

How Pre-Service Teachers Perceive Their ICT Competencies in Teacher Education Program

Ruth Xiaoqing Guo, Assistant Professor
Department of Computer Information Systems
Buffalo State College

Abstract

This study has three objectives. First, to increase an understanding of the practices and issues of information and communications technology (ICT) literacy in the teacher education program at a large university in western Canada; second, to assist in the design of future curriculum; and third, to investigate the correlations of student perceptions of ICT competencies and their attitudes toward ICT, frequency of ICT uses. Findings from this quantitative study suggest that there were strong correlations between the students' perceptions of their ICT competencies and their ICT uses during practicum.

1. Objectives

ICT literacy is defined to use digital technology, communication tools, and/or networks to access, manage, integrate, evaluate, and create information (ETS, 2004). The BC Ministry of Education (2004) outlined various ways in which ICT content could be delivered from Kindergarten to Grade 12.

The purpose of this study was to research ICT literacy in both elementary and secondary teacher education programs and to investigate the status of ICT literacy among teacher education students at a large university in Western Canada.

The rationale for conducting this research lies in the following. First, the shift from traditional practice to the incorporation of newer technological practices in education is underway.

Second, a systematic study of the characteristics and basic structure of ICT literacy will help policy makers effectively design technology curriculum. Third, making analytical comparisons between the data collected from pre- and post-program surveys on pre-service teachers' skills and beliefs pertaining to ICT literacy will provide better understanding of the pedagogical usefulness of technology.

The purpose of these investigations was to examine if the factors, including frequency of ICT use and students' attitudes, had an impact on student teachers' ICT literacy.

2. Theoretical framework

Although computers have been widely available in educational settings for well over two decades, a concern remains that teachers (in-service and pre-service) are neither confident nor competent users of ICT. Studies by Kerry (2000) and Wetzel, Wilhelm and Williams (2004), for example, indicate that many practicing teachers feel unprepared to use technology in their classrooms. Similarly, Watson found that many student teachers have low self-efficacy towards ICT and have negative attitudes towards ICT. These studies suggest that teacher education programs often fail to provide a structure through which teacher candidates can gain confidence and competence with ICT, and this inadequacy limits the possibility for meaningful use of technologies within educational settings (Watson, 1997).

Willis and Mehlinger noted that universities and teacher education programs typically fail to offer enough instruction to enable pre-service teachers to develop the necessary competencies and understandings for effectively incorporating ICT in their own teaching practices. This widespread problem contributes to feelings of inadequacy on the part of teacher candidates. Consequently, Gibson and Nocente (1998) observed "faculties of education throughout the country are experiencing increased pressure from government and school district level initiatives to produce graduates who are both confident and competent in using technology in their classrooms" (p. 324).

Despite these shortcomings in teacher education programs, ICT can be integrated in ways that make a difference. For instance, in a study with 222 primary/junior pre-service teachers at a university in southwest Canada, Kellenberger (1996) found that pre-service teachers increased self-efficacy toward ICT through their program. Kellenberger reported that pre-service teachers' perceptions of ICT were quite favorable at the end of the teacher education program because they experienced successful learning outcomes. Mitchell (2001) noted that when the students did their practicum they had difficulties in applying the technological knowledge and skills they obtained in the Teacher Education Program.

Given that there is an established correlation between attitudes and behavior (Ajzen, 1988; Shrigley, 1990), it

follows that student teachers' attitudes toward ICT may influence their behaviors and activities to study and use of ICT. Collins (1991) reported that self-efficacy beliefs were better predictors of career interests than their substantial abilities in communication and other quantitative skills. When pre-service teachers enter teacher education program with different levels of experiences and abilities with ICT, teacher educators should be aware of incoming attitudes and needs. Some might feel ICT was completely foreign while others might have a wide range of experiences using computers and other emerging technologies and that the prior experiences were the predictors of student attitudes. Researchers (Koohang, 1987, 1989; Loyd & Gressard, 1986; Hunt & Bohlin, 1993) found that the significance to teacher educators was that those students who believed ICT literacy was vital for living in today's society held positive attitudes toward ICT; however, many did not perceive that they needed a good command of ICT for their future profession and they generally had negative attitudes toward ICT.

Similarly, many researchers found that attitudes and learning behaviors were correlated. For example, findings from Watson's (1997) research showed that many student teachers had negative attitudes towards technology. Student teachers with different levels of ICT had different attitudes: the novice students appeared to have been the most negative while the more experienced were the most positive toward the learning potential provided by technologies. Moseley and Higgins (1999) found that teachers who successfully made use of ICT in classroom teaching had positive rather negative attitudes toward ICT. Kellenberger's research (1996) revealed that pre-service teachers developed positive attitudes toward ICT after training with technologies in their teacher preparation program. The factors that affected pre-service teachers' self-concept of their competency with ICT included hands-on experience with ICT and constructivist approaches in coursework with technologies.

3. Method

The data were collected from large-scale pre- and post-program surveys of student teachers (2,874) in the 2001-2002 and 2003-2004 academic years. Multiple regressions were used to examine the relationship between the dependent variable ICT competencies and a set of independent variables such as access, attitudes, and frequency of ICT use. Pearson's correlation was used to measure how the variables, including ICT scores, access, and attitudes were related. Pearson's correlation measures the linear association between two variables. Values of the correlation coefficient range from -1 to 1. The p-value was set at .01 (2-tailed). If there was no relationship among the variables, the correlation would equal zero. If the findings claimed that there was a relationship among the variables, then a frequency of ICT use and

integration of technology into coursework and practicum may be one of the solutions to enhance ICT literacy.

Both backwards and stepwise sequential analyses were used to compare the contributions of each independent variable and the results from the stepwise sequential analyses were presented. The stepwise sequential analysis arranges the results in the order of the correlations between the dependent variable and the independent variables from the smallest to the largest. Therefore, it was easy to tell which variable was the most powerful one. In backward selection procedure, all variables are entered into equation and then sequentially removed. The variable remaining in the equation with the smallest partial correlation is considered next. The procedure terminates when there are no variables in the equation that satisfy the removal criteria. At each step in stepwise sequential analysis, the independent variable not in the equation which has the smallest *F* value is entered. Variables are removed if the *F* value becomes sufficiently large. The method terminates when no more variables are eligible for inclusion or removal.

4. Findings and Discussions

Pearson Correlation tests in Table 1 indicates that there was a statistically significant association between TCPR1 (ICT competencies in 2001) and ATT (attitudes toward ICT): $r = .366, p < .01$. Analysis of Pearson correlations between TCPR1 and ACC1 (access in 2001) showed a correlation existed between the two variables: $r = .290, p < .01$. The correlation between ACC1 and ATT was also statistically significant: $r = .142, p < .01$. This means all the associations were statistically significant different (Table 1).

Table 1. Correlations of access and attitudes and ICT in 2001

		TCPR1	ATT	ACC1
Pearson Correlation	TCPR1	1.000	.366	.290
	ATT	.366	1.000	.142
	ACC1	.290	.142	1.000
Sig. (1-tailed)	TCPR1	.	.000	.000
	ATT	.000	.	.000
	ACC1	.000	.000	.
N	TCPR1	869	869	869
	ATT	869	869	869
	ACC1	869	869	869

The linear regression results in Table 2 showed that the *t* value for ATT was statistically significant different from zero, $t(869) = 10.740, p < .01$, indicating that the variables

ICT competencies and attitude were related and ICT competencies varied with attitudes. ICT competencies increase or decrease with the increase or decrease of attitudes toward ICT. Similarly, the slope value for the variable ACC1 was statistically significant different, $t(873) = 7.853$, $p < .01$, indicating that ICT competencies and access were related and ICT competencies varied with access. ICT competencies increased or decreased with the increase or decrease of access. The analysis of stepwise sequential regression showed that the independent variable was a stronger predictor of ICT competencies (Table 2).

Table 2. Regression of access and attitudes and ICT in 2001

Coefficients ^a						
Model		Std.		t	Sig.	
		B	Error Beta			
1	(Constant)	13.98	4.027	3.472	.001	
	ATT	1.021	.095	.332	10.74	.000
	ACC1	4.064	.518	.242	7.853	.000

a. Dependent Variable: TCPR1

According to the regression equation:

$$\hat{Y} = a + bX$$

$$\hat{Y} = 13.98 + .332x_1 + .242x_2$$

Where:

$$\hat{Y} = \text{TCPR1 (predictor ICT competencies scores)}$$

$$X_1 = \text{attitudinal scores (ATT)}$$

$$X_2 = \text{access scores (ACC1)}$$

As seen from Table 3, there was a statistically significant correlation between ICT competencies and attitude in 2003: $r = .380$, $p < .01$; analysis of Pearson correlations between ICT competencies and access showed a correlation existed between the two variables: $r = .177$, $p < .01$. However, the correlation between access and attitudes was not statistically significant: $r = .062$, $p = .075$ (Table 3).

The linear regression results in Table 4 for pre-program 2003 had the same pattern as that in Table 3 for 2001. The analysis from stepwise procedure showed that the slope value for attitude had statistically significant difference from zero, $t(823) = 11.598$, $p < .01$, indicating that the variable

Table 3. Correlations of access and attitudes and ICT competencies in 2003

		TCPR3	ATT	ACC3
TCPR3	Pearson Correlation	1	.380	.177
	Sig. (2-tailed)	.	.000	.000
	N	828	823	828
ATT	Pearson Correlation	.380	1	.062
	Sig. (2-tailed)	.000	.	.075
	N	823	823	823
ACC3	Pearson Correlation	.177	.062	1
	Sig. (2-tailed)	.000	.075	.
	N	828	823	828

ICT competencies and attitude were related and ICT competencies varied with attitudes. ICT competencies increased or decreased with the increase or decrease of attitudes. Similarly, the slope value for the variable access showed a statistically significant difference from zero, $t(828) = 4.761$, $p < .01$, indicating that ICT competencies and access were significantly related and ICT competencies varied with access. ICT competencies increased or decreased with the increase or decrease of access (Table 4).

Table 4. Regression of access and attitudes and ICT in 2003

Coefficients ^a						
Model		Std.		t	Sig.	
		B	Error Beta			
1	(Constant)	24.279	2.025	11.992	.000	
	ATT	1.088	.092	.380	11.763	.000
	ACC3					
2	(Constant)	16.015	2.647	6.050	.000	
	ATT	1.061	.091	.370	11.598	.000
	ACC3	1.225	.257	.152	4.761	.000

a. Dependent Variable: TCPR3

The regression equation could be expressed as:

$$\hat{Y} = 16.015 + .37x_1 + .152x_2$$

Like the results of the stepwise regression for the Pre-Program Survey 2001 (Table 3), the analysis of stepwise sequential regression showed that the independent variable was a stronger predictor of ICT competencies in the Pre-Program Survey 2003. The regression summary showed that there existed statistically significant relationships among the variables attitudes, access and ICT competencies: $r = .438$, $R \text{ Square} = .192$, $F(2, 866) = 102.602$, $p < .01$ for the Pre-Program Survey 2001; $r = .409$, $R \text{ Square} = .167$, $F(, 820) =$

83.34, $p < .01$, which indicated that all the variables attitudinal scales and access scales had strong relationships with the dependent variable ICT scores, measured by TCPR1 and TCPR3 for both the Pre-Program Surveys (2001, 2003) (Table 5).

Table 5. Regression summary of the Pre-Program Surveys for 2001 and 2003

ANOVA ^c						
Model		R	R Square	df	F	Sig.
1. Pre-Program 2001	Regression	0.438	0.192	2	102.6	.001 ^a
	Residual			866		
	Total			866		
2. Pre-Program 2003	Regression	0.409	0.167	2	82.347	.001 ^b
	Residual			820		
	Total			822		

a. Predictors: (Constant), ATT

b. Predictors: (Constant), ATT, ACC

c. Dependent Variable: TCPR

As seen from Table 6, the values of Pearson correlations of the four variables in 2002 were: 1) $r = .272$ for correlation of ICT competencies and frequency of use during university course work for 2002 (UA2), $p < .01$; 2) $r = .334$ for ICT competencies and the frequency of use during practicum for 2002 (UB2), $p < .001$; 3) $r = .496$ for ICT competencies and student teachers' students' frequency of use (UC2) in practicum schools for 2002. The correlation between frequency of ICT use and ICT competencies was statistically significant. There existed statistically significant correlations between use at university and practicum schools, and the use between the student teachers and their students. The strongest correlation was between the UA2 and UB2 (.697), meaning that the frequency of ICT use by student teachers during their course-work and during practicum was strongly related. The higher frequency of ICT use during course work increased the frequency of use in practicum. The other meaningful significant associations were UC2 and UA2 ($r = .338$, $p < .001$), UC2 and UB2 ($r = .327$, $p < .001$), which indicated that the student teachers' ICT use during the university course work and during practicum were statistically related their students' frequency of ICT use (Table 6).

Table 6. Correlations between ICT use and ICT competencies in 2002

		TCPS2	UA2	UB2	UC2
TCPS2	Pearson Correlation	1	.334*	.469*	.250*
	Sig. (2-tailed)	.	.000	.000	.000
	N	512	347	349	458
UA2	Pearson Correlation	.334*	1	.697*	.338*
	Sig. (2-tailed)	.000	.	.000	.000
	N	374	385	345	373
UB2	Pearson Correlation	.469*	.697*	1	.327*
	Sig. (2-tailed)	.000	.000	.	.000
	N	349	345	385	372
UC2	Pearson Correlation	.250*	.338*	.327*	1
	Sig. (2-tailed)	.000	.000	.000	.
	N	458	373	372	529

** . Correlation is significant at the 0.01 level (2-tailed).

As seen from Table 7, the pattern of correlations in 2004 was similar to that of 2002. Pearson correlations of the four variables in 2004 were: 1) $r = .258$ for ICT competencies and UA4 (frequency of use during university course work), $p < .01$; 2) $r = .420$ for ICT competencies and UB4 (frequency of use during practicum), $p < .01$; 3) $r = .218$ for ICT competencies and UC4 (frequency of ICT use by the students of the teacher candidates in practicum). The correlation between frequency of ICT use and ICT competencies was statistically significant. There existed a statistically significant correlation between the use at university and practicum schools, and the use between the student teachers and their students. In post-program 2004, the strongest correlation remained between the variables UA4 and UB4 (.590), indicating those who acquired higher ICT competencies had a tendency of using the skills and knowledge at practicum schools. The correlation between UC4 and UB4 was also high (.511), which indicated that the student teachers who had higher frequency of ICT use during the practicum also had high frequency of asking and encouraging their students to use ICT (Table 7).

5. Conclusions

The study indicated that there existed statistically significant relationships among the variables under examination (e.g., ICT competencies among attitudes, access, and frequency of ICT use during the university course work and during their practicum). The stepwise regression analyses showed that the strongest predictor for the Pre-Program Surveys were

Table 7. Correlations between ICT use and ICT competencies in 2004

		TCPS4	UA4	UB4	UC4
TCPS4	Pearson Correlation	1	.258**	.420**	.218**
	Sig. (2-tailed)	.	.000	.000	.000
	N	554	551	550	543
UA4	Pearson Correlation	.258**	1	.590**	.286**
	Sig. (2-tailed)	.000	.	.000	.000
	N	551	551	550	543
UB4	Pearson Correlation	.420**	.590**	1	.511**
	Sig. (2-tailed)	.000	.000	.	.000
	N	550	550	550	542
UC4	Pearson Correlation	.218**	.286**	.511**	1
	Sig. (2-tailed)	.000	.000	.000	.
	N	543	543	542	543

** . Correlation is significant at the 0.01 level (2-tailed).

attitudes. The linear regression results indicated that the variable ICT competencies and attitudes were strongly related in the Pre-Program Surveys 2001 and 2003 and ICT competencies varied with attitudes. The strongest correlations were student teachers' perceptions of ICT competencies and frequency of ICT use during practicum for both the Post-Program Surveys 2002 and 2004. UB2/UB4 for both post-program surveys (2002, 2004) was the most powerful variable which had strongest correlations with ICT competencies, UA2/UA4 (frequency of ICT use during coursework) and UC2/UC4 (frequency of student teachers' students' frequency of ICT use in practicum schools), indicating that the student teachers acknowledged their ICT competencies when they could use ICT in classroom settings.

Furthermore, the findings showed there was a correlation between student teachers' ICT competencies and their students' frequency of ICT use, suggesting that the student teachers may have made meaningful connections between what they had obtained and pedagogy in practicum. The strongest correlations were consistently between variables UA2 and UB2 in the Post-Program Survey 2002 ($r = .697$) and UA4 and UB4 in the Post-Program Survey 2004 ($r = .590$), meaning that the frequency of ICT use by student teachers during their course work and during practicum was strongly related.

References

Ajzen, I. (1988). *Attitudes personality and behavior*. Milton Keynes: Open University Press.

- BC Ministry of Education, Canada. (2004). Information and communications technology 11 and 12. *Integrated Resource Package*. British Columbia, Canada.
- Collins, A. (1991). The role of computer technology in restructuring schools. *Phi Delta Kappan*, 73(1), 28-36.
- Ely, D. P. (1996). *Trends in educational technology*. Syracuse, NY: Syracuse University.
- Educational Testing Service (ETS). (2004). *ICT literacy assessment*. Princeton, NJ: Author.
- Gibson, S., & Nocente, N. (1998). Addressing instructional technology needs in faculties of education. *Alberta Journal of Educational Research Edmonton*, 44(3), 320-333.
- Hunt, N. P., & Bohlin, R. M. (1993). Teacher education students' attitudes toward using computers. *Journal of Research on Computing in Education*, 25(4), 487-497.
- Kellenberger, D. W. (1996). Preservice teachers' perceived computer self-efficacy based on achievement and value beliefs within a motivational framework. *Journal of Research on Computing in Education*, 29, 124-140.
- Kerry, B. (2000). *The power of the Internet for learning: Moving from promise to practice*. Washington, DC: Web-Based Education Commission.
- Koohang, A.A. (1987). A study of the attitudes of pre-service teachers toward the use of computers. *Educational Communications and Technology Journals*, 35(3), 145-149.
- Koohang, A. A. (1989). A study of the attitudes toward computer: anxiety, confidence, liking, and perception of usefulness. *Journal of Research on Computing in Education*, 22 (2), 137-150.
- Loyd, B.H. , & Gressard, C.P. (1986). Gender and amount of computer experience of teachers in staff development programs: Effects on computer attitudes and perceptions of the usefulness of computers. *AEDS Journal*, 302-311.
- Mitchell, J. M. (2001). *Computer technology in teacher education: tool for communication, medium for inquiry, object of critique*. Ph. D. Dissertation. University of British Columbia, Canada.
- Moseley, D., & Higgins, S. (1999). *Ways forward with ICT: effective pedagogy using information and communications technology for literacy and numeracy in primary schools*. London: Teacher Training Agency.
- Shrigley, R. (1990) Attitude and behavior are correlates. *Journal of Research in Science Teaching*, 27 (2), 97-113.
- Watson, G. (1997). Pre-service teachers' views on their information technology education. *Journal of Information Technology for Teacher Education*, 6(3), 255-270.
- Wetzel, K., Wilhelm, L., & Williams, M. K. (2004). The introductory technology course: A tool for technology integration. *Contemporary Issues in Technology and Teacher Education*, 3(4), 453-465. Retrieved November 26, 2005, from <http://www.citejournal.org/articles/v3i4general4.pdf>

Wilhelm, A. G. (2000). *Democracy in the digital age: Challenges to political life in cyberspace*. UK: Routledge.

Willis, J. W., & Mehlinger, H. (1996). Information technology and teacher education. In T. Buttery, & E. Guyton (Eds.), *Handbook of research on teacher education* (2nd edition) (pp. 978-1029). New York: Macmillan.

Acknowledgements

This research was conducted in the teacher education program at the University of British Columbia, Canada.

Author Information

Ruth Xiaoqing Guo, Ph.D.
Assistant Professor
Educational Computing Program
Computer Information Systems Department
Buffalo State College
Chase 225

1300 Elmwood Avenue
Buffalo, NY 14222
716-878-5919
guorx@buffalostate.edu

Dr. Guo's research interests include integrating technology into curriculum, digital divide, constructivist pedagogy, video ethnography, multiliteracies, information and communication technology (ICT) literacy, and ICT assessment. She has published research papers and book chapters in these areas. She is an active member of various professional associations, including the American Educational Research Association (AERA).

Note: Dr. Guo's paper was first presented at the New York State Association for Computers and Technologies in Education (NYSCATE) 2007 annual conference and was part of the conference's Academic Proceedings.