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Factors Influencing Teachers' Use of Digital Technology: A Structural Model

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Abstract: Digital technology is widely employed nowadays, and its fast advancement has affected many aspects of daily life and how people live today. However, recent studies have shown that digital technology utilization among teachers, especially in Malaysia, is still not noticeable despite several initiatives being executed. This paper aims to predict the factors influencing Malaysian secondary school teachers' adoption of digital technologies. This will be achieved by identifying correlations between constructs such as personal innovativeness, technology self-efficacy, and digital competence, followed by developing a model using Structural Equation Modelling (SEM). In Pahang, 540 secondary school teachers from 50 public secondary schools in 11 districts participated in a survey. Correlational research has been suggested in order to investigate this issue quantitatively. Participants were requested to fill out a questionnaire of 63 close questions measured using 5 Likert scale points, with answers ranging from Strongly Disagree (1) to Strongly Agree (5). According to the model, personal innovativeness, technological self-efficacy, and digital competence significantly affect digital technology use. The overall structural model with three paths explains 41.9% of the variation in secondary school teachers' use of digital technologies. The paper's conclusion discussed potential explanations for the study's findings and proposed suggestions for further research. These findings highlight the significance of enhancing teachers' personal innovativeness, technology self-efficacy, and digital competence that impact teachers' use of digital technology to meet the requirements of future qualified professions and prepare students for the future digital world.

Keywords: Structural Equation Modelling, Digital technology, personal innovativeness, technology self-efficacy, digital competence

1. Introduction

It is undeniable that digital technology is widely used worldwide, and its rapid development has brought many changes and influenced modern societies. Digital technology has become significant and is part of our lifestyles, work, and society. Redecker (2017) defines *digital technology* as any product or service that can generate, display, share, alter, record, access, convey and obtain information. It comprises computer networks and any online service supported by these, any software, whether networked or installed locally, hardware or device, and digital content. Digital technology is widely employed in education as a mixed medium with a positive effect on academic performance, teaching, and learning in K-12 and postsecondary settings. Digital technology enhances teaching, and, in addition, it also provides teachers with extra resources, better planning, and more tailored teaching methods (Sargent & Casey, 2019; Walan, 2020).

One of digital technology's features is the ability to support learning anytime and anywhere. Murphy et al. (2014) discovered that many students engaged in mobile learning activities while traveling in a vehicle, at work, walking, and in public places. In addition, it

stimulates students' engagement and motivation, and making the class seem more attractive (Omar et al., 2019; Tomczyk, 2020). Digital technology also helps to improve students' focus and perception skills (Loudova & ElHmoudova, 2019). Not only learning with digital tools positively affects student learning outcomes and attitudes (Hillmayr et al., 2020), digital technology has been discovered to affect students' creativity depending on teaching and learning practices as well (Tang et al., 2022). Therefore, it can be concludedthat the use of digital technology in teaching and learning by the teachers can facilitate them in providing an understanding of what the students can learn, although there is a lack of confidence by some teachers in the capability of digital technology to help add value to their teaching and learning.

1.1 Problem Statement

Teachers' lack of access to ICTs or digital technology becomes a major concern in this study. Ebrahimi and Yeo (2018) revealed that ICTs are exclusively used for education by only 57 percent of teachers in Johor, Malaysia. One hundred twenty teachers and 120 pupils from thirty public schools in Johor participated in the study. At the same time, Abdullah et al. (2019) found that the usage of ICT in Malaysia among mathematics teachers remains low in comparison to South Korean teachers. The study was participated in by 71 mathematics teachers from Malaysia and 51 teachers of mathematics from South Korea. These studies reveal that the ICT usage among teachers in Malaysia is still not noticeable, even though several initiatives across Malaysia have been executed. Mynaríková and Novotný (2020) discovered that only 6.5 percent and 0.1 percent of the 1878 secondary school teachers were habitual and frequent ICT users in the Czech Republic. A study of 574 Norwegian and 239 American teachers showed that most had no online teaching experience (Gudmundsdottir & Hathaway, 2020). Therefore, this circumstance compels the researcher to learn more about the aspects that may impact digital technology use among teachers.

1.2 Factors Influencing Teachers' Digital Technology Utilization

According to Agarwal and Prasad (1998), personal innovativeness (PI) is the willingness to accept new technologies and significantly impacts user adoption of new technology. They discovered that people with more excellent PI had a more positive perspective on the technologies they were trying to manipulate. Pinho et al. (2020) explored the factors related to the use of Moodle as a Learning Management System (LMS) and found that PI in information technology positively influences the use of Moodle. Aldahdouh et al. (2020) explore technology use in higher education and the role of the PI in predicting the actual use of social media. Mustafa et al. (2020) discovered that PI significantly impacts the acceptance of virtual reality learning. In this study PI is the extent to which an individual is prepared to adopt digital technology and feels that digital technology will improve his or her teaching effectiveness.

Another factor that can be considered is technology self-efficacy (TSE). TSE refers to a teacher's perceived capacity to integrate digital tools into classroom and to provide meaningful education utilizing relevant digital resources (Holden & Rada, 2011). Thurm and Barzel (2020), who studied the TSE of mathematics teachers, found that teachers with a common belief in technology use in teaching also have a low frequency of technology use. Previous studies showed a positive correlation between TSE and the use of digital technology (Li et al., 2018; Rohatgi et al., 2016). Li et al. (2018) found that TSE was the only significant predictor of teachers' use of technology in general and the use of technology to promote teacher-centered instruction. There is a strong association between teachers' confidence in completing basic digital technology activities and their confidence in utilizing digital technology in online collaboration with students (Hatlevik, 2016). For this study, TSE refers to teachers' belief on their capability to use digital technology.

Digital technology use is often associated with higher digital competence (DC). Krumsvik (2007) defines a teacher's DC as a teacher's capacity to utilise ICT with an excellent understanding of teaching strategy via ICT and to be aware of how this may affect students' learning techniques and educational development. DC in this study refers to teachers' ability to use digital technology confidently, critically, and creatively to convey the content of the lesson

to the students. Hatlevik (2016) examines the relationship between teachers' DC and the use of ICT at school. The result showed that teachers' DC could explain variation in teachers' use of ICT. Yazon et al. (2019) examined the relationship between DC and research productivity using digital technology. The study revealed a strong and significant relationship between the two variables. Ghomi and Redecker (2019) and Guillén-Gámez et al. (2020) reported that teachers who use digital tools have higher levels of DC compared to teachers who do not use digital tools. Figure 1 depicts the three hypotheses developed in this study:

H1: Personal innovativeness has a significant effect on the use of digital technology. H2: Technology self-efficacy has a significant effect on the use of digital technology. H3: Digital competence has a significant effect on the use of digital technology.

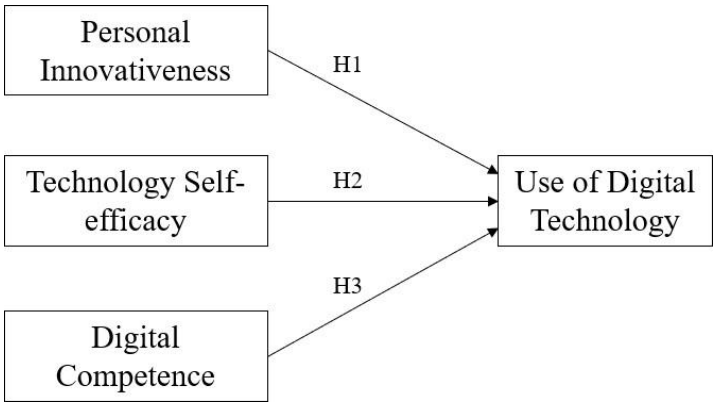

Figure 1. Proposed Model

The literature revealed that Structural Equation Modelling (SEM) attempts had been made in the field of educational technology, specifically for assessing the use of ICT and technology (Hatlevik & Hatlevik, 2018; Gudmundsdottir et al., 2020; Sailer et al., 2021; Jang et al., 2021). The current research aims to investigate the association between PI, TSE, DC, and UDT among secondary school teachers in Pahang, Malaysia.

2. Methods

2.1 Design and Participants

Correlational research was chosen as the research design conducted in this study as it is appropriate to evaluate the relationship between two or more variables in a group. The population in this study consists of public secondary school teachers who teach in day secondary schools in 11 districts in Pahang. In the study context, the teachers involved were those who teach form one to form five students. In total, the study sample comprises 540 teachers. The researchers utilized probability sampling, which includes cluster sampling, stratified sampling, and random sampling, to sample the study. The sampling process began with the number of secondary school teachers in Pahang, then moved on to the number of secondary school teachers by district and school. The school head will appoint a teacher to administer the questionnaire to the respondents, making the selection random as all teachers are eligible to answer the online questionnaire.

2.2 Instrumentation and Validation

The questionnaire was developed and adapted from the previous related studies in English and translated into Malay. The four constructs investigated were PI, TSE, DC, and UDT. The scale for PI was adapted from the Personal Innovativeness in Information Technology (PIIT) scale (Agarwal & Prasad, 1998). The TSE scale was adapted from the Technology Proficiency Self-

Assessment Questionnaire for 21st Century Learning (TPSA C-21) by Christensen and Knezek (2016). The DC scale was adapted from the DigCompEdu Framework scale (Ghomi & Redecker, 2019). At the same time, the scale for UDT was adapted from three different study scales done in the past (Hatlevik, 2017; Sadaf et al., 2012; Kamaruddin et al., 2017). The questionnaire was divided into two sections.

Section A was used to collect data on socio-demographic characteristics. Section B consists of four parts relating to the constructs studied. All parts are rated on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Three experts were invited to ensure the instrument's validity based on their experience in educational technology. Corrections were made based on the experts' comments as part of a validation procedure. A pilot study was conducted on 176 teachers from secondary schools in Pahang who would not participate in the actual study. Data collected for the pilot study to assess the instrument's reliability was analyzed using SPSS 26.0. The Cronbach's alpha value varied between 0.810 and 0.962. The internal consistency of the questionnaire is regarded as an acceptable instrument since all values exceed 0.7, according to Hair et al. (2019).

3. Findings and Discussion

3.1 Descriptive Statistics

Table 1 shows that out of 540 respondents in the study, most of them were females (n = 398, 73.7%) and 142 (26.3%) were males. The average age of the respondents in this study was 41 years old. Teachers aged 30 to 39 years old (n = 212, 39.3%) were the majority of the respondents. In terms of race, 94.3 percent (n = 509) were Malay. Most respondents had taught for 16 years or more (n = 261, 48.3%). 284 (52.6%) respondents identified using technology in teaching for less than five years. Only 20.4 percent (n = 110) respondents used technology to teach the class for more than 11 years.

Table 1. *Demographic Information*

Variable	Items	Frequency	Percentage
Gender	Male	142	26.3
	Female	398	73.7
Age (years)	<30	20	3.7
	30 – 39	212	39.3
	40 – 49	190	35.2
	≥50	118	21.8
Race	Malay	509	94.3
	Chinese	17	3.1
	Indian	9	1.7
	Others	5	0.9
Teaching experience (years)	≤5	45	8.3
	6 – 10	72	13.3
	11 – 15	162	30.0
	>16	261	48.4
Teaching with technology experience (years)	<5	284	52.6
	6 – 10	146	27.0
	≥11	110	20.4

3.2 Construct Reliability and Validity

This study conducted EFA on all sample constructs using IBM-SPSS 26.0. The analysis is suitable to be applied as the survey consists of four constructs with a minimum of 11 variables

each. The study collected 176 responses, well suited to the recommended sample size by Tabachnick and Fidell (2019) which is between 100 to 200 respondents. The communalities or correlation r of all items was greater than .30, which indicates a strong association between the variables (Tabachnick and Fidell, 2019)3es. In the end, indicators with missing values are omitted to avoid overestimation (Tabachnick & Fidell, 2019). Items with a factor loading of less than .50 were also deleted, as the standardized loading estimates should be at least .50 or higher (Byrne, 2016; Hair et al., 2019). Three items were omitted from PI, and seven items remained in DC. Meanwhile, TSE has removed nine items, and no items were deleted from UDT. Table 2 shows the factor loading of each item in PI, TSE, DC, and UDT. The Bartletts' Test of Sphericity is significant (p-value 0.05), and the findings showed that the KaiserMeyer-Olkin (KMO) measure of sampling value for PI, TSE, DC, and UDT were 0.937, 0.897, 0.845, and 0.893, respectively, which is outstanding (Awang et al., 2018). As Awang et al. (2018) suggested, Cronbach's Alpha of all constructs has exceeded 0.7. For the Average Variance Extracted (AVE), all the constructs studied achieved more than the suggested value of 0.50, it shows high convergent validity (Hair et al., 2019). Through CFA, four items were deleted, and the remains were as follows: PI (8), TSE (7), DC (6), and UDT (8).

Table 2. *Factor Loadings and Validities for Reliability Test and Convergent Validity*

Construct/Item	Standardized loadings	Cronbach's alpha	Composite reliability	AVE
Personal Innovativeness		.964	.947	.692
PI2	.815			
PI3	.836			
PI4	.868			
PI5	.886			
PI6	.815			
PI8	.850			
PI11	.791			
PI12	.789			
Technology Self-efficacy		.950	.921	.624
TSE4	.796			
TSE5	.746			
TSE6	.805			
TSE7	.831			
TSE9	.845			
TSE14	.722			
TSE16	.778			
Digital Competence		.932	.859	.505
DC11	.689			
DC14	.652			
DC18	.683			
DC20	.747			
DC21	.744			
DC22	.743			
Use of Digital Technology		.938	.936	.645
UDT4	.755			
UDT5	.805			
UDT6	.796			
UDT7	.853			
UDT8	.815			
UDT9	.805			
UDT10	.768			
UDT11	.825			

Table 3 shows the correlation between PI, TSE, DC, and UDT. The AVEs (values in bold) are higher than the squared correlation coefficient (r^2) between each construct. All of the constructs are different; hence the discriminant validity is proven.

Table 3. *Correlation of Constructs*

Construct	PI	TSE	DC	UDT
PI	**.692**			
TSE	.359	**.624**		
DC	.243	.309	**.505**	
UDT	.516	.191	.118	**.645**

3.3 Structural Model

A structural model depicts the relationship between independent and dependent variables (Whittaker & Schumacker, 2022). The findings of the structural model sought to determine if the model was fit and whether the pathways were significant. Additionally, they attempted to calculate the coefficient of determination (R2). Three hypotheses on the structural pathways influencing a secondary school teacher's use of digital technology were tested to determine the relationship between the study's constructs.

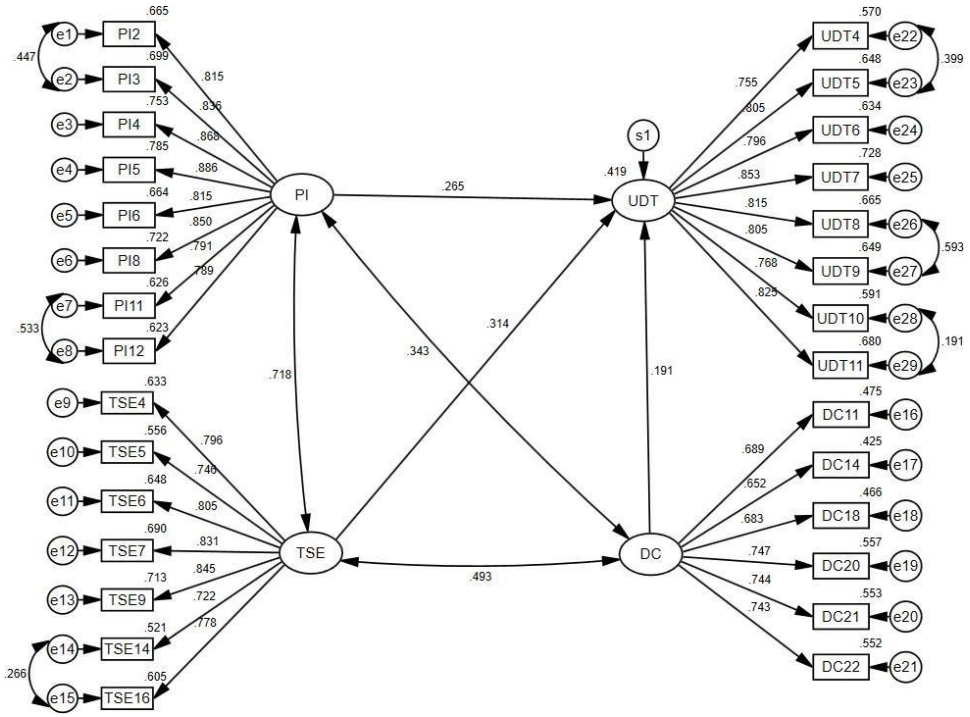

Figure 2. Structural Model

The proposed structural model fit indices in Table 4 showed that the value of x2/df was in recommended range (Bentler, 1990; Meyers et al., 2006). The values of Good of Fit Index (GFI), Adjusted Goodness of Fit (AGFI), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) were greater than 0.9, which showed good fit (Bentler and Bonett, 1980; Hair et al., 2019). Lastly, the Root Mean Square of Error Approximation (RMSEA) is also at a reasonable level (Hair et al., 2019; Byrne, 2016). These indexes indicate a good fit for the structural model. Given that the structural model validation results were favorable, there would be no procedure for improving the model (Awang et al., 2018).

Table 4. *Goodness-Of-Fit Indices of Structural Model*

Index	Accepted Value	Model
Absolute Fit		
Chi-Square	p-value > 0.05	0.000
RMSEA	RMSEA <= 0.08	0.040
GFI	GFI > 0.90	0.921
Incremental Fit		
AGFI	GFI > 0.90	0.905
CFI	GFI > 0.90	0.973
TLI	GFI > 0.90	0.970
NFI	GFI > 0.90	0.945
Parsimonious Fit		
Chisq/df	Chisq/df < 5.0	1.878

Table 5 reports the proposed structural model's standardized (β) and unstandardized (b) regression weights. The estimates of the path coefficients confirm the strengths of the links between dependent and independent variables of the study (Hair et al., 2019). The obtained outcome revealed that all three standardized coefficient paths were significant on a critical ratio test at 0.001 level, which needs to be higher than ±1.96 (Byrne, 2016).

Table 5. *Unstandardized and Standardized Regression Weights for The Structural Model*

Path	*b*	S.E	C.R	β	P-Level	Results
PI ❼ UDT	.304	.066	4.579	.265	***	Supported
TSE ❼ UDT	.296	.061	4.858	.314	***	Supported
DC ❼ UDT	.213	.052	4.067	.191	***	Supported

Based on Table 5, the PI ratio and p-value for predicting digital technology use are 4.579 and 0.001, respectively. It shows that PI significantly impacts the degree to which a secondary school teacher utilizes digital technology, so H1 is supported. In addition, the path coefficient is 0.265, indicating a positive relationship. It indicates that teachers who are more open to digital technology and believe it would facilitate their work are more likely to use it. This finding is coherent with many works of literature in existence. This study's results complement the findings of previous researchers who have shown that PI influences teachers' use of ICT (Aldahdouh et al., 2020; Ibieta et al., 2017; Pinho et al., 2020). More than 90 percent of teachers in the study believe that using digital technology helps them perform their tasks more quickly while also improving the quality of their work. Aside from that, teachers believe that digital technology may make their jobs easier. Teachers also acknowledge their intention to extend the use of digital technology in their work in the future. This implies that PI tends to drive teachers to look out for new ideas through various digital technologies in addition to what they have previously provided in the classroom.

Next, the critical ratio and *p*-value of TSE in predicting the use of digital technology are 4.858 and less than 0.001, respectively. To conclude, TSE has an effect on UDT among secondary school teachers. So, H2 is supported. Further, the path coefficient is 0.314, indicating a positive relationship, which means higher levels of TSE are associated with higher levels of UDT. This outcome is similar with several studies that have reached the same conclusion (Lee & Lee, 2014; Rohatgi et al., 2016; Hatlevik, 2016; Li et al., 2018). Teachers generally believe in

their capacity to utilize digital technology. Over 60 percent of teachers believe they can use different digital technologies, and emails, search engines, internet platforms, and video conferencing are just a few examples. As a result, as long as teachers believe in their capabilities to utilize digital technology, it is unquestionably a factor influencing their use.

Finally, the critical ratio and *p*-value of DC in predicting UDT are 4.067 and less than 0.001, respectively. The result verified that; DC has a significant effect on UDT. In conclusion, DC predicts UDT among secondary school teachers, so H3 is supported. Further, the path coefficient is 0.191, indicating a positive relationship, which means higher levels of DC are associated with higher levels of UDT. This finding is consistent with the study by other previous studies on teacher's digital competence and technology adoption (Ertmer et al., 2010; Hatlevik, 2016; Sundqvist et al., 2020; Guillén-Gámez et al., 2021). It can be concluded that, as teachers' digital competence increases, their use of digital technology may also increase. This signifies that when teachers get the expected benefits from using digital technology, they will gradually upgrade their digital competence because they believe it is worth using and expect more from it. At the same time, they will begin to practice utilizing digital technology for their jobs or personal lives. These attitudes not only result in an improvement in teachers' digital competence but also in teachers' eagerness to experiment with new technology.

Based on the findings from the inferential analysis, it was found that the proposed model is fit for predicting factors that influence teachers' use of digital technology. Thus, the structural model was calculated using the significance level of R2 measures and path coefficient results. The R2 value of the dependent variable is 0.419 for the use of digital technology. The Coefficient of Determination, or R2 value, is the most frequently applied to assess the structural model. In comparison, the coefficient is observed to measure the predictive accuracy of a model. The coefficient signifies the amount of variance in the latent dependent variable explained by all the independent variables linked to the dependent variable. The value of R2 ranges from 0 to 1. The model explains 41.9 percent of the variation in UDT, with the effects of PI, TSE, and DC being statistically significant. This shows a moderate level of acceptance (Cohen, 2018). For this reason, hypotheses H1, H2, and H3 are supported. The proposed predictive model also indicates that TSE had the most substantial influence on the endogenous variable: the use of digital technology.

4. Conclusion

The results of testing the structural model were consistent with previous studies in the education field. An interesting finding in this research is that, among the predictors of the use of digital technology, the effect of technology self-efficacy is the strongest. The weaker influence of digital competence on the use of digital technology can be interpreted that teachers considering their technology self-efficacy to be more important than digital competence in the use of digital technology. On the other hand, these findings can be justified since the teachers belong to different schools, and differences in how they were instructed, the subject or students that they taught, and how they use the digital technology might have influenced their responses. Significant relationships were verified between personal innovativeness, technology self-efficacy, and digital competence with the use of digital technology. The use of digital technology is a crucial issue to be discussed as teachers nowadays should look into the benefits of digital technologies for their teaching and daily activities.

This study has some implications, both in a theoretical and an applied sense. TSE, PI, and DC are established as the technology adoption factors. In addition, it contributes to the educational technology literature and might serve as a resource for researchers who seek to investigate digital technology use. Aside from that, the study's findings offer helpful information to stakeholders, such as schools, the Ministry of Education, and even third-party training providers, to accommodate better teacher training. It may assist teachers in progressively enhancing their confidence, willingness, and ability to utilize digital technology by planning structured and high-quality digital technology training. Training might involve a revised syllabus to guarantee proper training in increasing teachers' pedagogical use of digital technologies.

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