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The Role of Discipline in Determining Turkish Pre-Service Teachers' Behavioral Intentions to Use ICT

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Abstract

The purpose of this study is to determine the technology acceptance of a sample of final-year pre-service teachers of different disciplines in Turkey. Research sample is composed of 973 (583 females, 390 males) pre-service teachers. They complete a survey questionnaire measuring their responses to four constructs of Technology Acceptance Model (TAM). Structural equation modelling (SEM) was used as the main technique for data analysis. One of the main findings showed that the most important determinant of behavioural intention is perceived usefulness, this is followed by attitude towards computer use, and perceived ease of use. Another preliminary finding is that the participants somewhat agree with usefulness and easiness of ICTs and have positive attitude toward use of it in education In conclusion, the study has shown that the idea that perceived usefulness is a key variable in determining intention to use technology in education.

Keywords

Technology acceptance
TAM
Pre-service teachers
Structural Equation Modelling
Turkey

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Introduction

The inclusion of technology in teaching is addressed as a key idea in the education reforms implemented in many countries (Demetriadisa, Barbasb, Molohidesb, Palaigeorgioua, Psillosb, Vlahavasa, Tsoukalasa and Pombortsisa, 2003; Lim and Hang, 2003; van Braak, 2001). At the present time, investments in Information and Communications Technology (ICT) increasingly continue, and new technological tools including computers, tables, projectors, and smart boards are added to in classrooms as essential educational tools. Alev and Yiğit (2009) state that the use of ICT in education requires individuals to accept it, understand it, adopt it, and exert an effort to use it. It is highlighted that the knowledge and skills of teachers concerning ICT are crucial for the adaptation of students to the learning process (Cüre and Özdener, 2008; Rosen and Weil, 1995; Seferoğlu, Akbıyık and Bulut, 2008; Usluel, Mumcu and Demirarslan, 2007). On the other hand, teachers need to have the required belief and motivation for using ICT in their classes besides the knowledge and skills for full implementation (Göktas, Gedik and Baydaş, 2013). According to Pajares (1992), the beliefs of teachers are influential both on their own learning and on their course activities. Thus, the beliefs of teachers concerning the learning of students has an impact on constructing lessons, shaping the relevant curriculum, and establishing relations with students. As stated by Fullan (2007), real change can be achieved only when the change in education is put into practice, and teachers have a momentous role

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in such change. In this regard, it is emphasized that the thinking skills of teachers should be supported within the context of ICT use (Tsai and Chai, 2012). Accordingly, in order to enable students to use technology effectively, teachers must first have this skills in place (Fullan, 1991; Akkoyunlu and Orhan, 2003).

According to Dutt-Doner, Allen and Corcoran (2006), one of the most important steps to be taken for facilitating the adaptation of ICT to schools is to examine teacher training programs closely. It is emphasized that the positive contributions of effective adaptation of technology in such programs may be generalized to all schools. However, there are differences between the education received by pre-service teachers during pre-service training and real classroom practices. That puts teacher trainers in a difficult situation (Şahin, 2012). This general problem manifests its effects on the Turkish Education System, as in other education systems across the world.

As per the teacher training program in Turkey, pre-service teachers become a teacher when they complete a 4-year undergraduate education. This involves approximately 150 credits in total, and the training includes courses and activities concerning the profession, technology, and subject area. According to the teacher training report obtained from the Council of Higher Education, 50 to 60% of the courses offered in teacher training programs are about relevant subject areas, 25 to 30% are courses about relevant professions, and 15 to 20% are general culture courses about the characteristics of each program (YOK, 2007). There are two types of courses about technological education. One of them is the basic computer course aimed at providing pre-service teachers with technological knowledge, and the other is the teaching design and material development course aimed at developing skill to adapt technology to teaching among pre-service teachers. However, the research demonstrates that such courses included in teacher training programs are not sufficient for developing the skills expected from pre-service teachers (Çoklar, Kılıçer and Odabaşı, 2007; Sami, 2012).

Pre-service teachers use the knowledge and skills that they acquire in the pre-service training process when they start their professional lives. The effectiveness of the attitudes acquired in this process should be determined, and problems, if any, should be solved in this process. In this context, the following question should be asked: How can we evaluate pre-service teachers' behavioral intentions to use technology? Such an evaluation can be made via the Technology Acceptance Model (TAM).

The related literature contains studies based on various models and theories that examine the technology use of pre-service teachers. The present study aimed at revealing third and fourth grade pre-service teachers' behavioral intentions to accept and use technology by means of TAM. The study also made an attempt to answer the validity of TAM in explaining the technology acceptance of pre-service teachers.

Technology Acceptance Model (TAM)

This model was developed by Davis (1989), and aims at revealing how users accept and use technology. Many researchers have tried to explain the power of the Technology Acceptance Model, and obtained results consistent with one another. The theoretical basis of the model is the Theory of Reasoned Action (TRA) developed by Ajzen and Fishbein (1980). TRA argues that an individual behaves with his/her own decisive will. In the Theory of Planned Action (TPA), Ajzen (1991) suggests that the factors beyond one's control may affect his/her behaviors. Studies have been conducted both on TRA and TPA, and supporting evidence regarding their validity has been put forward. Both models have been widely used for explaining or predicting the effects of relationships between behaviors and beliefs, attitudes, and intentions on usage as well as the reasons for such effects. There is some evidence indicating that the Technology Acceptance Model, which is based on the above-mentioned two theories, predicts the use of a system by around 40% (Legris, Ingham and Collerette, 2003). The model reveals how expectations and attitudes affect technology (Silvo and Pan, 2005; Teo, 2009).

Research Model and Hypotheses

TAM is a validated theoretical framework that has been used for revealing the system use of individuals in different fields. It is generally used in the systems employing technology such as the Internet, social networks, e-commerce, and hospitals. In recent years, some studies have attempted to determine the technology uses and acceptances of pre-service teachers (Kiraz and Ozdemir, 2006; Ma, Andersson, & Streith, 2005; Teo, 2009). Many variables thought to be influential on technology use have been examined, and PU and PEU have been the two variables that are the most influential on the adaptation of users to a new technology and have been addressed most (Davis, 1989; Szajna, 1996; Venkatesh, 2000). As it is seen in figure 1, BI is directly affected by attitudes towards use. In addition, PU has an indirect effect and a direct effect on BI, and PEU has an indirect effect on BI. PEU and PU have a common effect on attitudes towards use, and PEU has a direct effect on PU.

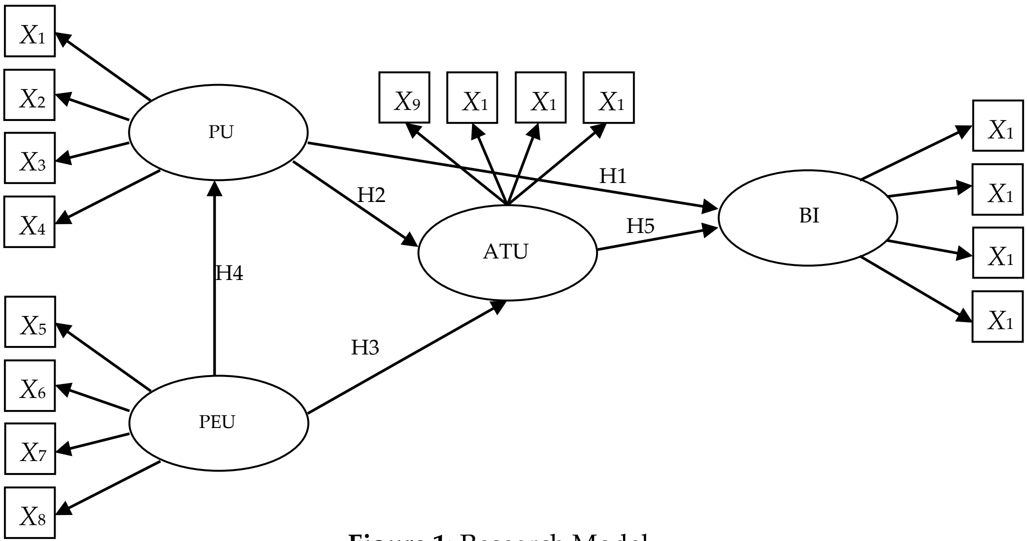

Figure 1: Research Model

Perceived use (PU)

PU is defined as the level of perception of a person regarding the increase in his/her job performance when s/he uses a particular system (Davis, 1989). Davis et al. (1989) stated that the most influential determinant of BI was PU. In other words, if there is a perception that use of a technology will be or will not be useful, such perception will affect BI. Accordingly, the present study tested the below-mentioned hypotheses in regard to the PU.

H1: PU has a significant effect on BI.

H2: PU has a significant effect on ATU.

Perceived ease of use (PEU)

PEU refers to the level of perception of a person regarding the ease of using a particular system (Davis, 1989). PEU is also defined as the effort to be exerted by a user for using the system (Davis, 1989). Davis et al. (1989) argued that the PEU was the second most influential variable in predicting BI, and directly affected PU and ATU, but indirectly affected BI. However, the literature also contains some divergent research findings on this subject, and results vary by institution and the technology used. The present study tested the hypotheses below in regard to the PEU.

H3: PEU has a significant effect on attitude towards computer use.

H4: PEU has a significant effect on PU.

Attitude towards Use (ATU)

According to Fishbein and Ajzen (1975), an attitude is any positive or negative judgment of a person who is to use a particular technology regarding the exhibition of such usage behavior. Ajzen and Fishbein (1980) state that attitudes towards a system affect intentions, which, in turn, affect behaviors regarding the object (i.e. usage). In the light of that, the present study tested the hypothesis presented below.

H5: ATU has a significant effect on BI.

Behavioral Intention (BI)

Ajzen and Fishbein (1980) describe BI as the measure of the probability of a person to display a behavior. Although there is generally no perfect fit between behavioral intention and actual usage, individuals primarily act in accordance with their intentions (Ajzen and Fishbein, 1980). In TAM, actual usage is explained by BI. The present study employed the BI as a dependent variable. Since all the pre-service teachers participating in the study used technology because of their academic and personal needs, most of them were inexperienced in the in-class application of technology. Thus, BI was used instead of actual usage in the present study. In addition, there are many studies showing that there is a relationship between BI and actual usage (Davis et al., 1989; Hu, Clark and Ma, 2003; Kiraz and Özdemir, 2006; Taylor and Todd, 1995). Moreover, the literature contains many studies measuring the BIs of teachers/pre-service teachers and university students to use technology (Becit-İşçitürk, 2012; Hu et al., 2003; Liaw and Huang, 2003; Teo, 2009, Teo et al., 2010; Teo, Ursavaş and Bahçekapılı, 2011; Ursavaş, 2014).

In summary, the present study, through testing the research hypotheses, attempted to reveal the factors influential on pre-service teachers' intentions to use information technologies as well as their levels of accepting such Technologies.

Method

Participants

The research participants were 973 (583 females, 390 males) third and fourth grade pre-service teachers attending the Faculty of Education of Karadeniz Technical University, in Turkey. The distribution of the pre-service teachers by discipline was as follows: 324 (203 females, 121 males) studied at primary school teaching program, 219 (140 females, 79 males) studied at primary school mathematics teaching program, 191 (95 females, 96 males) studied at social studies teaching program, and 239 (145 females, 94 males) studied at science teaching program. The age average of the participants was 21.39 (SD=1.54). 68.2% of the participants had a computer which they could use at home or at school. Among the participants, average time spent on a computer per day was 2.20 hours (SD=0.82).

The participants had been using a computer for 3.91 years in average (SD=0.98). Opportunity sampling was used and the participants were included in the study on a voluntary basis. No payment was made to respondents and no other benefit was conferred. The data were collected in course hours by obtaining permission from relevant instructors. The participants were requested to answer the scale in 10 to 12 minutes. Prior to answering, they were informed of the study and scale items. Furthermore, it was stressed that the responses of the participants would be kept confidential and be used only for the purposes of the present study. All of the students included in the study were in the last two years of their pre-service training periods, and had taken the Basic Information Technology course as per the university regulations for promotion to a higher grade.

Data Collection Tool

A measurement tool composed of two parts was used in the study. While the first part addressed the demographic characteristics of the participants, the second part contained a total of 16 items under four factors included in TAM. Each factor consisted of four items. The items were extracted from a published study Teo, Ursavaş and Bahçekapılı (2011) on each of the four variables in the TAM for this study. The variables (perceived usefulness [PU], perceived ease of use [PEU], attitude towards use [ATU] and behavioural intention to use [BI]) were measured using a 5-point scale, with 1 (strongly disagree) and 5 (strongly agree). The Turkish version of the questionnaire was piloted on 110 Turkish students and the result revealed acceptable reliability for all constructs. The Cronbach alphas were: 0.940 for PU; 0.951 for PEU; 0.899 for ATU, and 0.832 for BI.

Results

The research findings are presented in two sections according to the statistical techniques employed. While the first section involves descriptive statistics and reliability and validity analyses, the second section includes variables included in structural equation modeling created based on the research hypotheses as well as predictions about direct and indirect relationships between variables, the significance levels of such predictions, and model fit results.

Descriptive Statistics

Table 1 shows mean scores pertaining to the constructs included in the research model (PU, PEU, ATU, and BI). The means varied between 3.51 and 4.51. That indicated that all the participants were somewhat agree to the questionnaire items. In all groups, item standard deviation values were below 1.00 excepting a couple of values. In other words, the measures scores of the groups were around the mean score.

Table 1. Mean, Standard Deviation, Skewness, and Kurtosis Coefficients

	All Groups				Primary School T.				Mathematics T.				Social Studies T.				Science T.			
	M	SD	Sk	K	M	SD	Sk	K	M	SD	Sk	K	M	SD	Sk	K	M	SD	Sk	K
PU1	4.17	.91	-1.40	2.04	4.51	.74	-1.89	4.81	3.89	.95	-.87	.79	4.39	1.05	-1.85	2.79	4.20	.85	-1.12	1.49
PU2	4.32	.76	-1.01	.89	4.43	.72	-.105	.40	4.11	.80	-.84	.80	4.43	.78	-1.59	3.17	4.26	.73	-.70	.03
PU3	4.15	.85	-.78	.18	4.16	.85	-.58	-.57	3.85	.90	-.63	.27	4.47	.75	-1.32	1.03	4.16	.79	-.86	1.12
PU4	4.24	.80	-.81	.24	4.25	.81	-.66	-.51	4.02	.83	-.70	.59	4.48	.76	-1.48	1.83	4.24	.74	-.73	.49
PEU1	3.76	.90	-.36	-.08	3.78	.87	-.34	.01	3.67	.83	-.24	.03	3.79	1.04	-.60	-.02	3.81	.88	-.23	-.58
PEU2	3.85	.90	-.62	.42	3.90	.87	-.65	.57	3.75	.81	-.37	.26	3.74	1.00	-.56	.05	3.97	.90	-.82	.83
PEU3	3.65	.98	-.53	.09	3.61	.96	-.35	-.02	3.59	.86	-.42	.11	3.69	1.05	-.52	-.23	3.74	1.04	-.86	.58
PEU4	3.71	.96	-.57	.18	3.70	.95	-.53	.17	3.63	.92	-.44	-.01	3.73	.98	-.50	-.04	3.77	.99	-.82	.68
ATU1	4.06	.89	-.83	.52	4.03	.91	-.67	.07	3.84	.86	-.83	1.02	4.17	.90	-1.12	1.25	4.22	.84	-.94	.52
ATU2	4.20	.84	-.81	.17	4.24	.80	-.49	-1.19	3.95	.83	-.71	.69	4.42	.82	-1.44	1.76	4.19	.85	-.94	.69
ATU3	4.10	.86	-.79	.45	4.16	.82	-.57	-.40	3.76	.89	-.61	.40	4.30	.84	-1.24	1.87	4.17	.76	-.74	.67
ATU4	4.19	.83	-.82	-.69	4.23	.81	-.64	-.64	3.84	.83	-.63	.72	4.42	.81	-1.51	2.14	4.27	.77	-.89	.37
BI1	4.09	.85	-.69	.09	4.11	.85	-.64	-.07	3.77	.83	-.43	.19	4.30	.84	-1.24	1.61	4.19	.80	-.70	-.14
BI2	4.11	.82	-.61	-.09	4.09	.82	-.39	-.64	3.86	.82	-.61	.57	4.34	.80	-1.05	.45	4.18	.77	-.66	-.05
BI3	3.80	.99	-.59	-.06	3.88	.95	-.54	-.14	3.51	1.01	-.37	-.26	3.94	1.07	-.94	.34	3.85	.92	-.57	.15
BI4	4.15	.81	-.80	.56	4.17	.84	-.74	.12	3.81	.83	-.67	.54	4.45	.69	-1.14	1.11	4.20	.71	-.80	1.29

Maximum-likelihood estimation, a parametric technique, was employed in parameter estimations. This technique requires the fulfillment of multivariate normality assumption. In addition, each one of the variables observed for multivariate normality needs to have univariate normality. According to Kline (2005), univariate normality can be assumed if skewness and kurtosis values related to the variable do not exceed ǀ3.0ǀ and ǀ10.0ǀ respectively. In this regard, the values of the variables were calculated, and it was seen that the skewness varied between -1.89 and 0.24 while the kurtosis varied between 0.01 and 4.81 in the present study. These findings indicated that univariate normality could be assumed for all variables. Mardia's normalized multivariate kurtosis coefficient was calculated for multivariate normality test. This coefficient was found to be 137.35, 132.07, 101.96, 93.38, and 113.03

for the groups included in the study (entire sample, primary school teaching, mathematics teaching, social studies teaching, science teaching) respectively. For multivariate normality, the critical value was found to be 288 based on the equation, p(p + 2) advocated by Raykov and Marcoulides (2008). In this equation, p refers to the number of observed variables (scale items), which was 16 in the case of the present study. Multivariate normality can be assumed if the obtained coefficients are below this critical value.

Convergent Validity

Fornell and Larcker (1981) suggested a three-stage method in order to test the convergent validity concerning the responses given to the items of a scale: (1) the reliability of items of each construct, (2) composite reliability of each construct, and (3) the average variance extracted. Firstly, the reliability of an item is determined by its factor loading onto the underlying construct. According to Hair, Black, Babin, and Anderson (2010), a factor loading of above 0.50 is adequate evidence that the item is reliable. In the present study, the factor loadings of the variable varied between 0.66 and 0.91. Thus, it was concluded that convergent validity was adequate at the item level in all constructs. Secondly, the composite reliability of each construct was investigated. Some studies measure it using Cronbach's alpha, but Hair et al. (2006) recommend that the composite reliability should be used for calculating the reliability of each construct in structural equation modeling studies. Nunnally and Berstein (1994) point out that the composite reliability is achieved when the alpha value is 0.70 and over. In the present study, the composite reliability values of the constructs varied between 0.81 and 0.91. Lastly, the average variances extracted were calculated for values related to each construct separately. Convergent validity is judged to be adequate when average variance extracted equals or exceeds 0.50 (Fornell and Larcker, 1981). Otherwise, it is considered that it contains a high level of measurement error (Segars, 1997). In the present study, the average variances extracted varied between 0.53 and 0.76. Table 2 shows that convergent validity is adequate for the constructs of all groups.

Table 2. Convergent Validity

	All Groups (973)			Primary School (324)			Mathematics (219)			Social Studies (191)			Science (239)		
	FL	AVE	CR	FL	AVE	CR	FL	AVE	CR	FL	AVE	CR	FL	AVE	CR
Perceived Usefulness (PU)															
PU1	.69	.59	.85	.69	.60	.85	.66	.58	.84	.70	.61	.86	.66	.53	.81
PU2	.72			.70			.75			.70			.69		
PU3	.83			.84			.83			.85			.75		
PU4	.82			.84			.79			.85			.79		
Perceived Ease of Use (PEU)															
PEU1	.75	.56	.83	.74	.63	.87	.73	.63	.87	.78	.73	.91	.67	.58	.84
PEU2	.52			.74			.82			.84			.74		
PEU3	.84			.83			.80			.89			.81		
PEU4	.83			.84			.81			.89			.81		
Attitudes Towards Use (ATU)															
ATU1	.76	.66	.89	.82	.76	.92	.72	.64	.87	.71	.67	.89	.71	.59	.85
ATU2	.83			.87			.80			.85			.78		
ATU3	.88			.91			.87			.89			.80		
ATU4	.83			.88			.80			.79			.79		
Behavioral Intention (BI)															
BI1	.85	.71	.90	.88	.74	.92	.84	.72	.91	.77	.66	.88	.84	.64	.87
BI2	.85			.87			.84			.84			.83		
BI3	.79			.83			.81			.78			.69		
BI4	.86			.86			.90			.84			.82		

Note: FL is the factor loading of each construct determined through factor analysis; CR, the composite reliability coefficient, was calculated with the formula, $(\Sigma\lambda)^2 / (\Sigma\lambda)^2 + (\Sigma\eta)$; AVE (average variance extracted) was calculated with the formula, $(\Sigma\lambda^2) / (\Sigma\lambda^2) + (\Sigma\eta)$.

Discriminant Validity

Discriminant Validity ascertains the degree to which the constructs included in a model differ or differentiate from one another (Farrell, 2010). Constructs are expected to be different from one another on the one hand, but are expected to be related to one another at a particular level. The discriminant validity is assessed by the comparison of the square root of the average variance extracted from a construct and the correlation coefficient of this construct with other constructs. Table 3 presents correlation and average variance extracted values of the constructs. The parenthesized values on the diagonal are the square root of constructs' variances extracted. Those values which are on the rows and columns outside the diagonal refer to the correlations between the constructs. For adequate discriminant validity, the values on the diagonal need to be higher than their own row and column values (Fornell and Larcker 1981). In the present study, satisfying results were obtained both at item and at construct levels. Thus, it was concluded that the constructs included in the research model had adequate discriminant validity.

Table 3. Discriminant Validity

	All Groups				Primary School				Mathematics				Social Studies				Science			
	PU	PEU	ATU	BI	PU	PEU	ATU	BI	PU	PEU	ATU	BI	PU	PEU	ATU	BI	PU	PEU	ATU	BI
PU	(.77)				(.77)				(.76)				(.78)				(.72)			
PEU	.43*	(.75)			.47*	(.79)			.39*	(.79)			.39*	(.85)			.51*	(.76)		
ATU	.69*	.47*	(.81)		.70*	.56*	(.87)		.66*	.34*	(.80)		.66*	.42*	(.81)		.67*	.52*	(.76)	
BI	.70*	.50*	.79*	(.84)	.68*	.57*	.84*	(.86)	.70*	.44*	.78*	(.84)	.69*	.47*	.72*	(.81)	.65*	.49*	.72*	(.80)

All correlations included in the table are significant at the level of $p<.001$. The parenthesized values on the diagonal are the square root of the average variances extracted. Other values are the coefficients of correlations between constructs.

Test of the Structural Model

The fit of the structural model used in the study was tested via IBM SPSS AMOS 21. The researchers used a variety of fit indices for model fit. Brown (2006) identified three categories of fit: absolute fit, parsimony fit, and comparative fit. The absolute fit indices test the degree to which the proposed model measures the observed data well. The most frequently used fit indices are chi-square and SRMR. χ^2 (chi-square) is sensitive to sample size, and has a tendency to vary significantly as the sample size increases. Hair et al. (2006) stated that the ratio of degree of freedom (df) and χ^2 (χ^2/df) would be a measure for adequacy, and this value being 3 or below 3 would point to acceptable fit. The parsimony fit indices are similar to absolute fit indices except that they take into account the complexity of the model (e.g. RMSEA index). Lastly, the comparative fit indices examine the fit of an alternative model to the basic model in order to assess such alternative model (Harrington, 2009). CFI and TLI are two comparative fit indices. Table 4 demonstrates the results of the structural model for all groups as well as the proposed values.

Table 4. Goodness of Fit Indices Pertaining to the Proposed Model

Fit Indices	Index Threshold Value	Entire Sample	Primary School T.	Mathematics T.	Social Studies T.	Science T.
χ^2	insignificant $p< 0.05$	768.7 insignificant $p< 0.05$	232.5 insignificant $p< 0.05$	196.9 insignificant $p< 0.05$	120.9 insignificant $p< 0.05$	218.2 insignificant $p< 0.05$
χ^2/df	< 3	1.94	2.34	1.99	1.22	2.20
GFI	=>0.90	0.91	0.92	0.90	0.92	0.92
NFI	=>0.90	0.91	0.93	0.89	0.93	0.86
TLI	=>0.90	0.94	0.95	0.93	0.98	0.92
SRMR	<0.05	0.05	0.05	0.05	0.04	0.05
RMSEA	< 0.05 (good fit) > 0.08 (poor fit)	0.03 (0.02-0.03)	0.06 (0.05-0.07)	0.06 (0.05-0.08)	0.03 (0.00-0.05)	0.07 (0.05-0.08)
CFI	=>0.90	0.95	0.95	0.94	0.98	0.90

According to the examination of the results concerning the models created and tested based on groups in the present study, model fit was adequate because all indices except for χ^2 were acceptable. Coefficients were calculated for the model created for the entire sample (χ^2=768.7, p<0.05; χ^2 /df=1.94; TLI=0.94; CFI= 0.95; RMSEA=0.03 (LO90=0.02, HI90=0.03); SRMR=0.05), for the model created for pre-service primary school teachers (χ^2=232.5, p<0.05; χ^2/df=2.34; TLI=0.95; CFI=0.95; RMSEA=0.06 (LO90=0.05, HI90=0.07); SRMR=0.05), for the model created for pre-service mathematics teachers χ^2=196.9, p<0.05; χ^2/df =1.99; TLI=0.93; CFI= 0.94; RMSEA=0.06 (LO90=0.05, HI90=0.08); SRMR= 0.05), for the model created for pre-service social studies teachers (χ^2=120.9, p<0.05; χ^2 /df =1.22; TLI=0.98; CFI=0.94; RMSEA=0.03 (LO90=0.00, HI90=0.05); SRMR=0.04), and for the model created for pre-service science teachers (χ^2=218.2, p<0.05; χ^2 /df=2.20; TLI=0.92; CFI=0.90; RMSEA=0.07 (LO90=0.05, HI90=0.08); SRMR=0.05). In all models, BI was estimated by PEU, PU, and ATU.

Path Results

Figure 2 and Table 5 presents path analysis results. In path analysis, there are two effect types: direct effect and indirect effect. In path diagram, a one-way arrow drawn from one variable to another refers to a direct effect. However, there is an indirect effect if a one-way arrow is drawn from one variable to another from which a one-way arrow is drawn to again another variable. Total effect related to a variable is the sum of direct and indirect effects pertaining to it.

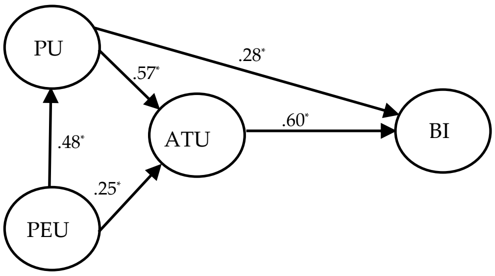

Figure 2a: All Groups

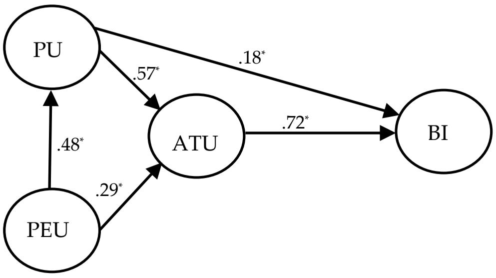

Figure 2b: Primary School

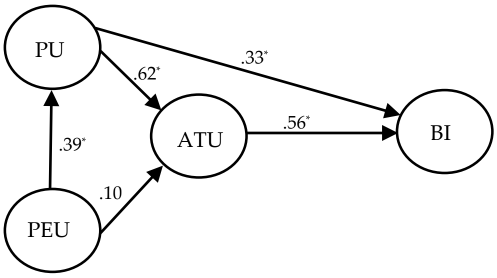

Figure 2c: Mathematics

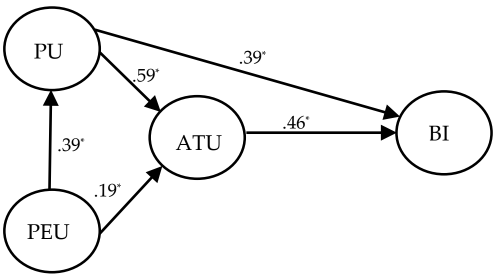

Figure 2d: Social Studies

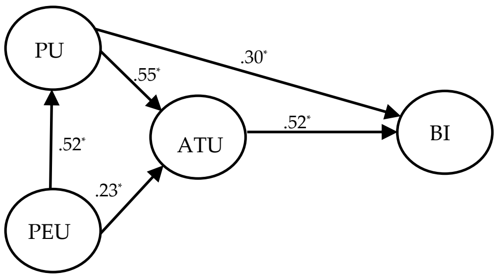

Figure 2e: Science

Figure 2. Path Results

For the entire sample, the most effective factor on behavioral intention was PU (0.648) followed by ATU (0.595) and PEU (0.408). They predicted 68% of BI. On the other hand, ATU was affected by PU (0.604) and PEU (0.473). They explained 52% of ATU.

For the primary school pre-service teachers, the most effective factor on BI was ATU (0.725). It was followed by PU (0.588) and PEU (0.492). They predicted 73% of BI. On the other hand, ATU was affected by PU (0.568) and PEU (0.564). They explained 56% of ATU.

For the mathematics pre-service teachers, the most effective factor on BI was PU (0.683). It was followed by ATU (0.560) and PEU (0.356). They predicted 67% of BI. On the other hand, ATU was affected by PU (0.622) and PEU (0.348). They explained 44% of ATU.

For the social studies pre-service teachers, the most effective factor on BI was PU (0.664). It was followed by ATU (0.464) and PEU (0.350). They predicted 60% of BI. On the other hand, ATU was affected by PU (0.593) and PEU (0.425). They explained 47% of ATU.

For the science teachers, the most effective factor on BI was PU (0.588). It was followed by ATU (0.519) and PEU (0.426). They predicted 57% of BI. On the other hand, ATU was affected by PU (0.554) and PEU (0.521). They explained 49% of ATU.

Table 5. Direct, Indirect and Total Effects

	Predicted	Predictor	Standardized Predictions		
			Direct	Indirect	Total
Entire Sample	Behavioral Intention (R^2 = 0.676)	PU	.288	.360	.648
		PEU	---	.408	.408
		ATU	.595	---	.595
	Attitude towards use(R^2 = 0.519)	PU	.604	---	.604
		PEU	.209	.264	.473
	Perceived usefulness(R^2 = 0.192)	PEU	.438	---	.438
Primary School	Behavioral Intention (R^2 = 0.737)	PU	.176	.412	.588
		PEU	---	.492	.492
		ATU	.725	---	.725
	Attitude towards use(R^2 = 0.567)	PU	.568	---	.568
		PEU	.293	.271	.564
	Perceived usefulness(R^2 = 0.227)	PEU	.477	---	.477
Mathematics	Behavioral Intention (R^2 = 0.674)	PU	.335	.348	.683
		PEU	---	.326	.326
		ATU	.560	-	.560
	Attitude towards use(R^2 = 0.448)	PU	.622	---	.622
		PEU	.104	.244	.348
	Perceived usefulness(R^2 = 0.153)	PEU	.392	---	.392
Social Studies	Behavioral Intention (R^2 = 0.608)	PU	.389	.275	.664
		PEU	---	.350	.350
		ATU	.464	---	.464
	Attitude towards use(R^2 = 0.477)	PU	.593	---	.593
		PEU	.191	.234	.425
	Perceived usefulness(R^2 = 0.155)	PEU	.394	---	.394
Science	Behavioral Intention (R^2 = 0.571)	PU	.301	.287	.588
		PEU	---	.426	.426
		ATU	.519	---	.519
	Attitude towards use(R^2 = 0.496)	PU	.554	---	.554
		PEU	.235	.286	.521
	Perceived usefulness(R^2 = 0.266)	PEU	.516	---	.516

Discussion, Conclusion and Suggestions

This study aimed at examining the BIs of third and fourth grade students receiving teacher training to use ICT, and examining the validity of the TAM. The results showed that the TAM was a valid and reliable model. PU and ATU had a direct effect on BI, and PU and PEU had an indirect effect on BI.

The model explained the variance in BI to use technology among the pre-service teachers by the following percentages: 67.6% for the entire sample; 73.7% for pre-service primary school teachers; 67.4% for pre-service mathematics teachers; 60.8% for pre-service social studies teachers; and 57.1% for pre-service science teachers. That may have resulted from the variation in the attitudes and expectations of the pre-service teachers receiving teaching training in different branches concerning technology use. On the other hand, all ratios (regarding the explanation of BI) were higher than the ratios reported in similar studies (Legris, Ingham and Collerette, 2003; Silvo and Pan, 2005; Teo, 2009; 2010; 2011), and thus engender confidence in the findings.

PU had significantly direct positive effect on BI. This finding indicates that technology use helps individuals in their work, and thus increases their BI. In addition, PU was found to have an indirect effect on BI through ATU. PU explained most of the variance in BI in all branches except for primary school teaching. Davis et al. (1989) reported that PU was the most important factor for determining BI. However, in the present study, PU ranked second in terms of total effect on BI among the pre-service primary school teachers. That implies that the BIs of pre-service primary school teachers are determined by some other factors which are more influential on such intentions of theirs in comparison to the benefit brought by ICT to their sphere of employment. Similar studies also detected positive and significant effects of PU on BI (Liaw, 2002; Ma, Andersson and Streith, 2005; Turan and Çolakoğlu, 2008; Teo, 2011; Teo, Luan and Sing, 2008; Teo and Schaik, 2009; Teo, 2009; El-Gayar, Moran, and Hawkes, 2011; Terzis and Economides, 2011; Teo, Ursavaş and Bahçekapılı, 2011; Teo and Ursavaş, 2012; Escobar-Rodriguez and Pedro Monge-Lozano, 2012; Teo, Ursavaş and Bahçekapılı, 2012; Ursavaş, 2013). If pre-service teachers conclude that ICT helps them in the activities conducted during pre-service training, such perception may be influential on them adapting technology advantageously in future teaching practice.

The effects of PEU on PU has frequently been the focus of examination in TAM studies, and this is because these two variables are the principal factors of the model. PU is significantly affected by PEU. From the perspective of technology use, when the effort needed for using or learning to use a technology is minimal, it is perceived that the technology is easy to use (Ursavaş,2014). It is more evident in the case of pre-service science teachers that the PU was predicted by the PEU.

The PU was found to be the most important factor influential on ATU. It explained the variance in attitude among the pre-service primary school teachers most. They were followed by pre-service science, social studies, and mathematics teachers. The factor having the highest influence on the BI was attitude among the pre-service primary school teachers. That implies that many technologies may be used in classroom for pre-service primary school teachers, and that ATU of such technologies, rather than their usefulness, is more influential on BI.

The examination of indirect and direct effects on the BI showed that ATU was the most important factor influential on intention, and it was followed by PU and PEU respectively. Another remarkable result of the study was that the indirect effect (through attitude) of the PU on the BI of the pre-service primary school teachers and mathematics teachers was higher than its direct effect on them. Thus, it can be safely concluded that creating positive attitudes towards technology use among pre-service teachers is important, and attitude may have a non-ignorable effect on the use of such technologies in the future.

Another research result was that while the effect of the PEU on ATU was insignificant among the pre-service mathematics teachers, the effect of the PU on ATU among them was higher and significant in comparison to other pre-service teacher groups. That means that the pre-service mathematics teachers thought that technology use would facilitate their job performance enhancement, thereby leading to a positive attitude, without concluding that technology use was easy.

The findings showed that the PU was a key variable in determining ATU. These findings were in parallel with those of similar studies (Huang and Liaw, 2005; Leigris et al. 2003; Teo, 2008; Teo et al., 2009). Similarly, Swain (2006) pointed out that when pre-service teachers were asked, they could list many benefits of computer use.

The present study also demonstrated that ATU was the second factor having a positive effect on BI (except for the pre-service primary school teachers). Other researchers (Luan et al., 2005; Teo et al., 2010; Teo et al., 2012) found out that attitude was a direct determinant of BI. The development of positive attitudes among pre-service teachers during their computer usage may imply that they will use such technologies in their future professional lives. On the other hand, Davis et al. (1989) discussed that PU and PEU of a technology would be enough for an individual to engage with it, without the individual developing a positive ATU.

Today, ICTs improve continuously. It is not likely that the intentions, attitudes, and beliefs of individuals remain the same in view of such improvements in technologies. It is inevitable that teachers/pre-service teachers update their technical and pedagogical knowledge for their professional improvement in view of such accelerated progress in technologies. From the perspective of pre-service teachers, the integration of today's technologies into current teacher training curriculum may bring great benefits to teachers during their professional lives. Otherwise, they may have various difficulties in conveying the content included in curricula even by means of traditional ways and tools. With reference to these trends in education, it is evident that faculties that train teachers should have both adequate technological infrastructure in place, and should provide encouragement, support and training for pre-service teachers to develop both confidence and competence in technology use. In this way, a positive contribution may be made to the improvement of attitudes and beliefs of teachers regarding technology use in their teaching lives.

The present study had some limitations. Firstly, the study was conducted with pre-service teachers, but the current situation of pre-service teachers may be different from the situation they will be in when working as a teacher in the future (Teo, 2009). Pre-service teachers may have some difficulties in handling ICT in a real school environment and adapting it to their lessons. Pre-service teachers now use ICT for learning purposes, but teachers use it in in-class activities and in professional practice. Thus, pre-service teachers are under less pressure and stress in comparison to teachers. Secondly, some technologies used by pre-service teachers while receiving education (digital camera, smart board, etc.) may not be available or may be different in the schools where they will work in the future. Thirdly, the results may contain common method variance (CMV) errors because the research data reflected only the self-evaluations of the pre-service teachers and were collected through a tool which the pre-service teachers were used to and might have had a tendency to fill in by memory repetition. CMV refers to the variance of a measured factor due to measurement method rather than its actual structure (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). Fourthly, the BI, which was the dependent variable of the present study, could be explained in the present study by three variables in the following percentages: 67.6% for the entire sample; 73.7% for the pre-service primary school teachers; 67.4% for the pre-service mathematics teachers; 60.8% for the pre-service social studies teachers, and 57.1% for the pre-service science teachers. However, there is still a non-explained part of BI for each model. This problem may be overcome by including different significant variables in the model. For example, Park (2009), Teo (2009), and Teo, Ursavas, Bahçekapılı (2012) determined that the variables of self-efficacy and technological chaos had a significant effect on BI. In addition, as seen in some studies (Paraskeva et al., 2008; Saade and Kiraz, 2007), variables such as self-esteem and anxiety can be included in the model. Eventually, the present study determined the BIs of the pre-service teachers to use technology rather than their actual usage. Although previous studies (Davis et al., 1989; Hu, Clark and Ma, 2003; Kiraz and Özdemir, 2006) argue that there is a relationship between BI and actual usage, the determination of the actual usage of a system would be more appropriate. The results demonstrated that the data collected via the proposed research model had a good fit. All the hypotheses (except for H3 for Mathematics) tested in the study were accepted. The model should be tested through different samples in future studies. Moreover, the model may be examined in terms of personal characteristics (sex, computer use experience, etc.) and the type of technology used (laptop, tablet, etc.). From a different point of view, a similar study should be conducted with teachers who work currently, as mentioned during the discussion of the limitations of the study. Finally, in consideration of the emphasis put on technology use in education across the world, it can be said that international and cross-cultural research should be conducted in order to determine and compare the behavioral intentions of pre-service teachers/in-service teachers concerning ICT.

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