that the teachers surveyed were representative of the total population of teachers. The second section contained 22 items to measure the five (5) research constructs examined in the hypothesized model. Furthermore, the questionnaire was pilot-tested to establish the preliminary reliability of the items. The result of pilot test showed high reliability of the items. The details of 5 constructs along with their items are illustrated in Table 2.

Table 2. The details of 5 constructs in the study

Construct	Item	Adapted & modified from	Measure	Reliability (Cronbach's alpha)
CSE	5	Compeau and Higgins (1995)	5 likert scales	.89
OS	4	Lee, Kozar and Larsen (2003)	5 likert scales	.79
PU	4	Davis (1989)	5 likert scales	.83
PEU	5	Davis (1989)	5 likert scale	.89
INT	4	Davis (1989)	5 likert scales	.88

RESULTS OF STRUCTURAL EQUATION MODELING (SEM) APPLIED ON THE DATA

Data Screening

Prior to running Structural Equation Modelling (SEM), the data were first screened for the descriptive analysis. The results showed that the means for the overall items fell within accepted ranges of the standard deviation (Hair at al., 2006). The mean scores from the 5 Likert scales ranged from 3.46 to 4.34. The standard deviations ranged from .61 to 1.08, indicating a narrow spread of items around the means.

The statistical values (z) of skew-ness and kurtosis fell within the recommended points of 3 and 10 respectively as recommended by Kline (2005). The Cronbach's alpha (internal consistency) for the 22 items based on the 5 variables was .93. In general, the statistical values for skew-ness and kurtosis were within the recommended points, indicating that the overall items appeared to be normally distributed and the instrument highly reliable. The descriptive statistics of the items are presented in Table 3.

Table 3. Items Distribution of Computer Self-Efficacy, Organizational Support, Perceived Usefulness, Perceived Ease of Use and Intention to Use

Variables	Mean	Std. DV	Skew-ness	Kurtosis
Cse1	3.92	0.83	-0.82	1.10
Cse2	3.46	1.08	-0.22	-0.78
Cse3	3.62	0.98	-0.48	-0.11
Cse4	3.82	0.96	-0.84	0.49
Cse5	3.59	1.02	-0.45	-0.34
Os1	4.20	0.75	-0.88	1.07
Os2	3.95	0.74	-0.48	0.29
Os3	3.97	0.88	-0.80	0.52
Os4	3.86	0.81	-0.49	0.21
Pu1	4.30	0.65	-0.59	0.34
Pu2	4.18	0.67	-0.34	-0.29
Pu3	4.34	0.63	-0.57	0.23
Pu4	4.02	0.72	-0.37	-0.02
Int1	4.10	0.68	-0.29	-0.27
Int2	4.16	0.61	-0.21	0.08
Int3	4.09	0.63	-0.24	0.14
Int4	4.24	0.61	-0.43	0.52
Peu1	3.57	0.87	-0.49	0.12
Peu2	3.82	0.90	-0.61	0.14
Peu3	3.70	0.91	-0.55	0.07
Peu4	3.50	0.93	-0.25	-0.42
Peu5	3.91	0.95	-0.88	0.61

Note. Cronbach's alpha reliability index was .93

This study applied a two-step structural equation modelling using AMOS software (version 16.0) to test the research hypotheses. In the first step, the study assessed the validity of the five (5) measurement models via a confirmatory factor analysis (CFA) of computer self-efficacy (CSE), organizational support (OS), perceived usefulness (PU), perceived ease of use (PEU) and intention to use (INT). The second step examined the good-fit of the proposed structural model using a full-fledged SEM.

The result of analysis indicated that the five (5) measurement models were consistent with the data. The overall fits of the 5 models were adequate and satisfied the recommended criteria. Furthermore, the models were also assessed in terms of their convergent validity by applying the following three procedures proposed by Fornell and Larcker (1981), namely (i) the item reliability of each measure should be equal to or exceed the recommended point of .70, (ii) the composite reliability of the construct should be equal to or exceed the threshold point of. 70, and (iii) the average variance extracted (AVE) should be $\geq$ .50. All models have met the recommended criteria for convergent validity except for OS. AVE for OS was slightly below the threshold of >.50, however, it was retained considering the large number of the respondents in the study. Table 4 illustrated the convergent validity of 5 constructs.

Table 4.The Convergent Validity of CSE, OS, PU, PEU and INT

Latent Variable	Items	Factor loadings (> .70)	Composite reliability (> .70)	AVE (> .50)
CSE	Cse1	.787	.83	.63
	Cse2	.786		
	Cse3	.794		
	Cse4	.852		
	Cse5	.757		
OS	Os1	.683	.80	.48
	Os2	.721		
	Os3	.679		
	Os4	.697		
PU	Pu1	.737	.80	.55
	Pu2	.791		
	Pu3	.746		
	Pu4	.689		
PEU	Peu1	.820	.83	.63
	Peu2	.812		
	Peu3	.818		
	Peu4	.797		
	Peu5	.714		
INT	Int1	.806	.80	.66
	Int2	.817		
	Int3	.833		
	Int4	.782		

Note. CR (Composite reliability) = (sum of standardized loading)^2/ (sum of standardized loading)^2 + sum of indicator measurement error). AVE (Average Variance Extracted) = (sum of squared standardized loading) / (sum of squared standardized loading + sum of indicator measurement error).

MODEL FIT

The results of the initial analysis indicated that the structural model demonstrated undesirable fit since some good-fit indicators of the model did not match the recommended criteria proposed by Kline (2005), and McDonald and Ho (2002). The model modifications (MI) indicated the existence of cross-loading and error covariance. The MI results revealed 2 items with a high value of error covariance. Decision was then made to revise the model by dropping problematic items (cse3 & peu5) to get a better fit and the model was re-estimated.

The results of the revised model indicated that the overall fit of the structural model was adequate and satisfied the recommended criteria with a chi-square value (χ^2 = 459.977, *df* = 163) and CMIN/df = 2.822. The TLI value of .972, CFI value of .976, and GFI value of .961 were above the threshold of .90. Furthermore, RMSEA = .040 showed a reasonable error of estimation. Furthermore, the result also revealed that CSE and OS were significantly correlated (.343) with CR >1.96. The statistical results supported the consistency of the data with the hypothesized model, therefore supporting the claim that the structural model fit the data. Since the model was adequate, the individual parameters were evaluated and the path coefficients estimated. The estimation of path relationships was analysed according to the hypothesized model of the study.

Path analysis

The results of path analysis revealed that seven (7) out of eight (8) hypotheses proposed in the model were supported by data collected from 1137 respondent teachers. Only hypothesis 4 was not supported in the model since it has a trivial relationship between organizational support (OS) and perceived ease of use (PEU) with a standardized direct effect of .131, which fell below the threshold of .20 (Chin, 1998). Nevertheless, organizational support has significance and direct influence on perceived ease of use and has indirect influence on intention to use with a standardized effect of .447 and .315 respectively.

The result also showed that computer self-efficacy (CSE) has significance influence on perceived ease of use and perceived usefulness of ICT with a standardized direct effect of .754 and .360 respectively. In addition, computer self-efficacy has significance and indirect influence on teachers' intention to use (INT) with standardized indirect effect of .439. Furthermore, perceived usefulness (PU) and perceived ease of use (PEU) have significant and direct influence toward teachers' intention to use with standardized direct effect of .622 and .285 respectively. Table 6 illustrated the result of path analysis.

Table 6.The Result of Analysis for the Revised Model

End. Variables	Determinants	Standardized Effects		
		SMC	Direct	Indirect
INT	-	.632		
	CSE		-	.439
	OS		-	.315
	PU		.622	-
	PEU		.285	-
PU	-	.440		
	CSE		.360	-
	OS		.447	-
PEU	-	.653		
	CSE		.754	-
	OS		.131	-

Note. SMC = Squared Multiple Correlation

The Proportion of Variance Explained in the Model

The endogenous variable intention to use (INT) obtained the greatest amount of variance explained by its predictors, which was approximately 63%. This could be due to the effects contributed by the four (4) predictors of computer self-efficacy, organizational support, perceived ease of use and perceived usefulness. Perceived ease of use (PEU) recorded a variance-explained of approximately 65% by its predictor, computer self-efficacy. Furthermore, 44% of the variance explained for perceived usefulness was contributed by computer self-efficacy and organizational support.

ESTIMATING THE STRUCTURAL MODEL INVARIANCE ACROSS GENDER

The structural model was subjected to gender invariant analysis, which aimed at identifying whether gender moderated the model. In doing so, the ratio of male and female respondents was carefully assessed prior to conducting the analysis. According to Byrne (2001), the difference in the total number of male and female respondents for invariance analysis should not be statistically significant. In this respect, the number of respondents for this study satisfied the condition, where 54.9% of the samples were male teachers, while 45.1% were female. Furthermore, the model was tested simultaneously for both genders without constraining the structural paths in order to get a baseline chi-square value. Then, the model was re-estimated by constraining all structural paths for both male and female groups. The analysis of this constrained model produced another chi-square value, which was then tested against the baseline value for statistically significant differences. The results of the analysis are presented in Table 7.

Table 7. The Results of Invariance Analysis of Gender

Variable	χ^2	df	Critical-Value	χ^2 Change
Gender				
Unrestricted	662.1	326		
Constrained	686.8	332	22.4	24.7*

Note. *Statistically significant at .001

The invariance analysis results revealed that gender moderated the structural model. This was justified by comparing the chi-square values for both the unconstrained model (baseline) and constrained model. The invariance test for the constrained model across the male and female groups produced a statistically significant change in the chi-square value, χ^2 (6) = 24.7, $p < .001$. In other words, the constrained model showed worse fit than the unconstrained model. This finding indicated that the path coefficients varied across the two levels of gender (male and female). Thus, gender moderated the causal relationships of the structural model and it also revealed that male teachers are better than female teachers in term of ICT adoption since the model had better fit for male teachers when it was estimated separately.

CONCLUSION

The current findings have extended TAM after the results confirmed the effects of two additional variables on teachers' acceptance and utilization of ICT. Computer self-efficacy and organizational support, in addition to the core constructs of perceived ease of use and perceived usefulness, are shown to be significant determinants of ICT acceptance among teachers teaching at Jember schools. Based on previous literature, the original TAM variables are not sufficient to understand and predict users' ICT acceptance, and this is considered as the major shortcoming of TAM (Legris et al., 2003). The current findings, however, have addressed these weaknesses. Organizational support and computer self-efficacy were found to be antecedent factors of perceived ease of use (PEU) and perceived usefulness (PU) in the proposed model, which affected teachers' intention to use of ICT in the future. Extending TAM by including these variables has produced a more comprehensive explanation of what factors determine teachers' acceptance of ICT. Based on the literature, lack of confidence and lack of school support were reported as barriers to teachers' ICT utilization in the schools. The study then brought these two factors for investigation considering that removing these barriers would

promote ICT acceptance and utilization. The results appear to support this assumption, as school support and teachers' computer self-efficacy were found to influence ICT acceptance. Overall findings have extended current understanding on ICT acceptance beyond the constructs of the original TAM.

In addition, in terms of the measurement of the ICT construct, the study used an operational definition of ICT that embraced myriad technological tools relevant to the needs of teachers in the school setting. Previous studies had only measured teachers' use of specific technological tools which may have not represented teachers' actual needs for ICT. In the school context, it requires various ICT facilities for teachers to professionally accomplish their instructional tasks. Examining specific technological tools would not comprehensively address teachers' acceptance of technology. Therefore the current study has contributed to a greater understanding of ICT acceptance among teachers by having broadly defined the ICT construct to include myriad tools, devices, software applications and the Internet. Thus identifying and examining factors that influence their use of ICT is essential for promoting ICT integration in schools. In reality, investigation into the complex interplay of factors impacting teachers' ICT adoption is still lacking in the literature. The current study in this sense has contributed to the body of empirical evidence concerning the interplay of CSE, OS, PU and PEU in determining teachers' ICT adoption. The findings can therefore, be used to guide initiatives toward galvanizing the utilization of ICT at the school level, especially by education stakeholders intending to promote greater ICT integration in classroom learning.

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