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THE IMPACT OF PRESERVICE TEACHERS' EMOTIONS ON COMPUTER USE: A FORMATIVE ANALYSIS

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ABSTRACT

Previous research on the effect of technology-based preservice education programs has been assessed by examining changes in computer ability and attitudes. Systematic exploration looking at the effect of these programs on computer use has been noticeably absent. In addition, the role of emotions and use of computers has been largely ignored with one exception, computer anxiety. The purpose of the following study was to examine the impact of four basic emotions (anger, anxiety, happiness, sadness) on use of computers by preservice teachers in their coursework (university use) and in their practice teaching (field use). Happiness was reported often while learning new software—anxiety, anger, and sadness were experienced sometimes. All four emotion constructs were significantly correlated with all four university use constructs at the beginning of the laptop program. Increased positive emotions (happiness) were significantly correlated with increased use of computers at the university by the end of the program. Finally, increases in positive emotions and decreases in negative emotions were significantly related to teacher and student-based use of computers in the field.

TEACHER EDUCATION AND TECHNOLOGY

Over the past 10 years, a number of large scale meta-analyses (Baker, Gearhart, & Herman, 1994; Kozma, 2003; Kulik, 1994; Mann, Shakeshaft, Becker, & Kottkamp, 1999; Scardamalia & Bereiter, 1996; SIIA, 2000; Sivin-Kachala, 1998; Wenglinksy, 1998) have reported significant improvement in achievement scores, attitudes toward learning, and depth of understanding when computers

were integrated with learning. However, gains observed in these studies were dependent on subject area (Kulik, 1994), type of software used (Sivin-Kachala, 1998), specific student population, software design, educator role, and level of student access (Sivin-Kachala, 1998). This research has prompted educational policy specialists and administrators to promote the presence of technology in classrooms, specifically focusing on student-to-computer ratio, high speed Internet access, and preservice teacher education (Bennett, 2000/2001; CEO Forum on Education and Technology, 2000; Compton & Harwood, 2003; ISTE/NCATE, 2003; McRobbie, Ginns, & Stein, 2000; National Council for Accreditation of Teacher Education, 2003; OTA, 1995; Plante & Beattie, 2004; U.S. National Center for Education Statistics, 2002).

A large number of nationally recognized organizations (e.g., CEO Forum on Education and Technology, 2000; ISTE/NCATE, 2003—see Bennett, 2000/2001 for a review; National Council for Accreditation of Teacher Education, 2003; OTA, 1995) have developed comprehensive standards for the use of technology in teacher preparatory programs. While preservice teacher education programs appear to be a natural place to start with respect to integrating technology into education, the evidence suggests that these programs have not been successful preparing new teachers to use technology effectively (CEO Forum on Education and Technology, 2000; Kay, 2006; Moursund & Bielefeltdt, 1999; OTA, 1995; U.S. Department of Education, 2000; Yildirim, 2000). However, research on the integration of technology in preservice education has been hampered by poor data collection instruments, vague sample and program descriptions, small samples, an absence of statistical analysis, and vague anecdotal descriptions of success (see Kay, 2006 for a review).

Kay (2006), in a review of 68 articles on technology and preservice education, noted that computer attitude, ability, and use were the principal dependent variables assessed, although clear definitions of ability, attitude, and use were rarely presented or theoretically justified. Computer ability was examined most often (60%, $n = 41$ out of 68), followed closely by computers attitudes (56%, $n = 38$ out of 68). Computer use, on the other hand, was looked at in only one third of the studies examined (33%, $n = 23$ out of 68). A closer look revealed that only 14 of 68 studies used reliable data collection methods combined with formal statistics. Of those 14 studies, only three looked at computer use. Clearly, computer use needs to be emphasized more, given that one of the ultimate goals of a computer-based component in a preservice education program should be to create meaningful and useful technological interactions in the classroom.

DEFINING COMPUTER USE

Computer use has been defined in variety of ways from the perspective of the teacher and the student. With respect to teacher use of computers, definitions have incorporated administrative tasks, lesson preparation, unit planning, the

ability to use a wide range of software; delivery of lessons, and special education (Compton & Harwood, 2003; Garland, 1999-2000; Maeers, Browne, & Cooper, 2000; Milbrath & Kinzie; 2000; Russell, Bebell, O'Dwyer, & O'Connor, 2003). Regarding student use of computers, definitions have included the ability to use a wide range of software tools, creativity, higher-order thinking skills, teacher-directed student use, and time (Baylor & Ritchie, 2002; Halpin, 1999; Pope, Hare, & Howard, 2002; Russell et al., 2003). A majority of computer use measures are limited in focus and/or do not provide reliability and validity estimates (Baylor & Ritchie, 2002; Halpin, 1999; Maeers et al., 2000; Milbrath & Kinzie, 2000; Pope et al., 2002; Russell et al., 2003; Thompson, Schmidt, & Davis, 2003; Wang & Holthaus, 1998-99).

EMOTIONS AND COGNITION

While traditional theorists view emotion and cognition as clearly separated constructs (Goleman, 1997; Lazarus, 1991a, 1991b), there is increasing evidence that emotion and cognition are integrated and intertwined (Fridja, 1986; Gray, 1990; LeDoux, 1989; O'Regan, 2003; Simon, 1967). LeDoux (1989), for example, claims that emotion and cognition are mediated by separate but integrated systems of the brain. Gray (1990) adds that the brain systems mediating emotion and cognition overlap. Finally, O'Regan (2003) notes that there has been a "growing awareness that, far from being polar opposites [emotion and cognition] are in fact inextricably connected" (p. 80). The current perspective, then, is that emotion and cognition are more connected, than separate.

Emotion is considered critical in the process of adapting to unpredictable environments or juggling multiple goals (Case, Hayward, Lewis, & Hurst, 1988; Neisser, 1963; Oatley & Johnson-Laird, 1987; Simon, 1967). An emotional reaction is likely when one is in danger of harm, being threatened, challenged, or, conversely, if one is in a situation of benefit or readiness (Lazarus, 1991b). Emotion could also be activated by a number of factors, including motivation, communication, or survival (Rolls, 1990). Since learning new software can be threatening, challenging, beneficial, motivating, and communicative, it is reasonable to speculate that emotions play a important role.

EMOTIONS AND COMPUTER USE

While emotions and cognition appear to be inextricably linked, the connection between emotions and use of computers has not been examined in a comprehensive and systematic way. In fact, only one emotion, anxiety, has been studied extensively with respect to computers, however precise and consistent definitions are lacking. Constructs have included *confidence* (Heinsen, Glass, & Knight, 1987; Loyd & Gressard, 1984), *positive or negative feelings* (Beckers & Schmidt, 2001; Ceyhan, 2006; Loyd & Gressard, 1984; Nickell & Pinto, 1986),

intimidation (Heinsen, Glass, & Knight, 1987; Nickell & Pinto, 1986), *fear* (Bronsan & Lee, 1998; Heinsen, Glass, & Knight, 1987), *damaging anxiety* (Ceyhan, 2006; Russell & Bradley, 1997), *equipment anxiety* (Marcoulides & Wang, 1990), *learning or task performance anxiety* (Ceyhan, 2006; Rosen & Weil, 1995; Russell & Bradley, 1997), *observation anxiety* (Bronsan & Lee, 1998; Dyck, Gee, & Smither, 1998), *anticipatory anxiety* (Bronsan & Lee, 1998), *state-anxiety* (Guadron & Vignoli, 2002; Wilfong, 2006), *fear of social embarrassment* (Russell & Bradley, 1997), *general or non-specific anxiety* (Hong & Koh, 2002; Todman & Day, 2006; Yaghi & Abu-Saba, 1998), *self-efficacy* (Beckers & Schmidt, 2001), and *cognitive beliefs* (Beckers & Schmidt, 2001). This range of constructs makes it difficult to build theory and a coherent knowledge base.

Only one study could be found looking at the role of another emotion, anger, with respect to computer related behaviour. Wilfong (2006) reported that computer anger was strongly related to self-efficacy, but not computer use or experience. Emotions such as sadness or happiness have yet to be formally evaluated in the context of computer use. In fact, considerable debate reigns on what constitutes a basic emotion. It is generally agreed upon, though, that there are at least four basic emotions: happiness, sadness, anxiety (fear), and anger (Arnold, 1960; Ekman, Friesen, & Ellsworth, 1972; Izard, 1969; James, 1884; Oatley & Johnson-Laird, 1987; Plutchik, 1980; Tomkins, 1962).

PURPOSE

The purpose of this study was to examine the impact of four basic emotions (anger, anxiety, happiness, sadness) on the use of computers by preservice teachers in their coursework (university use) and practice teaching (field use). Three key questions were addressed:

1. To what extent are emotions present when software is being learned?
2. How are emotions related to use of computers by preservice teachers at their university?
3. How are emotions related to use of computers by preservice teachers during their field placements?

METHOD

Sample

The sample consisted of 184, secondary (Grade 7-12), preservice teachers (123 females, 61 males) from a variety of cultural backgrounds (20% reported that their first language was not English), ranging in age from 23 to 58 years (M = 33.4; SD = 8.7). Eighty-one percent of the subjects reported having 10 or more years experience using computers. The total enrolment in the program was 190 students, therefore the response rate was 97%.

Description of the Program

The Bachelor of Education degree at this university is an eight-month consecutive program, focusing on Computer Science, Math, and Science (Physics, Chemistry, Biology, and General Science) at the intermediate-secondary school level (grades 7 to 12). All students were required to have a B.A. with five full university courses in their first teachable area and three full university courses in their second teachable area.

Every student in the preservice teacher education program was given an IBM R51 ThinkPad at the beginning of the year, loaded with a wide range of educational and application-based programs. All classrooms were wired with high-speed Internet access through cable and a wireless network. In addition, students had access to a wireless network throughout the university campus.

Model of Technology Use—Integration

An integrated model was used to incorporate technology into the preservice education. In other words, students used their laptop computers in all courses offered, but did not take a stand-alone course in technology use. All students attended a four-hour introductory workshop at the beginning of the year to introduce them to the basic operations of laptop computers and connecting to the Internet. All students were offered voluntary two-hour workshops throughout the year that focused on specific software skills in Word, PowerPoint, searching the Web, Web Page Design, and Dreamweaver. Finally, there was one support person available four hours per day, five days a week, to assist students with individual problems.

All faculty members created assignments and projects that required students to use the computer as a tool to solve meaningful, practical, and useful problems. A majority of the activities used were based on well-grounded, learning theory including cooperative learning (e.g., Kagan, 1997; Sharon, 1999), constructivism (e.g., Bruner, 1983, 1986; Vygotsky, 1978), facilitation and coaching (e.g., Brown & Palinscar, 1989; Collins, Brown, & Newman, 1989), incorporating a variety of learning styles (e.g., Gardner, 1983), problem-based learning (e.g., Albanese & Mitchell, 1993; Collins et al., 1989), higher-level thinking skills (e.g., Resnick, 1989), connecting concepts to real world knowledge (e.g., Lampert, 1986; Larkin, 1989; Sternberg, 1989), and actively applying knowledge (Carroll, 1990; Caroll & Mack, 1984).

Data Sources

Survey

The survey consisted of 3 sections (59 items) focusing on emotions (12 items), university use (22 times), and field use (25 items) (see Table 1).

Table 1. Description of Survey Instruments Used

Scale construct	No. items	Range	Internal reliability
Emotions			
Anger	3	0-3	$r = 0.69$
Anxiety	4	0-3	$r = 0.73$
Happiness	3	0-3	$r = 0.70$
Sadness	2	0-3	$r = 0.65$
University use			
Basic software	3	0-4	$r = 0.69$
Advanced software	10	0-4	$r = 0.91$
Collaboration	5	0-4	$r = 0.80$
Social	4	0-4	$r = 0.82$
Field Use			
Student	18	0-3	NA
Teacher	7	0-3	NA

Note: NA = not applicable.

Computer Emotions

Four theoretically distinct constructs (anger, anxiety, happiness, and sadness) were used to assess emotions of preservice teachers "while learning a software package." Oately and Johnson-Laird's (1987) four basic emotion categories were used in conjunction with a subset of their 590 emotional words to create appropriate emotional scale items (Appendix A). The internal reliability estimates for all constructs were moderate, but acceptable (Kline, 1999; Nunnally, 1978), ranging from .65 to .73 (Table 1).

A principal components analysis was done to explore whether the four emotions formed four distinct factors. Since all communalities were above 0.4 (Stevens, 1992), the principal component analysis was deemed an appropriate exploratory method (Guadagnoli & Velicer, 1988). Both orthogonal (varimax) and oblique (direct oblimin) rotations were used, given that the correlation among potential strategy combinations was unknown. These rotational methods produced identical factor combinations, so the results from the varimax rotation (using Kaiser normalization) are presented because they simplify the interpretation of the data (Field, 2005). The Kaiser-Meyer-Olkin measure of sampling adequacy (0.827) and Bartlett's test of sphericity ($p < .001$) indicated that the sample size was acceptable.

The principal components analysis was set to extract the four factors (Table 2). The resulting rotation corresponded relatively well with the proposed emotion

Table 2. Varimax Rotated Factor Loadings on Strategies Used to Incorporate Technology

Emotion items	Factor 1	Factor 2	Factor 3	Factor 4
Insecure	.79			
Nervous	.74			
Helpless	.70			
Anxious	.59			
Excited		.85		
Curious		.72		
Satisfied		.60		
Frustrated	.50		.47	
Angry			.86	
Irritable			.69	
Disheartened				.87
Dispirited			.47	.55

Factor	Eigenvalue	Pct of var	Cum pct
1	4.37	36.4	36.4
2	1.64	13.6	50.0
3	1.01	8.4	58.4
4	0.90	7.5	65.9

constructs with three exceptions. First, helpless was expected to load on the sadness construct, but it was grouped with the anxiety descriptors. Second, frustration loaded on both anxiety and anger constructs. Third, dispirited loaded with anger and sadness constructs. Overall, the structure was consistent with the proposed grouping of scale items listed in Appendix A.

Computer Use

A composite measure of computer use was developed based on a comprehensive review of research designed to assess computer use in preservice teachers (Baylor & Ritchie, 2002; Compton & Harwood, 2003; Garland, 1999-2000; Halpin, 1999; Maeers et al., 2000; Milbrath & Kinzie, 2000; Pope, Hare, & Howard, 2002; Russell et al., 2003; Thompson et al., 2003; Vannatta & Beyerbach, 2000; Wang & Holthaus, 1998-99). A decision was made to develop a new measure because previous measures were either limited in focus (Halpin,

1999; Maeers et al., 2000; Milbrath & Kinzie, 2000) or not statistically reliable (Baylor & Ritchie, 2002; Pope et al., 2002; Russell et al., 2003; Thompson et al., 2003; Wang & Holthaus, 1998-99). Use was looked at in two environments—at the university where preservice candidates took their classes and in the field placement where preservice teachers practiced their teaching.

In the university environment, four categories of computer use were assessed: basic software ($r = 0.69$), advanced software ($r = 0.91$), collaboration ($r = 0.80$), and social ($r = 0.82$). A principal component factor analysis supported the validity of this structure. Reliability estimates were moderate to high. Items for this scale are presented in Appendix B.

In the classroom environment where preservice teachers did their practice teaching (field placement), two categories of computer use were examined—teacher-based and student-based. Teacher-based use of computers involved the teacher employing computers to prepare and deliver lessons, where as student-based use looked at students working with computers during a class. The items from this scale were not designed to form coherent, reliable structures. The scale was designed to be a comprehensive checklist of technology tools that preservice candidates could use. However, given the wide range of tools examined and the limited time in the field placement (six weeks), it was anticipated that consistent and frequent patterns of use would be difficult to attain. Therefore a factor analyses and internal reliability estimates were not calculated. Items for this scale are presented in Appendix C.

PROCEDURE

Subjects were told the purpose of the study and then asked to give written consent if they wished to participate. The emotion (Appendix A) and university use surveys (Appendix B) were administered online at the beginning of the year (September). Both surveys were re-administered coupled with a field use survey (Appendix C) at the end of the year (April). In order to partially control for extraneous influences, surveys at the beginning and end of the year were filled in by subjects using their laptop computers in a large lecture hall. The survey battery took from 8 to 12 minutes to complete.

RESULTS

Frequency of Emotions Expressed

At the beginning of the integrated laptop program, happiness ($M = 1.83$; $SD = 0.52$) was the emotion that preservice teachers claimed they felt most often while learning new software. The remaining emotions, anger ($M = 0.70$; $SD = 0.45$), anxiety ($M = 0.65$; $SD = 0.48$), and sadness ($M = 0.55$; $SD = 0.47$) were experienced far less often. This means that, on average, preservice teachers felt happiness (curiosity, satisfaction, excitement) most of the time, and anger, anxiety, or sadness some of the time (Appendix A).

Emotion and University Use

Frequency of Use

Prior to the start of the integrated laptop program, basic use ($M = 3.2$; $SD = 0.85$) was the most frequent type of activity, followed by social use ($M = 2.4$; $SD = 0.93$), collaborative use ($M = 2.0$; $SD = 1.03$), and advanced use ($M = 1.5$; $SD = 0.84$). This means that, on average, preservice teachers reported that they used computers for basic activities often, social and collaborative use sometimes, and advanced activities rarely (see Appendix B).

Correlation among Pre-Laptop Emotions and Pre-Laptop University Use

There was a statistically significant relationship among all emotion constructs and computer use prior to the start of the program (Table 3). Happiness, anxiety, and anger showed the strongest correlations with all four use constructs. Preservice teachers who reported negative emotions (anxiety, anger, and sadness) while learning before the laptop program, used computer significantly less. On the other hand, those students reporting happiness while learning, used computers significantly more. It is worth noting that most correlations were small to medium ($r = .18$ to $r = .42$) according to Cohen (1988, 1992).

Correlation among Post-Laptop Emotions and Post-Laptop University Use

By the end of the integrated laptop program, only the happiness construct (exciting, satisfying, curious) was significantly and positively correlated with university use of computers. Happiness showed a significant, moderate correlation (Cohen, 1988, 1992) with all university use constructs, except for social use (Table 4).

Table 3. Correlations among Pre-Laptop Emotion Constructs and Pre-University Use of Computers

	Angry	Anxious	Happiness	Sadness
Basic use	–0.18*	–0.32***	0.33***	–0.30***
Advanced use	–0.29**	–0.38***	0.42***	–0.31***
Collaborative use	–0.15**	–0.26***	0.33***	–0.29***
Social use	–0.07	–0.25***	0.21**	–0.19*
Total use	–0.24***	–0.38***	0.42***	–0.34*

*$p < .05$ (2-tailed), **$p < .005$ (2-tailed), ***$p < .001$ (2-tailed).

Table 4. Correlations among Post-Laptop Emotion Constructs and Post-University Use of Computers

	Angry	Anxious	Happiness	Sadness
Basic use	–0.04	–0.14	0.25**	–0.12
Advanced use	–0.19*	–0.15	0.44***	–0.15
Collaborative use	–0.04	–0.07	0.31***	–0.06
Social use	–0.02	–0.01	0.09	–0.07
Total use	–0.12	–0.12	0.39***	–0.14

*$p < .05$ (2-tailed), **$p < .005$ (2-tailed), ***$p < .001$ (2-tailed).

Change in Emotions

After the eight-month, integrated laptop program, preservice teachers reported significantly less anxiety and anger when learning software (Table 5). Perceptions of happiness and sadness did not change. Happiness may not have increased because of a ceiling effect.

Change in Use

After the eight-month, integrated laptop program, preservice teachers reported significantly more use of computers in basic, advanced, and collaborative activities ($p < .001$) (Table 6). There was no statistically significant change with respect to social use of computers.

Correlation among Change in Emotions and Change in University Use

There are two notable findings with respect to how change in emotions related to change in university computer use over the eight-month, integrated laptop program. First, increases in basic and advanced skills were significantly correlated with increased happiness expressed while learning. Second, an increase in collaborative use was significantly correlated with a decrease in anxiety reported while learning (see Table 7). According to Cohen (1988, 1992), the magnitude of correlations, while significant, was relatively small ($r = .18$ to $r = .28$).

Emotions and Preservice Teacher Use of Computers in the Field

Frequency

The most frequent activities done by preservice candidates with respect to using technology in their field placements was creating lesson plans and support

Table 5. Emotion Construct Scores Before and After Integrated Laptop Program

Emotion construct (range)	Before program		After program			
	M	(*SD*)	*M*	(*SD*)	*df*	*t*
Anger (0-9)	2.05	(1.34)	1.72	(1.23)	149	3.41*
Anxious (0-12)	2.48	(1.93)	1.81	(1.64)	149	5.26**
Happiness (0-9)	5.47	(1.58)	5.69	(1.63)	149	–1.42
Sadness (0-6)	1.09	(0.92)	0.99	(0.87)	149	3.41

*$p < .005$, **$p < .001$.

Table 6. University Use Scores Before and After Integrated Laptop Program

University use (range)	Before program		After program			
	M	(*SD*)	*M*	(*SD*)	*df*	*t*
Basic (0-12)	9.7	(2.5)	11.1	(1.3)	147	–6.62*
Advanced (0-40)	15.2	(8.2)	26.5	(8.0)	147	–9.96*
Collaborative (0-20)	10.1	(5.1)	15.4	(3.4)	147	–4.51*
Social (0-16)	10.1	(3.7)	9.6	(4.4)	147	1.31
Total use (0-88)	45.1	(16.5)	62.7	(13.5)	147	–15.14*

*$p < .001$.

materials (handouts, worksheets) and searching for resources on the Web. The least frequent activity for supporting teaching was creating a Web page. Table 8 lists the frequencies of all computer activities undertaken by preservice candidates in preparation for teaching.

Correlations among Emotions and Total Teacher-Based Use

Higher levels of positive or happy emotions ($r = 0.23$; $p < .005$) and lower levels of angry emotions ($r = –0.17$; $p < .005$) were significantly correlated with higher levels of teacher-based use of computers by preservice candidates during their field placements. These correlations were relatively small in effect (Cohen, 1988, 1992).

Table 7. Correlations among Change in Emotion Constructs and Change in University Use of Computers

	Angry	Anxious	Happiness	Sadness
Basic use	–0.03	–0.12	0.27*	–0.08
Advanced use	–0.06	–0.16	0.28***	–0.05
Collaborative use	–0.12	–0.18*	0.07	–0.04
Social use	–0.07	–0.06	0.08	–0.23***
Total use	–0.10	–0.18*	0.23**	–0.12

*$p < .05$ (2-tailed), **$p < .01$ (2-tailed), ***$p < .005$ (2-tailed).

Emotions and Preservice Student Use of Computers in the Field

Frequency

Preservice teachers used computers less for student learning than they did for teacher-based activities. The means for student-based activities were lower than all those for teacher –focused activities with one exception (see Table 8). Preservice candidates instructed students to use word processing and the Internet as a research tool most often during their field placements. Fourteen of the 18 possible student-based activities showed means use below 0.50 indicating limited use.

Correlations among Emotions and Total Student Use

Higher levels of happiness ($r = 0.22$; $p < .05$) and lower levels of anger ($r = –0.25$; $p < .01$), sadness ($r = –0.24$; $p < .05$), and anxiety ($r = –0.18$; $p < .05$) were significantly correlated with the use of student-based computer activities by preservice teachers during their field placements. These correlations are considered small to medium by Cohen (1988, 1992).

DISCUSSION

The purpose of this study was to examine the relationship among four basic emotions (anger, anxiety, happiness, sadness) and the use of computers by preservice teachers. Three questions were explored:

1. To what extent are emotions present when software is being learned?
2. How are emotions related to use of computers by preservice teachers at the university?
3. How are emotions related to use of computers by preservice teachers during their field placements?

Table 8. Mean Scores for Field Placement Use of Computers

	Mean (*SD*)
Teacher-Based Use	
E-mailed associate/mentor teacher for instructional purposes	1.51 (1.03)
Created lesson plans	2.88 (0.40)
Created handouts, worksheets, resources	2.84 (0.50)
Create a Webpage for teaching/guiding your class	0.53 (1.05)
Created PowerPoint presentations or lessons/activities	1.71 (1.12)
Searched the Web for teaching resources or ideas	2.63 (0.66)
Shared computer resources with fellow teacher candidates	1.94 (1.09)
Student-Based Use	
Your students used online discussions	0.31 (0.84)
Your students did Internet research/exploration	1.25 (1.09)
Your students used word processing software	1.33 (1.10)
Your students used spreadsheet software	0.61 (1.01)
Your students did a WebQuest	0.27 (0.70)
Your students used a Java Applet	0.46 (0.88)
Your students used probes or probe ware (e.g., Pasco, Vernier)	0.41 (0.85)
Your students used graphic calculators	0.81 (1.12)
Your students did computer programming (e.g., Java, Turing, Visual Basic, etc.)	0.31 (0.89)
Your students created a Web page	0.14 (0.57)
Your students used the Robo Lab Kits	0.20 (0.69)
Your students used concept mapping software (e.g., Inspiration, Smart Ideas, etc.)	0.28 (0.71)
Your students used chemistry software (e.g., ChemSketch, simulated experiences)	0.18 (0.61)
Your students used physics software (e.g., Interactive Physics, Starry Night)	0.20 (0.66)
Your students used biology software (e.g., virtual dissection programs, wetlands software, anatomy software)	0.16 (0.54)
Your students used Fathom software	0.23 (0.72)
Your students used Geometer's Sketchpad software	0.39 (0.88)
Your students used graphing software (e.g., TI Interactive, Graphmatica)	0.35 (0.84)

Given that previous research on preservice teachers' use of technology has been hampered by a series of methodological problems including effective scale development (see Kay, 2006 for a review), it is prudent to discuss quality of measuring instruments used in the current study, before addressing the main findings.

Measuring Emotions and Use

The four basic emotions addressed by the computer emotion scale were selected based on extensive research (Arnold, 1960; Ekman, Friesen, & Elsworth, 1972; Izard, 1969; James, 1884; Oatley & Johnson-Laird, 1987; Plutchik, 1980; Tomkins, 1962). The reliability of the emotion scales was acceptable (Kline, 1999; Nunnally, 1978), hovering around .70. That said, it might be advisable to refine and possibly add items for the sadness scale, which had the lowest reliability estimate. As well, a qualitative pilot test of items used should be done to determine if the descriptors suggested by Oatley and Johnson-Laird (1987) actually represented the intended constructs. A principal component factor analysis confirmed that the four emotions assessed were relatively distinct constructs.

The computer use scale, based on a composite of previous research efforts (Baylor & Ritchie, 2002; Compton & Harwood, 2003; Garland, 1999-2000; Halpin, 1999; Maeers et al., 2000; Milbrath & Kinzie, 2000; Pope, Hare, & Howard, 2002; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Thompson et al., 2003; Vannatta & Beyerbach, 2000; Wang & Holthaus, 1998-99) resulted in four statistical distinct factors (basic, advanced, collaborative, and social use) that had moderate to high internal reliability estimates.

While the measures of emotions and university use of computers provided acceptable levels of reliability and validity for the specific population studied, more research needs to done to establish the integrity and longevity of these new scales.

Question 1—Emotions Present While Learning

Preservice teachers reported that emotions were present in varying frequencies when they learned new software. Happiness (curiosity, satisfaction, excitement) was experienced frequently, while negative emotions (anxiety, anger, and sadness) were experienced, on average, somewhere between never and sometimes. The focus of previous research on computer anxiety (e.g., Beckers & Schmidt, 2001; Bronsan & Lee, 1998; Ceyhan, 2006; Heinssen, Glass, & Knight, 1987; Loyd & Gressard, 1984; Marcoulides & Wang, 1990; Nickell & Pinto, 1986; Russell & Bradley, 1997) appears to have been too narrow. Happiness, perhaps measured indirectly by confidence or self-efficacy in the past, was a critical variable in this study and was significantly related to preservice teacher use of computers. Negative emotions, while not expressed as

often during the learning process, still had a statistically significant impact on use of computers at the university and in the field.

It is important to note that the emphasis on computer anxiety in past studies is not without some merit. Anxiety was a critical emotion in this study. While not reported often during learning, it decreased significantly after preservice teachers participated in the laptop program. In addition, the anxiety construct was significantly and negatively correlated with pre-laptop use of computers, changes in computer use, and student use in the classes taught by preservice teachers.

Question 2—Relationship among Emotions and University Use of Computers

There is evidence to support a significant relationship among emotions and preservice teacher's use of computers at the university. All four emotion constructs (anger, anxiety, happiness, and sadness) were significantly correlated with all four use constructs (basic, advances, collaborative, and social) at the beginning of the laptop program. This relationship among emotions and use was not as strong after the laptop program. Only happiness was significantly and positively correlated with university use after the laptop program. This result is consistent with the statistically significant reduction in negative emotions (anxiety and anger) observed at the end of the laptop program. In other words, negative emotions played a reduced role in effecting use of computers at the end of the laptop program because preservice teachers reported that they experienced them less while learning new software. Finally, significant increases in basic and advanced use appeared to be correlated with increases in happiness. As well, a decrease in anxiety was significantly related to increases in the collaborative use of computers.

The results provide moderate support that emotions and computer use are related, however, the dynamics of the relationship need to be investigated further. The main question that needs to be addressed in future studies is "do emotions effect cognitions leading to changes in computer use?" or "does increased use, as prescribed by the university laptop program, reduce negative emotions and build positive emotions?"

Question 3—Relationship among Emotions and Use of Computers in the Field

One goal of most technology-based teacher preparatory programs is to promote the thoughtful use of technology by preservice teachers in the classroom. In this study, there was a statistically significant relationship between emotions and use of computers in preservice teacher field placements. Increased happiness and decreased anger associated with learning new software was significantly correlated with increased teacher-based use of computers. In addition, all four emotion constructs were significantly correlated with student-based use of

computers. One reasonable explanation for this result is that the emotional reactions preservice teachers experience while learning new software tools in the laptop program had an impact on their use of computers when they taught in the classroom. If their emotional experiences were positive, use of computers increased in the field. If their emotional experiences were negative, preservice teachers were less inclined to employ computers as a teaching tool or strategy.

Caveats

The results of this study, while suggestive of a meaningful link between emotions and computer use should be treated with caution for the following reasons. First, self-report measures were used, therefore the responses need to be validated, perhaps by checking actual emotions expressed while learning a new software package. Second, subjects were asked, "In general, when I am learning how to use a new software package, I feel." While this prompt was intended to gather an overall impression of emotions experienced, it is reasonable to speculate that emotions expressed while learning may be largely dependent on the software being learned. Easy to use software might bring about a narrow range and limited expression of emotions, while more challenging software might elicit more intense emotions. Third, given moderate reliability estimates for the emotions scale, it would be wise to interview a sample of future subjects to check if the items they select actually correspond to the intended emotion of a construct. Fourth, the sample consisted of relatively advanced users, at least in terms of years of computer experience. A more diverse population with a wider range of computer experience is needed to be more confident in the generalizability of the results.

Finally, many of the correlations in this study, while significant, fell within the small to medium range according to Cohen (1988, 1992). This means, that emotions accounted for roughly 9% to 16% of the variance for computer use. However, this magnitude of correlation is typical of many studies in social science. While emotions play some role in accounting for computer use, it is likely that other factors such as computer ability, access to computers in the practicum, and attitude of the mentor teacher toward computers contribute to preservice teacher use of computers. In other words, emotions are only one piece of the computer use puzzle.

Implications for Education

Since this a formative study, the first to examine the relationship between emotions and preservice teachers' use of computers, it would not be prudent to make any strong conclusions with respect to implications for education. Several comments, however tentative, are worth noting.

First, exposing preservice teachers to an integrated laptop program, helped to significantly reduce reported anxiety and anger levels in just eight months. It

also helped to significantly increase the effective use of computers at the university. While there are no comparison groups, ubiquitous access to computing appears to play a significant role in altering computer related behaviours.

Second, the results of the study indicate that it is worth considering a full range of emotions that a new user feels while learning a new software package, not just anxiety levels. New users may experience emotions in private or may not show them externally, but clearly anger, happiness, and sadness are also present and important. Developing strategies to reduce excessively negative emotions or to promote curiosity and excitement may be important with respect to promoting use of computers at the university and in the field placements.

Third, emotions toward computers can be changed—they are not necessarily fixed, innate, pre-ordained, or inevitable. With a steady infusion of integrated computer use, more positive emotional responses can lead to increased use of computers.

Future Research

There are several suggestions for future research that would help build on the results obtained in this study, including:

1. expanding the number of emotional descriptors in Appendix A, through qualitative interviews;
2. validating descriptors through an interview process;
3. observing users while they are learning a new software package and interviewing them about the emotions they felt; and
4. exploring strategies that might help to promote positive emotion and reduce negative emotions

APPENDIX A
Computer Emotion Scale Items

In general, when I am learning how to use a new software package, I feel:

	None of the time	Some of the time	Most of the time	All of the time
1. Satisfied (H)	0	1	2	3
2. Disheartened (S)	0	1	2	3
3. Anxious (Ax)	0	1	2	3
4. Irritable (A)	0	1	2	3
5. Excited (H)	0	1	2	3
6. Dispirited (S)	0	1	2	3
7. Insecure (Ax)	0	1	2	3
8. Frustrated (A)	0	1	2	3
9. Curious (H)	0	1	2	3
10. Helpless (Ax)	0	1	2	3
11. Nervous (Ax)	0	1	2	3
12. Angry (A)	0	1	2	3

H = Happiness construct
S = Sadness construct
Ax = Anxiety construct
A = Anger construct

APPENDIX B
University Use Scale Items

We are interested in knowing **what you use your laptop for when you were in university classes or when you were working at home on your laptop/other computer** and how frequently you conducted this activity in a **typical week (on average).**

Please select one number choice for each type of activity.

	Never	Rarely	Some-times	Often	Very often
1. E-mailing for educational purposes (C)	0	1	2	3	4
2. Participating in online discussions (C)	0	1	2	3	4
3. Group work/projects using computers (C)	0	1	2	3	4
4. Sharing computer resources with peers/friends (C)	0	1	2	3	4
5. Scheduling/calendar/meetings/due dates (C)	0	1	2	3	4
6. School/work related assignments (B)	0	1	2	3	4
7. Word processing (B)	0	1	2	3	4
8. Internet research/exploration (B)	0	1	2	3	4
9. Taking notes in class (A)	0	1	2	3	4
10. Creating graphs/charts (A)	0	1	2	3	4
11. Creating presentations (e.g., PowerPoint) (A)	0	1	2	3	4
12. Working with spreadsheets (A)	0	1	2	3	4
13. Using educational software programs (A)	0	1	2	3	4
14. Creating Web pages (A)	0	1	2	3	4
15. Scanning documents (A)	0	1	2	3	4
16. Using a digital still camera/editing photos (A)	0	1	2	3	4
17. Using a digital video camera/editing video (A)	0	1	2	3	4
18. Using a data projector to present material (A)	0	1	2	3	4
19. Playing computer games (S)	0	1	2	3	4
20. E-mailing for social reasons (S)	0	1	2	3	4
21. Instant messaging (e.g., MSN, ICQ) (S)	0	1	2	3	4
22. Using a computer for entertainment (S)	0	1	2	3	4

APPENDIX C
Field Use Scale

Please indicate how often the following activities were done during your **most recent** practicum

	Never	Once	Several times	Regularly
1. E-mailed associate/mentor teacher for instructional purposes (T)	0	1	2	3
2. Created lesson plans (T)	0	1	2	3
3. Created handouts, worksheets, resources (T)	0	1	2	3
4. Created a Webpage for teaching/guiding your class (T)	0	1	2	3
5. Created PowerPoint presentations or lessons/ activities (T)	0	1	2	3
6. Searched the Web for teaching resources or ideas (T)	0	1	2	3
7. Shared computer resources with fellow teacher candidates (T)	0	1	2	3
8. Your students used online discussions (S)	0	1	2	3
9. Your students did Internet research/exploration (S)	0	1	2	3
10. Your students used work processing software (S)	0	1	2	3
11. Your students used spreadsheet software (S)	0	1	2	3
12. Your students did a WebQuest (S)	0	1	2	3
13. Your students used a Java Applet (S)	0	1	2	3
14. Your students used probes or probe ware (e.g., Pasco, Vernier) (S)	0	1	2	3
15. Your students used graphing calculators (S)	0	1	2	3
16. Your students did computer programming (e.g., Java, Turing, Visual Basic, etc.)	0	1	2	3
17. Your students created a Web page (S)	0	1	2	3
18. Your students used the RoboLab Kits (S)	0	1	2	3
19. Your students used concept mapping software (e.g., Inspiration, Smart Ideas, etc.) (S)	0	1	2	3
20. Your students used chemistry software (e.g., ChemSketch, simulated experiments) (S)	0	1	2	3
21. Your students used physics software (e.g., Interactive Physics, Starry Night) (S)	0	1	2	3
22. Your students used biology software (e.g., virtual dissection programs, wetlands software, anatomy software) (S)	0	1	2	3
23. Your students used Fathom software (S)	0	1	2	3
24. Your students used Geometer's Sketchpad software (S)	0	1	2	3
25. Your students used graphing software (e.g., TI Interactive, Graphmatica) (S)	0	1	2	3

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