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Predicting teachers' use of digital technology

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ABSTRACT

In recent years, the use of digital technology and its relationship to the ability known as digital competence has become a core concept in discussions about the skills that individuals should possess in a knowledge society. Teachers' skills in using digital technology are becoming a critical component of developing practical pedagogical knowledge for practice and student learning enhancement. The purpose of this study is to predict the factors that influence secondary school teachers when it comes to using digital technology. This study will establish relationships between personal innovativeness, technology self-efficacy, attitude toward digital technology, and digital competence. In Pahang, Malaysia, a survey was conducted with 493 secondary school teachers from 50 public secondary schools of 11 districts. Proportionate stratified sampling, cluster random sampling, and simple random sampling were used to obtain samples. The findings have established that technology self-efficacy, attitude towards digital technology, and digital competence significantly affect how teachers use digital technology. These findings emphasize the importance of increasing teachers' digital competence as well as numerous elements that influence teachers' use of digital technology to fulfill the expectations of future qualified professions and thus prepare students for their future.

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1. INTRODUCTION

In recent years, experts from all around the world have become intrigued by the term "digital technology". Digital technology is defined as a group of electronic technologies that includes hardware and software utilized in formal and informal settings by individuals for educational, social, and/or entertainment purposes, such as: i) Desktop computers; ii) Mobile devices; iii) Digital recording devices; iv) Data logging equipment and accompanying devices; v) Interactive whiteboards; vi) Web 2.0 technologies and other online resources; and vii) A variety of commercially available offline-capable instructional software packages. Digital technology has risen in prominence and is now ingrained in our daily lives, workplaces, and societies [1]. It is widely utilized for several purposes, including health [2], communication [3], business [4], agriculture [5], and education [6].

As a versatile medium, digital technology is used extensively in education field to improve teaching and learning in schools and higher education institutions. It has been proven that when digital technologies were utilized in the classroom, students were more motivated to participate in activities that were not only productive but also active and passive than when no technology were used in the classroom. In addition, students who took part in active, productive, and interactive activities had better learning outcomes [7].

Meanwhile, teachers found that digital technology improved their teaching, gave them additional tools to employ, facilitated better planning, and resulted in easier to assess their students and more personalized teaching [8], [9].

However, the Malaysian teachers' inadequacy access to digital technology was reported in several studies. Ebrahimi and Yeo [10] revealed that digital technologies are exclusively used for education only by 57% of teachers in Johor, Malaysia. While Abdullah *et al*. [11] found the usage of digital technology in Malaysia among mathematics teachers remains low in comparison to South Korean teachers. These studies reveal that the use of digital technology among teachers in Malaysia is still not noticeable despite several initiatives across Malaysia have been executed. Teachers' inadequacy access to digital technology not only happened in Malaysia, but similar situations were also discovered all around the world [12]. In addition, information and communication technology (ICT) facility or infrastructure sufficiency that can be accessed by the teachers in also becomes an issue in Malaysia. A study [13] found out that poor internet connection and facilities such as computer were few of challenge that influence teachers to use ICT. Another study [14] also uncovered the same result where inadequate schools' ICT tools still was among the challenges faced by the teachers. And this factor gives impact to the teacher's use of ICT in teaching and learning. Teachers also claimed that lack of school management and colleagues' support were the main barrier for them to use ICTs in teaching [12]. A study also revealed that 68% of participated teachers agree that inappropriate management support is one of the reasons for them not to use technology in class [15]. In another study, the evidence showed that school principals played an important role in driving teachers to use ICT in the classroom [16].

Studies have discovered that various factors can influence people to use digital technology. Personal innovativeness can be viewed as one of the variables since it increases employees' creativity in interacting with digital technologies in the organization [17]. Employees with higher levels of personal innovation are more likely to accept workplace-related technological components and activities [18]. From an educational standpoint, teachers play an important role in the development of innovation and innovativeness in society [19]. They are also the first to introduce and promote ideas to society [20]. Moreover, this can be accomplished when a society has highly innovative teachers on a personal level. This is because progressive educators recognize the potential of technology for their job and believe that utilizing technology will be straightforward [21], [22]. While Ertmer and Ottenbreit-Lefwich [23] stated that technology self-efficacy could impact teachers' digital technology use. This is because it is not enough for teacher to employ technology in the classroom, but teachers must also feel secure utilizing it. Teachers are more inclined to employ technology when they feel confident and capable of doing so [24]. Thurm and Barzel discovered that teachers who have poor confidence in using technology in education also have a low frequency of technology use [25]. Previous research has also found an association between technology self-efficacy and the use of digital technology [26], [27].

Furthermore, numerous studies have established a substantial correlation between teachers' attitudes and the use of technology in education, suggesting that the more teachers perceive technology to be useful, the more likely they are to develop and implement technology in the classroom. Several studies discovered that attitude had a positive and significant effect on the use of digital technology [28]–[30]. This emphasizes the importance of attitude in predicting teachers' use of technology in the classroom. Admiraal *et al*. discovered that attitudes appeared to be the only explanatory variable for teacher educators' usage of hardware facilities [31]. Similarly, Kreijns *et al*. [32] discovered that the teacher's attitude toward adopting digital learning materials was substantially explained. According to a research, teachers who are willing to experiment with technology are more likely to utilize it to support student-centered teaching practices [33]. Recently, Cattaneo *et al*. [34] confirmed the positive and significant effect between attitude towards technology, digital tool use frequency, and digital competence.

Another factor that can be considered is digital competence. According to Yazon *et al*. [35], there is a significant and robust relationship between faculty members' digital literacy, digital competence, and research output. That is, an improvement in faculty members' ability to conduct, complete, present, and publish a research paper is positively associated with an increase in comprehending, discovering, using, and creating knowledge using digital technology. Higher digital competence has also been linked to the usage of digital tools [36]–[38]. Teachers who used digital tools in their classrooms were frequently more digitally competent, based on the notion that competence grows with practice [39]. Not only that, Cattaneo *et al*. [34] also have shown that a positive attitude toward technology, how often people use digital tools, and their digital competence are linked. This study aimed to explore the influence of personal innovativeness, technology self-efficacy, attitudes towards digital technology and digital competence to digital technology utilization among secondary school teachers in Pahang, Malaysia.

2. RESEARCH METHOD

Correlational research is chosen as the research design conducted in this study. According to Fraenkel, Wallen, and Hyun [40], the correlational design is appropriate to the context of the study that evaluates 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, Malaysia. The study population is teachers who teach form one to form five students, which is 9138 teachers. The sample calculation using Cochran's [41] formula for this study is 493. Proportionate stratified sampling, cluster random sampling, and simple random sampling were used to obtain samples.

The questionnaire of this study consists of 87 items, which includes eight items in Section A and 79 items in Section B. Section A consists of items on respondents' demographic background. Meanwhile, section B will consist of items related to the four independent variables (personal innovativeness, technology self-efficacy, attitudes toward digital technology, and digital competence) and the dependent variable (use of digital technology).

As the dependent variable of the study, the use of digital technology will assess the degree to which teachers integrate technological tools and resources to improve their teaching. This construct consists of 11 items adapted from previous studies [36], [42], [43]. The first independent variable, personal innovativeness, will assess the degree to which teachers believe that accepting digital technology will improve their teaching performance and use it-all 14 items adapted from PIIT scale [44]. The construct of technology self-efficacy (16 items) will measure teachers' belief in their capability to use digital technology. Technology self-efficacy items were adapted from TPSA C-21 Scale [45]. Attitudes towards digital technology aim at assessing the teachers' driving force behind their digital technology use behavior. This construct consists of 16 items adapted from teacher bit attitude scale [46]. The final variable, digital competence, refers to teachers' ability to use digital technology confidently, critically, and creatively to convey the content of the lesson to the students. This study measures digital competence using DigCompEdu scales [39], consisting of 22 items.

In the pilot study/test, 36 teachers from secondary schools in the same state participated. Table 1 shows the Cronbach's alpha value results obtained in this study for the pilot and actual study. The reliability values vary between 0.823 to 0.962. The survey is considered an acceptable instrument due to its consistency, as all values are more than 0.7 [47].

Table 1. Reliability of the constructs

Construct	α: Pilot study (n=36)	α: Actual study (n=493)
Personal innovativeness	0.962	0.960
Technology self-efficacy	0.961	0.948
Attitude towards digital technology	0.841	0.858
Digital competence	0.918	0.932
Use of digital technology	0.895	0.883

3. RESULTS AND DISCUSSION

Table 2 shows the descriptive analysis for all variables studied. The mean for all variables studied is high. The highest mean of personal innovativeness is 4.04 (SD=0.609), implying that teachers believed integrating technology into their teaching and learning will improve their teaching performance. The respondents also have a firm belief in their capability to use digital technology in their teaching and learning (Mean=3.91, SD=0.631). Respondents also positively adapt information and communication technology (ICT) into teaching and learning (Mean=3.71, SD=0.529). However, respondents' digital competence is 3.05 (SD=0.627) which is slightly high. This indicated that respondents have acceptable digital competence that would help them use it in teaching and learning. The overall mean for the use of digital technology is 3.33 (SD=0.580). This indicates that respondents use digital technology either during their teaching and learning or activity related to academic tasks.

Table 2. Mean and standard deviation variables studied

	Mean	Standard deviation
Personal innovativeness	4.04	0.609
Technology self-efficacy	3.91	0.631
Attitudes towards digital technology	3.71	0.529
Digital competence	3.05	0.627
Use of digital technology	3.33	0.580

The next analysis determines the relationships between the four factors with use of digital technology among secondary school teachers as presented in Table 3. There was a positive correlation between technology self-efficacy (r=0.575; p<0.001), digital competence (r=0.560; p<0.001), attitudes towards ICT (r=0.488, p<0.001) and personal innovativeness (r=0.476; p<0.001) with teachers' use of digital technology. Correlation coefficients (absolute values) that are between 0.20 to 0.35 reflects low correlations, 0.35 to 0.65 is modest or moderate correlations, 0.65 to 0.85 is high correlations, and r coefficients more than 0.85 are considered as very high correlations [48]. As can be seen from Table 3, the teachers' technology self-efficacy, digital competence, attitudes towards digital technology and personal innovativeness are moderately correlated to teachers' use of digital.

Table 3. Correlation coefficients between teachers' personal innovativeness, technology self-efficacy, attitudes towards digital technology, digital competence, and use of digital technology

	Personal innovativeness	Technology self-efficacy	Attitudes towards digital technology	Digital competence
Use of digital technology	0.476.	0.575	0.488	0.560

3.1. Regression

A regression analysis was also performed to assess the research objective and discover the various variables influencing teachers' use of digital technology. Table 4 reveals that the multiple correlation coefficients were 0.436, suggesting that teachers' personal innovativeness, technology self-efficacy, attitudes toward digital technology, and digital competence accounted for approximately 43.6% of the variation in the use of digital technology. According to Table 5, there was a statistically significant relationship between the variables under consideration and the outcome (F (4,492) =94.187, p=0.001). It became clear from this that any one of the mentioned factors might be a substantial predictor of the degree to which teachers make use of digital technology.

Table 4. Model summary

Model	R	R Square	Adjusted R Square
1	0.660	0.436	0.436

Predictors: (Constant), Personal_innovativeness, Technology_selfefficacy, Attitude_toward _digital_technology, Digital_competence

Table 5. ANOVA

Model	Sum of squares	df	Mean square	F	Sig
Regression	72.01	4	18.002	94.187	0.000
Residual	93.274	488	0.191		
Total	165.284	492			

The findings of the multiple regression analysis as shown in Table 6, suggested that technology self-efficacy, attitudes toward digital technology, and digital competence influenced secondary school teachers' use of digital technology. Beta values (β) were used to determine the relative importance of the three predictors of teachers' use of digital technology, and the results show that technology self-efficacy (β=0.262), attitude toward digital technology (β=0.141), and digital competence (β=0.329) were in that order. In other words, digital competence contributed 32.9% of the variance, technology self-efficacy explained 26.2%, and attitude towards digital technology explained 14.1% of the variance teachers' use of digital technology.

Table 6. Model coefficients

Model	Unstandardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	0.627	0.153		4.092	0.000
Personal innovativeness	0.064	0.05	0.067	1.269	0.205
Technology self-efficacy	0.241	0.049	0.262	4.888	0.000
Attitude towards digital technology	0.154	0.052	0.141	2.961	0.003
Digital competence	0.304	0.038	0.329	8.013	0.000

3.1.1. Dependent variable: use of digital technology

This study examined five variables: personal innovativeness, technology self-efficacy, attitude towards digital technology, and digital competence, which are the predictive factors for the use of digital technology among secondary school teachers. Despite the higher mean compared to other variables, personal innovativeness was insignificant to teachers' use of digital technology. Naturally, according to Gupta, Bhardwaj, and Singh, people with higher levels of personal innovativeness are likely to accept workplace-related technological components and activities [18]. However, in this case, teachers probably already have the traits where they believe that using technology would improve their performance in teaching. Given that, at some point, they have already passed the phase where they need to improve their belief in using technology. Either the teachers have high or low belief in using digital technology, it does not affect or encourage them to use the digital technology. Hence, personal innovativeness can be excluded as a factor that predicts the use of digital technology among teachers.

On the other hand, it was discovered that teachers' technology self-efficacy was significantly related to their usage of digital technology. In a similar manner, previous researches that were conducted and published in the past have shown a relationship between technology self-efficacy and the use of digital technology [26], [27]. This study demonstrated that the variable explained 26.2% of digital technology utilization among teachers. Ghomi and Redecker [39] also obtained quite a similar result, where the effect size is 24%. According to several studies, feeling confident and secure is important to make a teacher to use technology [23]–[25], [49]. One of the reasons for having confidence and security, or technology self-efficacy, is the availability of digital technology knowledge. Taimalu and Luik [50] highlighted that technology integration was directly influenced by knowledge of technology and its integration. The daily routine of a teacher may demand that they use digital technology as simple as a smartphone to get the job done. This kind of knowledge makes them more confident in using digital technology. Another reason that can be considered is the school culture. With the encouragement and technical assistance from the school management, teachers felt confident and safe using digital technology and learning new technology in creating their teaching materials.

In addition, attitude towards digital technology was found to influence teachers' use of digital technology positively. Attitude towards digital technology explains that 14.1% of teachers' use of digital technology. When teachers have a positive attitude towards digital technology, the teachers will have more interest and motivation to keep using digital technology, whether in teaching or in facilitating them to prepare their lesson plan in learning process. Teachers also feel enthusiastic about utilizing digital technology because they believed it inspired their students and ease the assessment process. This finding is consistent with previous studies' results which showed that teachers have positive attitudes towards digital technology and its utilization [29], [51]–[53].

Finally, it was established that digital competence is significant for a teacher's use of digital technology, contributing to 32.9% of the variance. This figure, according to Cohen [48], indicates medium strength. This is most likely due to the COVID-19 pandemic, which require teachers to use various digital technology to teach. Throughout this quarantine period, teachers received extensive in-house training, including webinars and online workshops, to aid them in implementing digital technologies. Teachers who engage in webinars and online workshops are also awarded certificates to encourage them to improve their digital competence level actively. Similarly, the Ministry of Education provides an update of the Digital Educational Learning Initiative Malaysia (DELIMa) Portal to keep up with the demands of teaching and learning. It is prepared to support teachers and students. The portal involves several apps, training modules, and materials that align with the current curriculum. Furthermore, we noticed that teachers' digital competence has increased due to their exposure to digital technology. Digital competence not only predicts the use of digital technology, but the exact relationship can be reversed. As documented by Ghomi and Redecker [39], since the curriculum requires science, technology, engineering, and mathematics (STEM) teachers to use digital technology more frequently, this group of teachers has a higher level of digital competence than non-STEM teachers.

4. CONCLUSION

Given the findings acquired within this scope, it was determined that digital competence is the most significant predictor of digital technology utilization among secondary school teachers. A citizen needs to have the knowledge, skills, and attitude to use technology in five different domains-information management, communication, media production, design, design and design-as well as the ability to create content. This reaffirms the importance of teachers having a high level of digital competence, which not only enables teachers to use digital technology more effectively, but also enables teachers to educate students toward becoming digitally competent citizens. For that reason, Malaysian Ministry of Education has implemented a variety of training programs for teachers. However, the training is deemed insufficient to assist teachers in

effectively using technology. Therefore, future training should be structured to incorporate new technical knowledge more efficiently. This is essential so that the training may help teachers increase not just their digital competence but also their confidence, willingness to explore, and attitude toward the use of digital technology. The given training should also be easy to comprehend for teachers of all levels, so as to encourage them to adopt digital technology as one of the tools to improve their teaching effectiveness.

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