Constructivist Beliefs And The Attitudes Towards Computers As Predictors Of Classroom Technology Use Amongst Pre-Service Teachers

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ABSTRACT

Despite vast improvements in technology infrastructure and classroom technology implementation across Malaysia, there still remain teachers who fail to seamlessly integrate technology in their lessons. Potential explanations for this behaviour span from low self-efficacy and computer anxiety to personal attitudes and beliefs. Technology has been shown to aid learning and even contribute to an improvement in standardized test results when integrated into the curriculum in a meaningful manner. This study investigates the causes for the reluctance to integrate technology in classrooms. It also looks into whether it can be understood from teachers' attitudes towards computers or from their constructivist teaching beliefs. A correlational research study was conducted with 135 pre-service teachers from 3 public Malaysian universities. Multiple regression analysis was performed to establish the predictive value of the variables. Our analysis showed that teachers' attitudes towards computers can directly predict how likely they are to incorporate technology in their lessons. However, constructivist beliefs did not predict pre-service teachers' intention to use technology in the classroom. Additional analysis and t-test found that female teachers were significantly less likely to want to incorporate technology in their lessons when compared to males. We concluded that when teachers' attitudes towards computers are more positive, they are more likely to use technology in their future lessons. However, this may not apply across the board, with female teachers appearing less likely to utilise technology when compared with male teachers.

Keywords: *Pre-service, constructivist, attitudes, computer, technology*

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INTRODUCTION

The use of digital technology in physical classrooms around the world is a hotly debated subject. As today's teachers and lecturers struggle to prepare the next generation for the challenges brought on by the 'Fourth Industrial Revolution', there has been a paradigm change in the field of education towards advocating a more student-centred, conceptually oriented approach to teaching.

With the rapid advancement of technological phenomena such as 'Web 3.0' and 'Web 2.0' trends such as the 'Internet-of-things', research is struggling to keep up with the pace of technological change. Therefore, any new technology must be thoroughly assessed before being implemented in an educational context.

Additionally, there needs to be an understanding amongst researchers and educators of the promise that technology brings while remaining aware of its limitations and potential for ineffective use. As technology progresses, educators must continue to embed good teaching practices in their classes and facilitate authentic learning by focusing on implementing technology that is rooted in student-centred pedagogical theory, such as Constructivism; and established models of technology integration, such as TPACK (Technological Pedagogical Content Knowledge), WST (Will Skill Tool) or SAMR (Substitution, Augmentation, Modification and Redefinition). It is only through these lenses that the successful implementation of technology can be achieved.

One of the central tenets of constructivism is advocating student-centred learning. Technology, incidentally, has enabled teachers to shift, with much more ease, from being a 'sage on a stage' to a 'guide on the side', encouraging students to take ownership of their learning in new and exciting ways. Aside from promoting more student-centred approaches to learning, the design of learning environments is also the subject of both constructivism and technology (Gilakjani, Lai-Mei, & Ismail, 2013). The relationship between constructivism and technology goes even further. Research shows that teachers who hold constructivist views, that is, constructivist-based principles and values, are more likely to use technology in their classrooms than teachers who adopt other learning theories. (Gilakjani et al., 2013). In addition, a positive association between teachers with student-centred beliefs and how much they use technology to improve learning has been established. (Gilakjani et al., 2013).

As convincing a theory as it may be, constructivism on its own cannot predict a teacher's technology use. As individuals, teachers have their own preferences, teaching style, personality and attitudes that must be taken into consideration. Research has shown that a teacher's personality (Men & Noordin, 2019), culture (Chai, Hong, & Teo, 2009), computer-related anxiety (Mathew Myers & Halpin, 2002), perceived ICT (Information Communication Technology) competence (Aslan & Zhu, 2017), specific teaching speciality, (Teo, 2008) and pre-existing attitudes to computers (Teo & Milutinovic, 2015) can all affect the use of technology in their teaching practices. Furthermore, teachers are much less likely to incorporate technology if they experience a lack of training and support from their institutions (Ganapathy, Singh, Kaur, & Kit, 2017).

As mentioned, another significant factor to predict the intention of teachers when it comes to using technology is their attitudes towards the use of computers. (Teo & Milutinovic, 2015). It stands to reason that those teachers who have negative experiences when first introduced to computers develop negative attitudes towards computers and end up more reluctant to use technology in their teaching (Honey & Moeller, 1990). A teacher's attitude towards computers, and their predisposition towards using technology, is therefore arguably inculcated long before beginning their journey as a teacher.

Malaysia is a good location to conduct research into the impact that technology is having on education, as it is a rapidly developing nation, located in the heart of south-east Asia. Its proximity and trade relations with various technology powerhouses such as China, Singapore and Korea allow for easy access to new technologies and inexpensive hardware. Additionally, Malaysia benefits from its close ties with two of the world's education 'giants', the United Kingdom and Australia. As part of the Commonwealth of Nations, Malaysia is frequently influenced by Australia, where education has flourished in recent years and where "world-class research and development institutions focus on areas of emerging information technology relevant to education" ("*Australian Education Technology*," 2017, p. 6); and the UK where the Department for Education recently announced that it aims to "support and enable the Education sector in England to help develop and embed technology in a way that cuts workload, fosters efficiencies, removes barriers to education and ultimately drives improvements in educational outcomes." ("*Realising the potential of technology in education: A strategy for education providers and the technology industry*," 2019, p. 5)

Despite these connections, Malaysia has fallen behind in world education rankings in the last few years. Since its inaugural participation in the Trends in International Mathematics and Science Study (TIMSS) in 1999, Malaysia has dropped in its performance to below the international average in both subjects in 2015 and in the most recent Programme for International Student Assessment (PISA), students in Malaysia scored lower than the OECD (Organisation for Economic Co-operation and Development) average in Reading, Mathematics and Science (OECD, 2019). It is important to note, however, that Malaysian students' scores have risen from 2012 to 2018 in the PISA and from 2011 to 2015 in the TIMMS. In 2013, the Malaysian Ministry of Education

(MoE) published a review of Malaysia's education system and proposed a 12-year plan to revamp the system. While we cannot attribute the increase in PISA and TIMMS scores solely to the changes that have been implemented since the plan, there appears to be a noteworthy improvement.

Technology offers many positive qualities to both our students and teachers all over the world. The overall trend in education tends to be shifting away from teacher-centred, behaviourist approaches. If we are going to push for the use of technology in the classroom, it is important to first look at why it is not being used in the classroom when it should be.

In the years leading up to the COVID-19 outbreak, the upward trend in Malaysian educational technology was looking promising. However, implementation of ICT in Malaysian classrooms was still in its infancy (Rashid, Yunus, & Mohamad, 2015). Worryingly, there were reports of teachers not integrating ICT in their lessons seamlessly and where there was integration, it was insufficient and not fully optimised (Men & Noordin, 2019). Reports suggested that the difficulty teachers faced in using technology in the classroom stemmed from a lack of computers, a lack of time in the preparation of lesson plans involving technology and the little to no technical support provided in schools (Jamrus & Razali, 2019). Additionally, teachers reported that the primary challenge that they encountered was the intensive curriculum that was holding them back from using ICT in their classrooms (Men & Noordin, 2019).

On the surface, it appears that the main obstacles to successful technology integration reported by Malaysian teachers are 'external' barriers related to infrastructure and access to technology and training. The good news is that problems such as these are easily alleviated. What is more difficult to understand is when teachers do not experience a shift in teaching practise due to integrating technologies in their lessons, despite having access to technology-rich resources (Palak & Walls, 2009). This phenomenon indicates that even after the barriers to technology integration are removed, teachers do not undergo a change in their teaching practice.

Research that has been conducted on technology use and pre-service teachers focuses on constructs such as self-efficacy and perceived usefulness of technology as predictors of technology use. There is a lack of research on constructivist beliefs and attitudes towards computers as forecasters of classroom technology use. Furthermore, in Malaysia there are a lack of studies looking at pre-service teachers and their technology use. Instead, studies choose to focus on technology in English language teaching and the differences between rural and urban schools in Malaysia. Many of the teachers who are entering the profession today are already considered 'digital natives' and thus are expected to be competent in their use of technology and ICT. Understanding the factors that influence this, such as their teaching beliefs and attitudes toward computers, is therefore a crucial topic of research.

The results of this study could highlight the broader issue of how to encourage teachers to utilize technology in the classroom. Even in countries where technology is commonplace in the classroom, it may not be utilized in an effective manner or at all. The results of this research may offer useful information to help inform stakeholders of how to structure teacher-training programs to increase the likelihood of pre-service teachers integrating technology later in their teaching. This study also hopes to provide useful data to better inform school administrators and teaching colleges on how to encourage technology use and integrate technology effectively in the Malaysian education system. At the time of writing, research on the factors responsible for the future use of technology by pre-service teachers remains limited.

The goal of this study is to explore, amongst pre-service teachers in Malaysia, the levels of constructivist beliefs, attitudes towards computers and technology use in terms of age, gender, grade level taught, experience and the university they attend. The study also investigates the relationships between constructivist ideas, computer attitudes, and technology use intention. The research similarly attempts to see if pre-service teachers' intentions to employ technology in the classroom can be predicted by constructivist views and attitudes toward computers. Finally, we consider the differences between pre-service teachers in terms of gender and university, regarding their constructivist beliefs, their attitudes towards computers and their intention to use technology in the classroom.

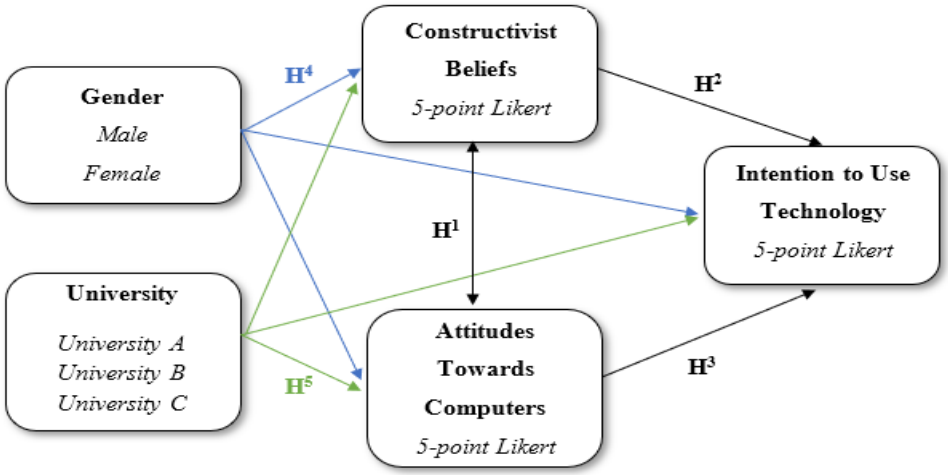

Figure 1. *The conceptual framework of the current study*

The hypotheses in the model are stated below:

- **Hypothesis 1 (H_1)**: Constructivist beliefs are significantly correlated with attitudes towards computers and intention to use technology.
- **Hypothesis 2 (H_2)**: Constructivist beliefs significantly predict the intention to use classroom technology amongst pre-service teachers.
- **Hypothesis 3 (H_3)**: Attitudes towards computers significantly predict the intention to use classroom technology amongst pre-service teachers.
- **Hypothesis 4 (H_4)**: There are significant differences between pre-service teachers in terms of gender regarding their constructivist beliefs, attitudes towards computers and their intention to use technology in the classroom.
- **Hypothesis 5 (H_5)**: There are significant differences between pre-service teachers in terms of university regarding their constructivist beliefs, attitudes towards computers and their intention to use technology in the classroom.

RESEARCH METHOD

Research Model

This study employed a correlational approach to identify the relationship between three variables: *constructivist beliefs* (predictor variable), *attitudes towards computers* (predictor variable) and intended *classroom technology use* (criterion variable). This resulted in a prediction research design The variables consisted of constructivist beliefs, attitudes towards computers, classroom technology use, gender and university. Constructivist beliefs relate to how highly a teacher scores on the Constructivist Teaching Beliefs Scale (CTB) with a higher score indicating a more strongly constructivist belief system. In the context of this study, a teacher's attitude towards computers relate to how highly a teacher scores on the Attitudes towards Computers in Education Scale (ACE), with a higher score indicating a more positive attitude towards the use of computers in education. Intention to use technology relates to how highly a teacher scores on the Intention to Use Technology Scale (IUT) with a higher score indicating a higher behavioural intention to use technology. Gender refers to the self-identified gender of the teacher (male/female/prefer not to disclose) while university refers to one of the three public universities that participants belonged to. The variables of constructivist beliefs and attitudes towards computers were subjected to Pearson correlation to determine their relationship. The variables of constructivist beliefs, teacher's attitudes towards computers and intention to use technology were subjected to multiple linear regression analysis to determine the predictive value of the variables.

Participants

There were a total of 135 participants in this study. Their ages ranged from 18-25 years old. The participants were pre-service teachers studying for an education-related degree at three Malaysian public universities. They were representative of the larger population of pre-service teachers currently pursuing a recognised teaching degree in the Klang Valley and Perak. The three universities that were selected were chosen from a list of several public universities based on their high academic record and reputation in Malaysia. It was therefore anticipated that they would be a representative sample of the population of overall pre-service teachers in Malaysia. The sample was expected to be skewed in terms of gender, with more females than males. This is because the teaching profession in Malaysia is still dominated by females (Azman, 2013). It was expected that most participants would have less than 10 hours of in-class teaching experience. It was also expected that the sample had frequent access to both technology (laptops/tablets/smartphones) and the internet.

The sampling method used was cluster sampling. The population of pre-service teachers in the Klang Valley and Perak were divided into subgroups (each of the three universities). These subgroups were further divided into the classes (from each university) that the researcher recruited participants from. The selection of classes was not random. Instead, the classes that were used were the ones that the researcher was granted permission to survey. Access to all the classes in each university was not logistically possible and was made more difficult with the advent of the COVID-19 pandemic.

Data Collection Tools

As data collection was performed during the COVID-19 pandemic, data was collected using an online form that was sent to each participant during their online lectures or via email/instant messaging. A total of three instruments were administered to measure the three separate constructs of the research. The first two scales, the Constructivist Teaching Beliefs Scale (CTB) and the Attitudes towards Computers in Education Scale (ACE) were taken from Sang, Valcke, Braak & Tondeur (2010). A new instrument, the 'Intention to Use Technology'(IUT) scale was created from two instruments, one from Teo (2011), the other from Teo, Lee, Chai, & Wong (2009), Teo & Noyes (2011) and Teo, Ursavaş, & Bahçekapili (2011).

Constructivist Teaching Beliefs Scale (CTB)

Participants were asked to rate their level of agreement on a 5-point Likert scale (1=strongly disagree to 5=strongly agree). There were 7 items for the CTB that included items measuring shared control and critical voice. None of the items in the CTB were reverse coded. Reliability of the CTB scale was calculated using Cronbach's Alpha (α=.86), which was consistent with the reliability (α=.81) reported in Sang et al. (2010).

Attitudes towards Computers in Education Scale (ACE)

The 8-item ACE scale was used to measure the participants' attitudes towards computers. Participants were asked to rate how strongly they agreed with the statements on the ACE using a 5-point Likert scale (1=strongly disagree to 5=strongly agree). None of the items in the ACE were reverse coded. Internal consistency of the ACE was also measured using Cronbach's alpha (α=.86), similar to the reliability (α=.81) reported in Sang et al. (2010).

Intention to Use Technology Scale (IUT)

The 5-item IUT scale was used to measure the participants' behavioural intention to use technology in the classroom. Participants were asked to rate their level of agreement on a 5-point Likert scale (1=strongly disagree to 5=strongly agree). A new instrument was created as there was no existing scale that measured the experimental variables in the detail required and for the demographic that was being investigated. Internal consistency of the IUT were calculated using Cronbach's alpha (α=.83).

Validity and Credibility

The face validity of the CTB, ACE and IUT was verified using an expert tester. The tester indicated further validity of the newly constructed IUT due to one of the source instruments being used in a Malaysian context (Teo, Lee, Chai & Wong, 2009). Convergent validity was established for the new scale by looking at

correlation coefficients of the IUT scale against the ACE scale, a theoretically related construct. Analysis showed a significant positive correlation between the variables $r(13) = .65$, $p < .01$. Analysis of the correlation coefficients of the IUT scale against age also showed significant correlation $r(13) = -.57$, $p < .05$, failing to confirm discriminant validity for the IUT scale. However, the sample used in this analysis was taken from a pilot study which was small (n=15) and also had a small age range (21-23). Therefore, measures of discriminant validity of the IUT would likely be confirmed with a larger, more diversified sample.

Collection of Data

Participants were approached during their online lectures and asked to take part in the study. Participants were invited to give informed consent, prior to data collection through an initial form that began with information about the voluntary nature of the study, the anonymity of the participants' data, risks & benefits, and informed consent. Participants were informed of their right to withdraw from the study at any time and of the nature of the study and purpose of the research. They were then shown a link and a quick response (QR) code leading them to the questionnaire section. After the data were collected, the participants were debriefed, any questions were answered by the researcher and the participants were invited to email the researcher for their individual results if required. This was enabled through the use of the participant's student numbers.

Data Analysis

Tests for normality were taken alongside a visual inspection of histograms and Q-Q plots for the CTB, ACE and IUT scales. CTB score had a mean of 4.25 (SD = 0.46), a minimum of 2.86 and a maximum of 5.00. In terms of distribution, the CTB scale was found to have a skewness of -0.43 and a kurtosis of 0.05 making the scores fairly symmetrical and normally distributed. The ACE score had a mean of 4.19 (SD = 0.66), a minimum of 2.38 and a maximum of 5.00. The ACE scale had a skewness of -0.62 and a kurtosis of -0.34 making the scores moderately, negatively skewed and platykurtic. The IUT score had a mean of 4.52 (SD = 0.53), a minimum of 3.00 and maximum of 5.00. The IUT scale had a skewness of -0.95 and a kurtosis of 0.04 making the scores moderately, negatively skewed and mesokurtic. Data from all three scales were found to significantly deviate from a normal distribution. However, due to the large sample size (>50), the impact on validity was not considered to be high (Pituch & Stevens, 2015). Therefore, the researcher proceeded with parametric data analysis.

The aggregate means from each university can be seen in Table 1. It appeared that University A students hold the most constructivist teaching beliefs and University C students have the most positive attitudes towards computers in education and have the most intention to use technology in the classroom.

Prior to analysis, initial cleaning of the data was performed, and data was checked for missing values, duplicate values, participants who exceeded 10 hours of in-class teaching experience and participants who did not have access to the internet or a device to access the internet on a daily basis.

For multiple linear regression analysis to be performed, the data had to conform to assumptions of linearity, homoscedasticity, absence of collinearity and a normal distribution. A priori testing revealed to detect a medium effect size of $f^2 = 0.15$ with 90% power (alpha = .05), the study would need 88 participants in a multiple regression analysis. A simple correlation was also performed to determine if there was a relationship between a *teacher's attitudes towards computers* and their *constructivist beliefs*. A priori testing revealed that in order to detect a Pearson's correlation coefficient of $r = .60$ with 90% power (alpha = .05, one-tailed), the study would need 20 participants. Finally, demographic data were used to investigate the differences, if any, between pre-service teachers in terms of *gender* and *university*, regarding their *constructivist beliefs*, their *attitudes towards computers* and their *intention to use technology*. A priori testing revealed that in order to detect an effect size of Cohen's $d = 0.80$ with 90% power (alpha = .05, two-tailed), the study would need 76 participants per group (N = 152) in an independent samples t-test. Additionally, a priori testing showed that in order to detect an effect of $f = 0.60$ with 90% power in a one-way between-subjects multivariate analysis of variance (MANOVA) (three groups, alpha = .05), the study would need 30 participants in each group (N=90).

FINDINGS

A total of 206 participants took part in the survey. After the data was cleaned and filtered by inclusion criteria the final sample consisted of 135 responses. Responses that indicated that they had over 10 hours of teaching experience and those who did not have access to the internet or a device to access the internet at home were removed. It was felt that if a teacher did not have access to these items, it would significantly impact their intention to use technology when teaching. It was also felt that teachers who had had over ten hours of teaching experience would have had enough teaching hours to no longer fit, for the purpose of our study, our definition of a 'student teacher' with little to no experience. Finally, some responses were also removed due to lack of consent.

Table 1. *Combined data showing Gender, University and tests for normality*

		N	%	CTB	ACE	IUT
Gender	Female	114	84.40	4.24	4.16	4.49
	Male	19	14.00	4.36	4.38	4.72
University	A	56	41.50	4.31	4.21	4.50
	B	51	37.80	4.18	4.07	4.43
	C	28	20.70	4.28	4.36	4.72

	Mean	Sd	Min	Max	Kurtosis	Skewness
CTB	4.25	.46	2.86	5.00	.05	-.43
ACE	4.19	.66	2.38	5.00	-.34	-.62
IUT	4.52	.53	3.00	5.00	.04	-.95

The majority of respondents were Female (n = 114) representing 84.4% of the sample. Males accounted for 14% of the sample (n = 19). University A students (41.5% of the sample) scored highest on the CTB scale, while University C students (20.7% of the sample) scored highest on the ACE scale and the IUT scale. CTB scores had a mean of 4.25 (SD = 0.46), a minimum of 2.86, a maximum of 5.00, a skewness of -0.43 and a kurtosis of 0.05. The ACE scores had a mean of 4.19 (SD = 0.66), a minimum of 2.38, a maximum of 5.00, a skewness of -0.62 and a kurtosis of -0.34. Finally, the IUT scores had a mean of 4.52 (SD = 0.53), a minimum of 3.00, a maximum of 5.00, a skewness of -0.95 and a kurtosis of 0.04.

Table 2. *Pearson Correlation for CTB, ACE And IUT*

Variable	n	M	SD	1	2	3
1. Constructivist Teaching Beliefs score (CTB)	135	4.25	0.46	–		
2. Attitudes towards computers score (ACE)	135	4.19	0.66	.423**	–	
3. Intention to use technology score (IUT)	135	4.52	0.53	.324**	.608**	–

** $p < .01$.

A Pearson correlation was carried out to establish the relationship between the scales of CTB, ACE and IUT. The analysis revealed that IUT scores were positively correlated with CTB score r(133) = .32, p < .01 and

positively correlated with ACE score $r(133) = .61$, $p < .01$. Furthermore, ACE scores were positively correlated with CTB score $r(133) = .42$, $p < .01$ (see Table 2). The relationships between the IUT and the CTB, and the ACE and the CTB were medium correlations, while the relationship between the IUT and the ACE was a strong correlation. In all three cases the significance levels were less than .01.

Table 3. *Regression Coefficients of CTB and ACE*

Variable	Model 1		
	B	*β*	*SE*
Constant	2.170		.356
CTB Score	.096	.082	.088
ACE Score	.464**	.573	.061
R^2	.375		

Multiple linear regression was performed on the three scales with CTB and ACE acting as predictor variables for the dependent variable IUT (see Table 3). Taken as a set, the predictors of ACE score and CTB score accounted for 38% of the variance in IUT score $F(2,132) = 39.54$, $p < .01$, $R^2 = 0.38$. When examined further, the CTB score was not a significant predictor in this model $B = 0.10$, $t(132) = 1.10$, $p > .05$, 95% CI [−0.08, 0.27]. Therefore, constructivist beliefs do not appear to predict intention to use technology.

When examined further, ACE score significantly predicted IUT score $B = 0.46$, $t(132) = 7.54$, $p < .01$, 95% CI [0.34, 0.59]. It appears, therefore, that attitudes towards computers predict the intention to use technology. The entire model's observed R^2 yields an effect size (f^2) of 0.60. This indicates a large effect size. Analysis of residuals indicated that normality of error distribution was assumed.

Table 4. *Results of Male/Female Differences in Test Scores*

Logistic Parameter	Males		Females		*t*(131)	*p*	Hedges's *g*
	M	*SD*	*M*	*SD*			
CTB Score	4.36	0.39	4.24	0.46	-1.087	.279	0.269
ACE Score	4.38	0.57	4.16	0.66	-1.334	.185	0.331
IUT Score	4.72	0.38	4.49	0.55	-2.234	.033**	0.432

To investigate the gender differences in the three instruments' scores, independent samples t -tests were carried out for all three scales (see Table 4). There were significantly higher scores for males (M = 4.72, SD = 0.38) compared to females (M = 4.50, SD = 0.55) in IUT score $t(31.64) = -2.23$, $p = .03$, $g = 0.43$, 95% CI [−0.44, −0.02] but no significant differences in CTB score $t(131) = -1.09$, $p > .05$, $g = 0.27$, 95% CI [−0.34, 0.10] or ACE score $t(131) = -1.33$, $p > .05$, $g = 0.33$, 95% CI [−0.53, 0.10] in terms of gender. This means that males significantly differed in their intention to use technology but not in their constructivist beliefs or their attitudes towards computers. Due to the differences in sample sizes for males (n=19) and females (n=114), Hedges *g* was used to calculate effect size instead of Cohen's d, though their interpretations are similar. This means that the effect size for the difference between males and females in the IUT ($g = 0.43$) was a medium effect size.

Table 5. *MANOVA of University on Test Scores*

Measure	University		F(2,132)	Partial η^2
	M	SD		
CTB Score	4.25	0.46	1.238	.018
ACE Score	4.19	0.66	1.813	.027
IUT Score	4.52	0.53	2.825	.041

To investigate the effect of university on CTB, ACE and IUT scores a MANOVA was used with the three scales as dependent variables (see Table 5). Results of the MANOVA showed that scores were not significantly dependent on which university participants attended $F(6,260) = 1.36$, $p > .05$, Wilk's $\Lambda = 0.94$, partial $\eta^2 = 0.03$. Results of the MANOVA also indicated no significant effect of university on CTB score $F(2,132) = 1.24$, $p > .05$, partial $\eta^2 = 0.02$, ACE score $F(2,132) = 1.81$, $p > .05$, partial $\eta^2 = 0.03$ or IUT score $F(2,132) = 2.83$, $p > .05$, partial $\eta^2 = 0.04$.

In conclusion, IUT scores were positively correlated with CTB scores and positively correlated with ACE scores while ACE scores were positively correlated with CTB scores. While CTB scores were not a significant predictor of the intention to use technology, attitudes towards computers did predict the intention to use technology. Males significantly differed when compared to females in their intention to use technology but not in their constructivist beliefs or their attitudes towards computers. Finally, CTB, ACE and IUT scores were not significantly dependent on which university participants attended.

DISCUSSION AND CONCLUSION

Results from the correlation found that the ACE score was positively correlated with the CTB score. In other words, teachers who hold more positive attitudes towards computers also tend to have more constructivist teaching beliefs. This finding supported the hypothesis (H_1) and reaffirms the findings found by So, Choi, Lim & Xiong (2012). Furthermore, the IUT score was found to be positively correlated with both CTB and ACE scores indicating that the three constructs were uniquely interdependent on one another. Both constructivist beliefs and attitudes towards computers have a positive impact on whether a pre-service teacher intends to use technology in his/her classroom. The relationship observed between the ACE scale and the CTB scale is supported by prior research which has found that constructivist teachers are more likely to hold positive attitudes towards computers and place a positive value on technology (Hsu, 2016; So et al., 2012). The same is true for the observed positive relationship between constructivist beliefs and intention to use technology. Prior research has found that teachers with constructivist principles tend to be more 'high tech' and are more likely to integrate and use ICT in the classroom (Ertmer, 1999; Honey & Moeller, 1990; Sang, Valcke, van Braak, Tondeur & Zhu, 2011). The relationship between IUT and ACE can be easily explained if it is inferred that a positive attitude towards computers can lead to a positive attitude towards all technology and therefore a higher propensity to utilize it. It is worthy of note that constructivist beliefs may play a mediating role in the relationship between attitudes towards computers and the intention to use technology. A similar finding was made by Sang et al. (2010) who found that constructivist teaching beliefs impacted future ICT use, indirectly through attitudes towards computers.

Regression analysis discovered that the ACE score significantly predicted the IUT score. This suggests that pre-service teachers' attitudes towards computers will predict teachers' intention to utilize technology in the classroom. Supporting our hypothesis (H_3) the regression analysis also found that the CTB score was not a significant predictor in the model, therefore the null hypothesis (H_{02}), is not rejected. It is not surprising that the ACE score predicts IUT given they are moderately correlated in a linear fashion. The CTB scores, however, do not predict IUT. This may be because the relationship between these variables is not linear which would account for the positive correlation but the non-significant linear regression. Additionally, it may be that the effect of constructivist beliefs on the intention to use technology is mediated by other constructs like

teaching efficacy and computer self-efficacy which were not measured (Sang et al., 2010; Vannatta & Nancy, 2004).

Interestingly, gender differences were observed in the IUT scale with males scoring significantly higher in their intention to use technology than females. This supports part of the hypothesis (H_4), while differences in the other scales were not observed. These findings were not surprising, as differences in technology and computer use and anxiety between males and females has been observed by other researchers (Awofala, Akinoso & Fatade, 2017; Van Braak, 2001). The differences observed between males and females on IUT scores may possibly be a result of gender norms. It may be that the differences found between males and females in measures of technology or attitudes towards technology are down to the fact that technology and computing are still seen, around the world, as a male interest or male-dominated profession. Females, according to our results, appear to be less likely to incorporate technology in their classrooms when compared to their male counterparts. Despite this, it is surprising that male/female differences were not found on the ACE scale which, as we have seen, is correlated with the IUT scale. There were also no statistical differences between male and female scores reported in the CTB scale, this is expected when we see that other researchers have found a similar story when investigating gender differences in constructivist beliefs (Zikre & Eu, 2018).

Results of the multivariate analysis of variance (MANOVA) found no significant effect of university on any of the scales. This leads to a failure to reject our null hypothesis (H_{05}). Again, this result is unsurprising as it would have been highly unlikely that students from one university would have significantly different attitudes towards computers or constructivist beliefs when compared to a student from another university. The lack of effect of university on variable scores indicates that students' scores do not differ from one Malaysian public university to another. This is good news and an indication that the standard of teaching and the curriculum used in all three universities is of similar quality and execution.

Limitations to the study exist in the form of multicollinearity of the variables used to measure constructivist beliefs, attitudes towards computers and intention to use technology. By being inter-correlated the interpretation of some of the significance tests in our regression analysis must be met with caution. The results of this study must be taken in context and because of the unorthodox nature of the timeframe (COVID-19 pandemic), it is possible that the results may not be entirely generalisable to other periods in time. Additionally, the sample size is relatively small as encouraging participants to take part online proved more difficult than anticipated, due to the pandemic.

Future research could look into the particularly pressing topic of why females appear to have lower levels of intention to use technology in the classroom when compared to males. Following a similar research design, the inclusion of private Malaysian universities would add an extra dimension to the literature and looking at the possible differences of constructivist beliefs, attitudes towards computers and intention to use technology between public and private universities may inform us further about the preparedness of Malaysian teachers using technology in the classroom. Similarly, research into the differences between public school teachers and private school teachers could be a worthwhile avenue of investigation. Inclusion of a focus group aspect to a replication of this study would allow researchers to gain feedback on the newly developed Intention to Use Technology (IUT) scale. As a mixed-method approach, this study could even include interviews with pre-service teachers asking them about their attitudes towards computers, their constructivist beliefs, and their intentions to use technology in the classroom. Another avenue of investigation could be to measure the differences, if any, between student teachers of different courses, especially when compared to teachers who are training to become computer science or ICT teachers.

We live in a time of great and rapid change where technology has evolved more in the last ten years than in the previous hundred. As educators, we must stand prepared to meet the challenges posed by the next generation of 'digital natives'. As more and more students enter the classroom with technology in hand, it is our responsibility to ensure that we are well-informed on the best ways to guide them in using this technology responsibly and effectively as digital citizens in a rapidly changing world.

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