

Chapter XXV

**EXAMINING THE DIGITAL COMPETENCIES
OF PRE-SERVICE TEACHERS¹**

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Abstract: This study aims to examine the variables that may influence pre-service teachers' digital competencies at the Faculty of Education in Jagodina. If pre-service teachers are expected to integrate information and communication technology (ICT) into future teaching processes, they need to possess a high level of adequate competencies. In this study, digital competencies were identified as: (a) competencies to support pupils for ICT use in the class and (b) competencies to use ICT for instructional design. Four variables (support from teacher training institution (TTI), perceived usefulness, perceived ease of use and attitudes towards ICT use) were hypothesized to have direct and positive influences on digital competencies. This study also investigated whether support from TTI, perceived ease of use, perceived usefulness and digital competencies had any effect on the pre-service teachers' intention to use technology in their future teaching practice. Moreover, the development of pre-service teachers' digital competencies while studying at the Faculty (i.e. differences between freshmen, juniors and master students) were examined. With data gathered from 131 participants, using a survey questionnaire, linear regression analysis revealed positive effects of the strategies, perceived usefulness, attitudes, and perceived ease of use on pre-service teachers' digital competencies. Furthermore, the results revealed a positive impact of pre-service teachers' perceived usefulness, perceived ease of use and digital competencies in their intention to use digital technology in future teaching. On the other hand, the strategies do not affect intention to use ICT. Various contributions to research and implications for teacher training are discussed.

Keywords: *digital competencies, intention to use technology, linear regression, pre-service teachers, teacher training.*

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Introduction

With the rapid development of technology in recent decades, digital competence is increasingly becoming a competence of key importance for all employees and citizens and has been acknowledged as one of the eight key competencies for lifelong learning by the European Union (Ferrari 2012; 2013). Digital competence can be broadly defined as the confident, critical and creative use of ICT to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society (Ferrari 2012; Janssen et al. 2013).

From the long term aspect, basic digital competencies are generated in the educational system, and students' level of digital competencies depends on the level of digital competencies of teachers. Therefore, teachers are expected to have an adequate level of digital competencies, especially to be familiar with modern concepts, methods and tools in the fields they teach in (*Digital Competence Framework – Teacher for a Digital Age* 2017). However, research indicates that teachers' scarcely use ICT for teaching and learning, or constrainedly to low-level purposes (Davies, Pittard 2008; Teo, Milutinović, Zhou, Banković 2017; Wastiau et al. 2013).

It has been widely recognized that pre-service teachers should be prepared to adequately integrate ICT into their educational practice. A number of studies have addressed the evolving, critical importance of integrating digital technology into pre-service teacher education programs (Angeli, Valanides 2009; Tondeur, Aesaert, Prestridge, Consuegra 2018). Teacher training institutions (TTI) are thus expected to provide pre-service teachers with the necessary competencies to integrate technology in their classrooms (Tondeur, Aesaert, Pynoo, van Braak, Fraeyman, Erstad 2017).

The Faculty of Education in Jagodina is one of the five TTI in Serbia that educates future primary school teachers. In order to prepare future teachers to achieve educational goals, all TTIs in Serbia are required to offer at least one compulsory course for pre-service teachers to acquire necessary basic skills in ICT and the other course for educational technology. However, after continuous efforts to integrate ICT into pre-service teachers' education in Serbia, there is still a gap in the literature about its effectiveness on pre-service teachers' level of digital competencies or their intention to use ICT in future teaching practice.

This study will focus on determining the level of pre-service teachers' digital competencies at the Faculty of Education in Jagodina and a set of factors that could contribute to their development as well as intentions to use ICT in teaching. A key reason for studying this is to better predict future ICT use in teaching (Venkatesh, Morris, Davis, Davis 2003). Furthermore, the process of gaining digital competencies and intention to use ICT in teaching practice throughout the training years of pre-service teachers are examined.

By doing so, we intend to gain insight into the level and progress of development of pre-service teachers' digital competencies and intention to use ICT in educational practice in order to give recommendations for their improvement at TTIs in Serbia.

Literature Review

Pre-service teachers' digital competencies

Different frameworks aim to define various ICT competency skills for (pre-service) teachers in order to enable them to integrate technologies into their teaching and learning process. Some of them are: *UNESCO ICT Competency Framework for Teachers* (2011), *International Society for Technology in Education (ISTE) standards* (2008), *Becta's review of Digital Literacy* (Newman 2008). Serbian Ministry of Education, Science and Technological Development published a *Digital Competence Framework – Teacher for a Digital Age* (2017) in accordance with the *Strategy for the Development of Education in Serbia by 2020*, recognizing the importance and role of new technologies in improving the educational system.

In all these ICT frameworks, different terms are used, such as digital competencies, digital literacy, ICT literacy, ICT competencies, computer literacy, media literacy (Ala-Mutka 2011; Ferrari 2012; Wastiau et al. 2013). These concepts may have different meanings in diverse academic, cultural, historical, social, and educational contexts (Krumsvik 2011). Moreover, it is not recommended to focus on simply specific technological skills, as these may vary according to the hardware and software that is used (Tondeur, van Braak, Valcke 2007). More generic competencies should be fostered, involving different ways of using technology for teaching and learning across technologies and subject domains (Tondeur et al. 2017). For the purpose of this study we accepted concept of digital competencies, developed by Tondeur et al. (2017), as competencies necessary to support pupils for ICT use in class and competencies to use ICT for instructional design. More specifically, they distinguished two types of ICT competencies: (1) the ability to use ICT for facilitating student learning competencies in using ICT (ICTC-PU) and (2) the ability to manage ICT for their own teaching purposes (ICTC-ID).

Factors affecting digital competencies

The importance of ensuring that students coming out of teacher education programs demonstrate competencies in Technological Pedagogical Content Knowledge (TPCK) has been noted by many researchers (Almerich, Orellana,

Suárez-Rodríguez, Díaz-García 2016; Angeli, Valanides 2009; Teo et al. 2017; Tondeur et al. 2018).

Past studies into ICT competencies have emphasized that teachers' attitudes towards ICT play a key role in their development (Tondeur et al. 2018). Venkatesh et al. (2003) defined attitudes towards using technology as an individuals' overall affective reaction to using a system. Tondeur and associates (Tondeur, Siddiq, Scherer, Van Braak 2016) argued that ICT competencies can be strongly affected by specific attitudes, such as "attitudes toward ICT in education" and "usefulness". According to Davis et al. (1989), perceived usefulness is defined as the degree to which a person believes that using a technology will enhance his or her job performance, and perceived ease of use refers to the degree to which a person believes that the use of a technology will be free of effort.

Additionally, Tondeur et al. (2018) investigated the impact of pre-service teachers' background (age and gender) and ICT characteristics (e.g., attitudes towards ICT, perceived ease of use) in combination with the support they receive from their TTI on their ICT competencies. They found positive association between the strategies and pre-service teachers' ICT competencies, as well as the positive impact of pre-service teachers' attitudes towards ICT and ease of use on their ICT competencies for educational practice. Furthermore, the results revealed that gender and age did not affect pre-service teachers' ICT competencies for educational practice. Other studies (Franklin 2007; Røkenes, Krumsvik 2014; Wozney, Venkatesh, Abrami 2006) argued that ICT related training programs and strategies develop teachers' competencies in computer use.

For this reason, in the current study, factors such as attitudes, perceived usefulness, perceived ease of use and strategies were considered to affect pre-service teachers' digital competencies.

Pre-service teachers' intention to use digital technology in teaching practice

Various models and theories have been proposed to examine the key determinants that influence pre-service teachers' intention to use technology (Milutinović 2016a; 2016b; Teo, Milutinović 2015; Teo et al. 2017), such as the theory of planned behaviour (Ajzen 1991) or unified theory of acceptance and use of technology (Venkatesh et al. 2003). Behavioural intention is indicated by the degree of one's willingness to use technology.

There are numerous factors that could influence pre-service teachers' intention to use ICT in teaching such as, on a personal level, feelings, knowledge and attitudes or, on the school level, support, funding, training and facilities (Kreijns, Vermeulen, Kirschner, Buuren, Acker 2013).

Teo et al. (2017) found that the most dominant determinant of behavioural intention to use technology in teaching mathematics in Serbia was pre-service teachers' TPACK competencies, followed by their attitude towards computer use. As discussed in different studies (Bordbar 2010; Buabeng-Andoh 2012; Kreijns, Van Acker, Vermeulen, Van Buuren 2013; Peralta, Costa 2007), teachers' computer competence could be one of the major predictors for integrating technology in instructional activities.

Teachers' professional development is found to be among the key factors to successful integration of ICT into teaching practice (Franklin 2007; Wozney et al. 2006). Sandholtz and Reilly (2004) argued that teachers' technology skills are strong predictors of ICT integration, but they stated that training programs should concentrate on ICT pedagogical training, in order to help teachers accept technologies in teaching and learning.

Research has shown that teachers' attitudes towards technology influence their acceptance and its integration into teaching (Kreijns et al. 2013; Teo, Milutinović 2015; Wong 2015). Milutinović (2016a; 2016b) found that pre-service teachers' intention to use computers in teaching in Serbia is directly and dominantly predicted with their perceived usefulness and perceived ease of use.

Taking reference from the above-mentioned works, this study will explore if factors such as digital competencies, strategies, attitudes, perceived usefulness, and perceived ease of use were considered to affect pre-service teachers' intention to use digital technology in the classroom.

The development of pre-service teachers' digital competencies throughout the training years

Pajares argued that teachers form beliefs about teaching throughout all schooling experience as a student and make decisions regarding 'good' and 'bad' teachers (Pajares, 1992). Early perceptions may raise some difficulties, as once a belief has been held for a long time, it could become extremely difficult to change it (Hoy, Spero 2005). This is the reason why it is important to study pre-service teachers' development of beliefs about ICT integration in education and creation of a firm foundation for their future teaching since they will have an influence on their students.

Woodcock (2011) argued that teachers' judgments in their ability to motivate students and promote learning can play a vital role in determining a student's performance in the classroom. On the other hand, he showed that the training courses for primary school teachers appeared to have no influence on teacher efficacy levels.

It has been claimed that a new generation of students – named Millennials, NetGen, Generation Y, Homo Zappiens, or Digital Natives – is entering

institutions of higher education. This generation, who have grown up with ICT, is argued to have sophisticated technology skills and a whole new set of cognitive capacities (Prensky 2001) and most educational systems are not prepared to accommodate the needs of the new generation of learners. It is reasonable to believe that pre-service teachers in Serbia, as a developing country, did not have the opportunity to create early perceptions concerning the use of ICT in education prior to the training to become a teacher.

For this reason, in this study we examined to what extent pre-service teachers' level of digital competencies and intention to use ICT in educational practice is changing during their teacher training years.

Research method

Aims of the research

The main objective of this study was to examine the variables that have significant influence on digital competencies (DIGCOMP) and the intention (BI) to use digital technology in teaching in elementary schools (i.e., behavioral intention) among pre-service teachers in Serbia. Taking into account the results of numerous studies, we have extracted the key predictors: support (SQD) pre-service teachers receive from their TTI, their perceived usefulness (PU), perceived ease of use (PEU) and attitudes towards ICT use (ATU). This study could serve to inform teacher education instructors and administrators on the variables that directly impact on pre-service teachers' intention to use technology in their future jobs. Being guided by the findings of this study, pre-service teachers could be led to strengthen their digital competencies and the intention to use technology in their capacity as future teachers.

Specifically, this study attempts to answer the following research questions:

1. To what extent do PU, PEU, ATU and SQD influence pre-service teachers' DIGCOMP?
2. To what extent do PU, PEU, ATU, SQD and DIGCOMP influence pre-service teachers' BI?
3. Are there significant differences in the level of digital competencies and intentions to use technology between freshmen, juniors and master students

Context and sample

Participants in this study were 131 pre-service teachers from the University of Kragujevac, Faculty of Education in Jagodina, Serbia. Of these, there were 116 female (88.5%) participants, a representative gender distribution of

the pre-service teachers in Jagodina. The average age was 21.4 years old ($SD = 3.56$). Among the participants, 52 (39.7%) were at the beginning of their study (freshman), 44 (33.6%) in the third year of their study (juniors), and the others were master students.

On average, each participant took about 10 minutes to complete the questionnaire. No course credits or rewards were given to the participants, and participation was voluntary.

Instruments

A survey questionnaire was employed in this study. In addition to the questions on demographics (age, gender, study year), items were compiled to assess participants' responses in order to measure the variables in the research model. These are perceived usefulness, a four-item scale (Cronbach's $\alpha = 0.90$), perceived ease of use, a five-item scale, (Cronbach's $\alpha = 0.88$), attitude towards ICT in education, a four-item scale (Cronbach's $\alpha = 0.85$), and behavioral intention to use ICT in education, a three-item scale (Cronbach's $\alpha = 0.87$). Each item was measured on a 5-point Likert scale with 1 = strongly disagree and 5 = strongly agree. Items were adapted from various published sources (see Appendix) and translated into the Serbian language.

The SQD-scale developed by Tondeur and associates (Tondeur et al. 2016) is a uni-dimensional scale including six effective strategies for the content and delivery methods to prepare pre-service teachers for technology use (1) using teacher educators as role models, (2) reflecting on the role of technology in education, (3) learning how to use technology by design, (4) collaboration with peers, (5) scaffolding authentic technology experiences, and (6) providing continuous feedback (24 items, Cronbach's $\alpha=0.96$). Respondents were asked to rate each statement on a six-point Likert scale, anchored between (1) strongly disagree and (6) strongly agree.

The DIGCOMP scale is an instrument to measure pre-service teachers' ICT competencies developed by Tondeur and associates (Tondeur et al. 2017). It consists of two factors: ICT Competence Pupil Use (ICTC-PU), the ability to use ICT for facilitating student learning competencies in using ICT, and ICT competence Instructional Design (ICTC-ID), the ability to manage ICT for their own teaching purposes (19 items, Cronbach's $\alpha=0.95$). The 11 items on ICTC-PU were designed to measure the extent to which pre-service teachers are competent to educate pupils in the use of ICT for learning processes. The eight items on instructional design (ICTC-ID) measure the degree to which pre-service teachers are competent to use ICT to support and strengthen their instructional practice. Respondents were asked to rate each statement on a five-point Likert scale, anchored between (0) strongly disagrees and (5) strongly agree.

Data Analyses

The data was analyzed using the multiple regression analysis conducted with SPSS Statistics 17.0. The analysis involves testing for data normality, linearity, homoscedasticity, and multicollinearity as well as research models representing the relationships between the variables in this study. In order to obtain reliable results in regression analysis, researchers recommend about 15 subjects per predictor (Stevens 2012). Given that the sample size of this study is 131, multiple regression is regarded as an appropriate technique for data analysis.

Furthermore, univariate ANOVA tests were conducted to explore differences in digital competencies and intention to use technology with participants' background variable (grade).

Results

Descriptive analysis

Using SPSS software, we determined descriptive statistics of items. Aiming to facilitate evaluation of the intention of pre-service teachers towards ICT use and their ICT competencies, we present below the descriptive analysis, organized by constructs. For all of the constructs in the questionnaire we calculated the means, standard deviations, skewness, kurtosis and Cronbach α , which are given in Table 1. As we can see in Table 1, the scores obtained show the students' inclination towards the use of ICT in their future educational practice and all other measured items, with mean scores above 4, out of a maximum of 5 except for the SQD where maximum is 6, in all of the items indicating positive responses to the constructs. The standard deviations ranged from 0.59 to 0.91, reflecting a fairly narrow spread in participants' responses around the mean. The skewness and kurtosis indices indicated a degree of normality that was acceptable for the purposes of this study because, as a rule of thumb, data may be assumed to be normal if the skew and kurtosis are well within the accepted level of $|3|$ and $|10|$, respectively (Kline 2011). The internal consistency is judged to be adequate when Cronbach's alpha equals or exceeds 0.7 (De Vellis 2003). The internal consistency (Cronbach's alpha) of all constructs range from 0.85 to 0.96.

Table 1: Descriptive statistics of the constructs and composite reliability

Variable	Mean	Std. Deviation	Skewness	Kurtosis	Cronbach's Alpha (a)
SQD	4.47	0.91	-0.168	-0.628	0.96
DIGCOMP	4.18	0.60	-0.533	-.0504	0.95
PEU	4.24	0.61	-0.420	-0.466	0.88
PU	4.42	0.66	-0.894	-0.213	0.90
ATU	4.43	0.59	-0.932	0.465	0.85
BI	4.36	0.71	-0.862	-0.280	0.87

Note. SQD = strategies for the content and delivery methods; PU = perceived usefulness; PEU = perceived ease of use; ATU = attitude toward ICT use; DIGCOMP = digital competencies; BI = behavioural intention.

Correlation and multiple regression analyses were conducted to examine the relationship between variables. One-Way ANOVA was conducted to find the differences among freshmen, juniors and master students.

Preliminary analysis has shown that the assumptions of normality, linearity, homoscedasticity, and absence of multicollinearity were not disturbed.

 Table 2: Correlation coefficients among the constructs; ** $p < .01$

	BI	PEU	DIGCOMP	ATU	PU
PEU	0.603**				
DIGCOMP	0.596**	0.665**			
ATU	0.746**	0.707**	0.683**		
PU	0.579**	0.621**	0.688**	0.673**	
SQD	0.416**	0.478**	0.588**	0.462**	0.431**

We can see from Table 2 that all four variables (SQD, PU, ATU and PEU) are correlated with the DIGCOMP and correlations are positive.

Multiple regression analysis was used to test if strategies, perceived usefulness, attitudes and perceived ease of use significantly predicted pre-service teachers' ratings of digital competencies. The results of the regression indicated the four predictors explained 64.4% of the variance ($R^2 = 0.644$, $F(4,126) = 56.87$, $p < 0.001$). It was found that perceived usefulness predicted digital competencies ($\beta = 0.307$, $p < .001$), as did strategies ($\beta = 0.262$, $p < 0.001$), attitudes ($\beta = 0.216$, $p < 0.05$), and perceived ease of use ($\beta = 0.197$, $p < 0.05$).

As can be seen in Table 2, all five variables (DIGCOMP, SQD, PU, ATU and PEU) are correlated with the BIT and correlations are positive. However, the correlation coefficient among ATU and BIT is higher than recommended 0.7, hence we omitted ATU from the regression equation.

Second multiple regression analysis was used to test if strategies, perceived usefulness, perceived ease of use and digital competencies significantly predicted pre-service teachers' intention to use digital technology in the classroom.

The multiple regression model with all four predictors produced $R^2 = 0.459$, $F(4,126) = 26.71$, $p < .001$, indicating that four predictors explained 45.9% of the variance. Predictors perceived usefulness ($\beta = 0.213$, $p < 0.05$), perceived ease of use ($\beta = 0.31$, $p < 0.01$) and digital competencies ($\beta = 0.217$, $p < 0.05$) had significant positive regression weights, indicating students with higher scores on these scales were expected to have higher intentions to use digital technologies in the classroom. The strategies scale did not contribute to the multiple regression model.

*Table 3: Means and standard deviations for freshmen, juniors and master students and multiple comparisons among the groups (ANOVA); * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$*

Dependent Variable	(I) category	N	Mean (M)	Std. Deviation (SD)	(J) category	Mean Difference (I-J)	Sig.
BI	Freshmen	52	4.13	0.76	Juniors	-0.26	0.155
	Juniors	44	4.39	0.67	Master students	-0.25	0.231
	Master students	35	4.65	0.55	Freshmen	0.51**	0.002
	Total	131	4.36	0.71			
DIGCOMP	Freshmen	52	3.94	0.6	Juniors	-0.26	0.056
	Juniors	44	4.20	0.57	Master students	-0.32*	0.033
	Master students	35	4.52	0.45	Freshmen	0.58***	0.000
	Total	131	4.18	0.6			

The differences in digital competencies and intention to use technology among freshmen, juniors and master students are given in Table 3. Prior to conducting the ANOVA, homogeneity of variances was tested. Levene's test revealed that the equal variances assumption of the ANOVA was met ($p < 0.05$). The main effect of year in college was found to be significant for digital competencies $F(2,128) = 11.56$, $p < 0.001$, and behavioral intention $F(2,128) = 6.02$, $p < 0.01$.

Master students ($M = 4.52$, $SD = 0.75$) reported significantly higher levels of digital competencies than did freshmen ($M = 3.94$, $SD = 0.6$) and juniors ($M = 4.2$, $SD = 0.57$). First-year and third-year students did not significantly differ on the reported level of digital competencies and behavioral intention (see Table 3 for means and standard deviations). For behavioral intention, only master students ($M = 4.65$, $SD = 0.55$) reported significantly higher intentions to use digital technology in education than freshmen ($M = 4.13$, $SD = 0.76$). The results did not show significant differences in intention between freshmen and juniors and juniors and master students.

We calculated Partial eta-squared (η^2) in order to measure effect size. As a rule of thumb (Cohen 2013), the effect may be assumed to be small if $\eta^2 \sim 0.01$, medium if $\eta^2 \sim 0.06$, and large if $\eta^2 > 0.14$. For digital competencies eta-squared is 0.15, indicating a large difference between groups. Eta-squared for intention to use ICT in education is 0.9 indicating medium effect size.

Discussion

The aim of this study was to examine the variables that have a significant influence on digital competencies and the intention to use digital technology in elementary school teaching among pre-service teachers in Serbia.

To answer the first research question, regression analysis was conducted, and the results of this study suggest that perceived usefulness, perceived ease of use, attitudes and strategies have a significant direct impact on the level of digital competencies of pre-service teachers. Among these four predictors, the most influential was found to be perceived usefulness followed by strategies, attitudes, and the least influential perceived ease of use. This means that when pre-service teachers find technology useful, they are more positive towards the development of their digital competencies. This was in line with past findings that perceived usefulness significantly predict ICT competencies (Jegede, Dibbu-Ojerinde, Ilori 2007). In addition, the more pre-service teachers perceive the occurrences of the strategies during their teacher education, develop positive feelings towards the use of digital technology, and find technology easy to use, the higher their perceived digital competencies for educational practice. This finding is consistent with a recent study that examined the impact of

pre-service teachers' background and ICT profile in combination with the support they receive from their teacher training institution on their ICT competencies (Tondeur, Aesaert, Prestridge, Consuegra 2018). Jegede et al. (2007: 172) suggested in their study that "findings revealed that attitude bears a significant relationship with and also predicts competence".

Furthermore, for the second research question, the results of this study suggest that digital competencies, together with perceived usefulness, and perceived ease of use, are significant factors that influence pre-service teachers' intention to use digital technology for teaching in the first four grades of elementary school in Serbia. Attitudes were excluded from the regression equation because of the high correlation with behavioral intention. On the other hand, past studies have emphasized that both perceived usefulness and perceived ease of use (Teo et al., 2009a) play a big part in forming the attitudes towards technology (Teo, Milutinović 2015; Teo, Milutinović, Zhou 2016; Wong 2015).

The most dominant determinant of behavioral intention was perceived ease of use, followed by digital competencies and perceived usefulness. These findings are consistent with studies that examined the influence of perceived ease of use and perceived usefulness on intention to use computer among pre-service teachers in Serbia (Milutinović 2016a; 2016b).

The positive influence of digital competencies on intention is consistent with findings of Peralta and Costa (2007) and Buabeng-Andoh (2012) who found that technical competencies influenced teacher's use of technology in teaching. Bordbar (2010) discussed that teachers' computer competence is a major predictor for integrating technology in teaching.

On the other hand, strategies did not affect pre-service teachers' intention to use digital technology in educational practice. The lack of significant influence found for strategies on behavioral intention to use technology in this study was not aligned with research (Franklin 2007; Wozney et al. 2006). It is possible that strategies alone are not a sufficiently strong driver for pre-service teachers to use technology to teach and that the nature of primary school teaching with technology is perceived to be relatively complex so that other variables such as perceived ease of use and perceived usefulness have to be present to have a significant influence on their behavioral intention to use technology.

For the third research question in this study, ANOVA results for the paired samples and effect size indicated that, on average, master students hold stronger digital competencies and intention to use digital technology as compared to freshmen students. There were no significant difference between freshmen and juniors. On the other hand, master students' digital competencies were significantly higher than juniors'.

These results indicate that the study year does influence digital competencies and intentions. This result is not consistent with findings of Woodcock (2011) who showed that training courses for primary school teachers appeared to have no influence on teacher efficacy levels. On the other hand, this result is consistent with findings of Sang and associates (Sang, Valcke, Tondeur, Zhu, Van Braak 2012) who showed significant differences in constructivist teaching beliefs with respect to study year. Students in Serbia probably did not have the opportunity to form and hold for a long time their beliefs about the use of digital technology throughout all schooling experience. This may be due to teachers being “digital immigrants” (Prensky 2001) as well as poor technological equipment of primary and secondary schools in Serbia. Because of that, pre-service teachers’ digital competencies, beliefs and attitudes towards digital technology usage can be significantly changed with good learning strategies during their teacher training courses.

Limitations and recommendations for future research

The data provided empirical support to the selected variables that were capable of explaining 64.4% of the variance in pre-service teachers’ digital competencies and 45.9% in behavioral intention. This leads to the conclusion that possibly some other variables that may significantly impact on the digital competencies and the acceptance of technology in teaching were overlooked or excluded.

Although all methodology precautions were undertaken, one of the limitation of this study is collecting the data through self-reports, which may lead to common method variance and thus may inflate the true relationships between variables. Researchers suggest that subjective self-assessment lacks appropriate validity and is not an accurate stand-alone predictor of digital competence among preservice teachers (Maderick, Zhang, Hartley, Marchand 2016). Future research could include testing of pre-service teachers’ digital competencies and their actual usage of ICT in teaching practice, as soon as they start working, as well as examination of other variables which could be of interest to education in the first four grades of elementary school.

Conclusion

This study examined the variables that influence the development of digital competencies and intention to use digital technology in primary school teaching among pre-service teachers in Serbia.

The results suggested that, of the four variables, perceived usefulness was found to have the most influence on digital competencies, followed by

strategies, attitudes and perceived ease of use. Furthermore, perceived ease of use was found to have the most influence on intention to use technology, followed by digital competencies and perceived usefulness, while strategies did not significantly affect intention. This finding suggests that the pre-service teachers' intention to use technology in this study were driven by their affect and skills more than their perceptions of support. Finally, significant differences were found in the pre-service teachers' digital competencies and intention to use technology, by their year of study, among freshmen and master students.

It is hoped that this study could serve as a starting point in understanding pre-service teachers' development of digital competencies and intention to use digital technology in primary school teaching in Serbia and societies that share a similar level of technological advancement.

Given the dearth of research of this nature in Serbia, this study serves as a starting point in understanding pre-service teachers' intentions to use technology to teach in primary school. From a theoretical perspective, this study contributes to enhancing the debates around digital competencies and technology acceptance for teaching in primary school and among users in cultures that do not have the same level of technological advancements from the studies that are widely reported in the literature.

Implications for theory and practice

This study should help policy makers and managers at teacher training institutions (particularly in Serbia) to pay special attention to factors that have a determining role in improving pre-service teachers' digital competencies and acceptance of technology in primary school teaching.

If teacher educators want to motivate pre-service teachers to use technology in primary school teaching, they need to make sure that students have enough opportunities to acquire digital competencies. There should also be a conscious effort in creating conducive learning environment, applying adequate strategies during courses, from the beginning of their studies, where pre-service teachers can gain successful experiences in harnessing technology for teaching and learning. From this study, perceived usefulness, perceived ease of use, and digital competencies are important constructs that shape pre-service teachers' intention to use technology. It is reasonable to expect that a successful experience with technology, being useful and easy to use, would foster the development of digital competencies and positive intention to use technology among pre-service teachers.

On their part, teacher educators, by modeling the integration of technology through their lesson delivery and assessment design, may act as facilitators to shape pre-service teachers' perceived usefulness and perceived ease of use of technology. Røkenes, and Krumsvik (2016: 17) argued that "if teacher

education programs want to prepare ESL student teachers to teach ESL in innovative ways with ICT, then teacher educators and mentor teachers need to reflect on how they use these digital tools in their own teaching practice". Because of their status in the institutions, these educators act as referent others for their students and help them form and hold for a long time their beliefs about the use of digital technology.

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Appendix:

List of Constructs and Corresponding Items

Perceived ease of use (adapted from Davis et al. 1989; Teo 2009b)

PEU1 Learning how to use ICT in the educational practice would be easy for me;

PEU2 I find it easy to interact with ICT;

PEU3 I find it flexible to interact with mobile devices

PEU4 It would be easy for me to become skillful at using ICT in educational practice

PEU5 In general, I consider ICT to be easy to use.

Perceived usefulness (adapted from Davis et al. 1989; Teo 2009a, b)

PU1 The use of ICT improves the educational practice;

PU2 The use of ICT makes the educational practice more effective;

PU3 The use of ICT makes it easier to carry out educational tasks;

PU4 In general, I consider that ICT are useful in education.

Attitudes towards use of ICT in educational practice (adapted from Venkatesh et al. 2003; Teo 2009b)

ATU1 The use of ICT would make educational practice more interesting.

ATC2 Working with ICT in education would be fun.

ATC3 I would like to use ICT in educational practice.

ATC4 I look forward to those aspects of my job that require me to use ICT.

Behavioral intention (adapted from Teo 2009b)

BI1 I intend to use ICT frequently in my future educational practice.

BI2 I will probably use ICT in my educational practice as soon as I start working.

BI3 I will use ICT in my future educational practice.